THERMOSET FRP DUCT CONSTRUCTION MANUAL

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

THERMOSET FRP DUCT CONSTRUCTION MANUAL

FIRST EDITION – JUNE, 1997

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC.
4201 Lafayette Center Drive
Chantilly, VA 20151-1209

THERMOSET FRP DUCT CONSTRUCTION MANUAL

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

4201 Lafayette Center Drive
Chantilly, VA 20151–1209

Printed in the U.S.A.

FIRST EDITION – JUNE, 1997
Second Printing – February, 2002

FOREWORD

The selection of fiberglass reinforced plastic (FRP) duct for use in corrosive environments is increasing. FRP duct is frequently being selected for fume hood exhaust systems, for air pollution and odor control systems in facilities such as waste water treatment plants, and other corrosive environments.

FRP ducts are routinely designed and manufactured to meet a systems unique requirements. This represents a major advantage over thermoplastic (PVC), metallic, and coated metallic ductwork. FRP ducts are manufactured using specifically designed reinforcement systems, bonded together with thermosetting plastic resins. These resins are selected for their ability to resist specific chemicals known to be present in the corrosive environment in which the ductwork is to be installed.

Working with resin and FRP duct manufacturers, SMACNA contractors have researched the current and future potential use of FRP duct and its physical properties. This effort resulted in an authoritative manual that SMACNA contractors, architects, engineers, managers, and plant owners can rely upon for the proper selection, manufacture, and installation of specifically tailored FRP duct systems. To establish these manufacturing and construction standards, SMACNA contracted with Dr. Joseph M. Plecnik of the Civil Engineering Department at California State University, Long Beach, to develop and test duct design procedures for the manufacture and installation of round and rectangular duct systems. Dr. Plecnik investigated round duct systems ranging from 4 to 72 inches (100 to 1800 mm) in diameter and rectangular duct systems ranging from 12 to 96 inches (300 to 2400 mm) in width and depth, operating at a static pressure within a range from -30 to +30 in. wg (-7500 to +7500 Pa) and within a temperature range from ambient to 180°F (82ºC).

By following the manufacturing, construction, and installation details specified in this manual, a contractor should be able to develop a duct system that dependably meets the stated requirements of the customer. As with all products, there are limits to the successful use of FRP duct systems. It is imperative that the customer provide an accurate definition of the corrosive environment in which the FRP duct system is to be installed. Proper selection of the thermoset resins and reinforcing material ensures that the customer receives a well designed duct system that meets his needs for the foreseeable future.

Throughout the manual and its appendices, we have included the engineering design criteria and safety factors selected to achieve a safe, and cost effective construction standard. This includes ample consideration of the manufacturing variables that occur in a product built to meet the individual requirements of each application.

SMACNA is indebted to representatives from thermoset resin and FRP duct manufacturers, and the SMACNA contractors who, as members of the FRP Task Force, volunteered their time and effort to the development of this manual. SMACNA appreciates their dedication and willingness to share their knowledge and experience in the design, fabrication, and installation of FRP duct systems.

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

FRP TASK FORCE

Michael J. Daugharty, Chairman
Heating & Plumbing Engineers Inc.
Colorado Springs, CO

Joseph J. Flannagan, Jr.
Primary Plastics, Inc.
Endwell, NY

Norman T. R. Heathorn
N.V. Heathorn, Inc.
Oakland, CA

G. A. Navas, Staff
SMACNA, Inc.
Chantilly, VA

CONSULTANTS

Dr. Frank A. Cassis
Ashland Chemical, Inc.
Los Angeles, CA

Robert M. Hahn
Xerxes Corporation
Avon, OH

Le Rodenberg
Industry Consultant
Escondido, CA

Joseph M. Plecnik, PhD, P.E.
Cal State University, L.B.
Long Beach, CA

Robert C. Talbot
Technical Writer
West Worthington, OH

NOTICE TO USERS OF THIS PUBLICATION

1. DISCLAIMER OF WARRANTIES

a) The Sheet Metal and Air Conditioning Contractor's 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

FIGURES

CHAPTER 1

INTRODUCTION

1.1 SCOPE

This manual covers the physical properties, manufacture, construction, installation and methods of testing fiberglass reinforced thermosetting plastic duct, intended for air conveyance in corrosive environments, as manufactured by hand lay–up, spray–up, and filament winding fabrication techniques.

- Round duct 4 to 72 in. (100 to 1800 mm) diameter
- Rectangular duct 12 to 96 in. (300 to 2400 mm) diameter
- Static pressures –30 to +30 in. wg (–7500 to +7500 Pa)
- Temperature range ambient to 180ºF (82ºC) (Depending on resin selection)

1.2 USES

Fiberglass reinforced plastic (FRP) has been used for various types of process equipment, in the chemical, pulp and paper, power, mining, municipal sewer treatment, and water treatment (odor pollution abatement) as well as many other associated industries handling corrosive environments.

FRP process equipment of all shapes and sizes, such as columns, scrubbers, hoods, ducts, fans, and stacks as well as piping, tanks, grating, mist eliminator blades, heat exchanger shells, tube sheets, and many other types of equipment are required for severely corrosive applications.

1.3 WHAT IS FRP?

FRP stands for “fiberglass reinforced plastic.” FRP is also used to define fiber reinforced plastic (fibers other than glass). Terms used interchangeably with FRP are reinforced thermoset plastic (RTP) or glass reinforced plastic (GRP), which is used in Europe and Australia.

1.3.1 Laminate

Laminate refers to the “composite material” that is manufactured from a thermosetting resin matrix with layers of reinforcement fibers. Typical techniques for the fabrication of round and rectangular duct are hand lay–up, spray–up, and filament winding. Hand lay–up and spray–up typically apply layers of chopped strand and woven fabric to build up structural layers over a form or mold. Filament winding applies a structural layer of continuous fiber strands wrapped around a rotating mold or mandrel. The reinforcing fiber is impregnated with a catalyzed thermoset polyester or vinyl ester. It is then allowed to reach full cure to form a hard and dense composite laminate for corrosion applications. Once cured (exceeding initial Barcol hardness), the formed laminates are removed from the molds and preconditioned for field assembly. At this point, the fabricated duct sections are inspected and approved for shipment to the job site.

1.3.2 Thermoset Plastics

Thermosetting resins, once fully cured and hardened, cannot be reverted to their original liquid state. The chemical reaction of thermoset resins is exothermic, where the liquid catalyzed resin heats up and continues to increase in temperature to form a cured solid resin state. This is the basic difference between “thermoplastic” and “thermoset plastic.”

While both types of plastics find application throughout the air handling industry, the scope of this particular manual will be confined to air handling systems fabricated with thermoset plastic materials.

1.3.3 FRP Duct Use

The most common use for FRP duct is for corrosion control in air pollution and odor abatement ventilation and exhaust systems. The corrosion resistance of FRP depends on the selection of the proper generic type of thermosetting resin to handle the corrosive application.

Corrosion resistant FRP is generally superior to carbon steel, galvanized steel, lower grades of stainless steel, and different types of lined steel equipment.

This manual is primarily directed to the above air handling systems.

The FRP duct industry is a dynamic industry with new products, systems, and procedures evolving on a regular basis. Resins and other products not covered by this manual are not necessarily inappropriate for use in a specific duct system. The contractor must ensure that the owner, design engineer, resin manufacturer, and duct manufacturer are all in agreement that the specified FRP duct system will meet the owner’s corrosion resistance requirements.

1.4 PURPOSE

This manual proposes to accomplish the following objectives: