HVAC AIR DUCT LEAKAGE TEST MANUAL

ANSI/SMACNA 016–2012

Inch-Pound Version

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC.
www.smacna.org

HVAC AIR DUCT LEAKAGE TEST MANUAL

SECOND EDITION – 2012

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC.
4201 Lafayette Center Drive
Chantilly, VA 20151-1219
www.smacna.org

HVAC AIR DUCT LEAKAGE TEST MANUAL

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC.

4201 Lafayette Center Drive
Chantilly, VA 20151-1219

Printed in the U.S.A.

FIRST EDITION – 1985
SECOND EDITION – 2012

FOREWORD

SMACNA first published a procedure for leakage testing of so-called medium and high pressure ductwork since January 1965. It appeared in Chapter 10 of the high velocity (later high pressure) construction standards and in Chapter 8 of the "*Balancing and Adjustment of Air Distribution Systems Manual*" of 1967 vintage. In the 1970's energy conservation measures led to a decline in the use of truly high pressure commercial HVAC systems. Now, greater concern with the amount of leakage in systems of less pressure has evolved from the efforts of reducing carbon via energy saving strategies.

New research in the leakage rates of sealed and unsealed ductwork has disclosed a need for a better method of evaluating duct leakage. European countries introduced an evaluation approach using the surface area of the duct and the pressure in the duct as the basic parameters. SMACNA concluded that this approach is far superior to the arbitrary assignment of a percentage of fan flow rate as a leakage criteria. The surface area basis highlights the effect of system size and is now one of the primary factors of SMACNA duct leakage classifications.

Leakage testing on job sites disrupts productivity and is costly. Only recently has industry begun to recognize the extent of leakage of any in-line equipment. Designers must account for equipment leakage separately from duct leakage allowances as they evaluate system leakage. SMACNA encourages designers to specify equipment leakage control and to rely on prescriptive sealing of ductwork as measures that will normally lead to effective control of leakage without the need for extensive leakage testing. Non-Ducted Under Floor Air Distribution (UFAD) systems present a unique set of circumstances that make leakage testing a very time consuming process not fully covered in this standard. Further information on this topic can be found in the commentary of this manual.

Application of the information and guidance herein should facilitate design, improve system performance and reduce the difficulty of testing and balancing newly installed systems. SMACNA expresses appreciation to all of those whose knowledge and effort led to the introduction of this new publication.

SHEET METAL AND AIR CONDITIONING CONTRACTORS'
NATIONAL ASSOCIATION, INC.

HVAC AIR DUCT LEAKAGE TASK FORCE

Thomas Boniface, *Chairman*
Independent Sheet Metal, Co.
Hawthorne, NJ

Jon Bloker
Streimer Sheet Metal Works, Inc.
Portland, OR

Richard Freeman
Stromberg Metal Works, Inc.
Beltsville, MD

Caleb Goldkamp
Frank Fischer Design Aire Inc.
Bridgeton, MO

Michael F. Mamayek
Illingworth Corporation
Milwaukee, WI

Robert Tuck
Atlas Heating & A/C Co.
Oakland, CA

Eli P. Howard, III, *Staff Liaison*
SMACNA National
Chantilly, VA

Mark Terzigni, *Staff Liaison*
SMACNA National
Chantilly, VA

OTHER CONTRIBUTORS

Mark Hershman,
Philadelphia, PA

Earl Burmeister,
W. Des Moines, IA

Daniel J. Driscoll,
Philadelphia, PA

Frank D. Ellis,
Sparks, NV

Daniel Streimer,
Portland, OR

Robert S. Deeds,
Salt Lake City, UT

Norman T.R. Heathorn,
Oakland, CA

H. Andrew Kimmel,
Warren, Ml

William J. Knecht,
Camden, NJ

John H. Stratton,
Vienna, VA

NOTICE TO USERS OF THIS PUBLICATION

1. DISCLAIMER OF WARRANTIES

a) The Sheet Metal and Air Conditioning Contractors' National Association ("SMACNA") provides its product for informational purposes.

b) The product contains "Data" which is believed by SMACNA to be accurate and correct but the data, including all information, ideas and expressions therein, is provided strictly "AS IS," with all faults. SMACNA makes no warranty either express or implied regarding the Data and SMACNA EXPRESSLY DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE.

c) By using the data contained in the product user accepts the Data "AS IS" and assumes all risk of loss, harm or injury that may result from its use. User acknowledges that the Data is complex, subject to faults and requires verification by competent professionals, and that modification of parts of the Data by user may impact the results or other parts of the Data.

d) IN NO EVENT SHALL SMACNA BE LIABLE TO USER, OR ANY OTHER PERSON, FOR ANY INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING, DIRECTLY OR INDIRECTLY, OUT OF OR RELATED TO USER'S USE OF SMACNA'S PRODUCT OR MODIFICATION OF DATA THEREIN. This limitation of liability applies even if SMACNA has been advised of the possibility of such damages. IN NO EVENT SHALL SMACNA'S LIABILITY EXCEED THE AMOUNT PAID BY USER FOR ACCESS TO SMACNA'S PRODUCT OR $1,000.00, WHICHEVER IS GREATER, REGARDLESS OF LEGAL THEORY.

e) User by its use of SMACNA's product acknowledges and accepts the foregoing limitation of liability and disclaimer of warranty and agrees to indemnify and hold harmless SMACNA from and against all injuries, claims, loss or damage arising, directly or indirectly, out of user's access to or use of SMACNA's product or the Data contained therein.

2. ACCEPTANCE

This document or publication is prepared for voluntary acceptance and use within the limitations of application defined herein, and otherwise as those adopting it or applying it deem appropriate. It is not a safety standard. Its application for a specific project is contingent on a designer or other authority defining a specific use. SMACNA has no power or authority to police or enforce compliance with the contents of this document or publication and it has no role in any representations by other parties that specific components are, in fact, in compliance with it.

3. AMENDMENTS

The Association may, from time to time, issue formal interpretations or interim amendments, which can be of significance between successive editions.

4. PROPRIETARY PRODUCTS

SMACNA encourages technological development in the interest of improving the industry for the public benefit. SMACNA does not, however, endorse individual manufacturers or products.

5. FORMAL INTERPRETATION

a) A formal interpretation of the literal text herein or the intent of the technical committee or task force associated with the document or publication is obtainable only on the basis of written petition, addressed to the Technical Resources Department and sent to the Association's national office in Chantilly, Virginia. In the event that the petitioner has a substantive disagreement with the interpretation, an appeal may be filed with the Technical Resources Committee, which has technical oversight responsibility. The request must pertain to a specifically identified portion of the document that does not involve published text which provides the requested information. In considering such requests, the Association will not review or judge products or components as being in compliance with the document or publication. Oral and written interpretations otherwise obtained from anyone affiliated with the Association are unofficial. This procedure does not prevent any committee or task force chairman, member of the committee or task force, or staff liaison from expressing an opinion on a provision within the document, provided that such person clearly states that the opinion is personal and does not represent an official act of the Association in any way, and it should not be relied on as such. The Board of Directors of SMACNA shall have final authority for interpretation of this standard with such rules or procedures as they may adopt for processing same.

b) SMACNA disclaims any liability for any personal injury, property damage, or other damage of any nature whatsoever, whether special, indirect, consequential or compensatory, direct or indirectly resulting from the publication, use of, or reliance upon this document. SMACNA makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

6. APPLICATION

a) Any standards contained in this publication were developed using reliable engineering principles and research plus consultation with, and information obtained from, manufacturers, users, testing laboratories, and others having specialized experience. They are

subject to revision as further experience and investigation may show is necessary or desirable. Construction and products which comply with these Standards will not necessarily be acceptable if, when examined and tested, they are found to have other features which impair the result contemplated by these requirements. The Sheet Metal and Air Conditioning Contractors' National Association and other contributors assume no responsibility and accept no liability for the application of the principles or techniques contained in this publication. Authorities considering adoption of any standards contained herein should review all federal, state, local, and contract regulations applicable to specific installations.

b) In issuing and making this document available, SMACNA is not undertaking to render professional or other services for or on behalf of any person or entity. SMACNA is not undertaking to perform any duty owed to any person or entity to someone else. Any person or organization using this document should rely on his, her or its own judgement or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstance.

7. REPRINT PERMISSION

Non-exclusive, royalty-free permission is granted to government and private sector specifying authorities to reproduce *only* any construction details found herein in their specifications and contract drawings prepared for receipt of bids on new construction and renovation work within the United States and its territories, provided that the material copied is unaltered in substance and that the reproducer assumes all liability for the specific application, including errors in reproduction.

8. THE SMACNA LOGO

The SMACNA logo is registered as a membership identification mark. The Association prescribes acceptable use of the logo and expressly forbids the use of it to represent anything other than possession of membership. Possession of membership and use of the logo in no way constitutes or reflects SMACNA approval of any product, method, or component. Furthermore, compliance of any such item with standards published or recognized by SMACNA is not indicated by presence of the logo.

TABLE OF CONTENTS

TABLES **PAGE**

FIGURES **PAGE**

CHAPTER 1

FOR THE DESIGN PROFESSIONAL

1.1 INTRODUCTION

It is imperative that HVAC system design and specifying engineers have a thorough knowledge of duct air leakage, equipment air leakage, accessory air leakage, and how they combine to create *HVAC Air Distribution System Air Leakage*.

Air duct leakage is the leakage of air from the air distribution system ductwork. The leakage can occur at joints, seams, and penetrations. Research shows that air duct leakage can be represented as a function of duct surface area, leakage class, and static pressure. Leakage class is determined by the construction methods employed in duct fabrication in accordance with the ANSI/SMACNA *HVAC Duct Construction Standards*.

Equipment and accessory air leakage is the air leakage associated with HVAC equipment and all other inline accessories such as VAV boxes, fire dampers, control/volume dampers, access doors, etc..

ASHRAE Standard 193 provides standardized methods to test for equipment leakage, and ASHRAE Standard 130 provides leakage tests for VAV boxes. In most cases it is not practical to seal these components "air tight" since they must be accessible for service and field adjustments.

Sealing fire dampers beyond the manufacturer's installation instructions can render the damper useless, void the listing, and create liability risks for the author of the specification.

Volume dampers, access doors, and other accessories require moving parts to function properly. The design of these types of devices shall be specified so that the desired leakage is achieved by permanent gaskets, seals or other methods such that attempts at after-installation sealing do not prevent these items from working as designed. When performing duct air leakage tests the leakage for these items needs to be accounted for separately and, where practical, shall not be tested with the ductwork. Designers must consider the leakage rates for these accessories and provide allowances when they are included in a duct air leakage test. (Refer to Appendix D for sample specifications)

Because system air leakage is the combination of duct, equipment, and accessory air leakage it is usually impractical or impossible to test the entire system as a whole. Where testing is desired or economically justified, the duct must be tested by logical subsystems. For example, with VAV systems it is often impractical to test the low pressure side of that sub-system. The workable approach would be to test the high pressure side but do not include any VAV boxes in the test. It is not correct to test the "high" pressure side and the "low" pressure side simultaneously. The duct on either side of a VAV box is constructed differently based on the design pressure class and shall be tested at different pressures, their operating pressures as listed by the HVAC system designer.

Leakage requirements shall not be an arbitrary value and shall be assigned on the basis of:

- Static Pressure
- Construction
- Type of duct
- Research and experience

1.2 SEAL CLASS REQUIREMENTS AND PREDICTED AIR LEAKAGE RATES

If a system is constructed to 2 in. wg per ANSI/SMACNA *HVAC Duct Construction Standards* the ductwork must be sealed to seal class C unless specified otherwise. For rectangular duct the leakage class determined through testing is 16, and for round the leakage class is 8. If a seal class of A or B is specified it is reasonable to expect less leakage but predicting the exact relative result is difficult. Other factors affect the performance of the duct work. The types of joints and seams used and fabrication must also be considered. In keeping with SMACNA's policy on sustainability, contractors are encouraged to use products with the least environmental impact for the intended application and jobsite conditions.

Seal class specifies where sealant is applied. Seal class does not denote a leakage class or leakage rate.

Other considerations must also be made when writing specifications for duct sealing. Requiring the sole use of water based sealants is not always practical. It is impossible to properly apply a water based sealant when outside temperatures are below 40°F (5°C) and the building has not been enclosed and heated.

1.3 INFORMATION ON SPECIFICATIONS

Specifications that read "test per SMACNA" or similar are invalid. A properly written leakage testing specification contains the following: