

Manual of Water Supply Practices

M45

Fiberglass Pipe Design

Third Edition

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Fiberglass Pipe Design, Third Edition



American Water Works
Association

M45

Fiberglass pipe is used in many industries for myriad applications. Its durability, strength, and corrosion resistance eliminate the need for interior linings, exterior coatings, and cathodic protection. Fiberglass pipe systems offer great design flexibility, and fiberglass pipe is available in a multitude of diameters ranging from very small to very large. M45, *Fiberglass Pipe Design*, delivers both technical and general information for the design, specification, procurement, installation, and understanding of fiberglass pipe and fittings. This manual covers:

- The history and use of fiberglass pipe across multiple industries
- The composite materials, including the different types of glass fiber reinforcements and resins
- The physical properties, including the chemical, temperature, and abrasion resistance of fiberglass pipe
- The various methods of manufacturing, including filament winding and centrifugal casting
- How to determine the hydraulics in fiberglass pipe, depending on the type of flow and level of accuracy required
- How to design a buried fiberglass pipe system, complete with calculations to determine appropriate soils, loading, and more
- The installation of underground and aboveground fiberglass pipe and appropriate thrust restraints
- The design and installation of an aboveground fiberglass pipe system
- Shipping, handling, storage, and repair

 American Water Works Association

Dedicated to the world's most important resource, AWWA sets the standard for water knowledge, management, and informed public policy. AWWA members provide solutions to improve public health, protect the environment, strengthen the economy, and enhance our quality of life.

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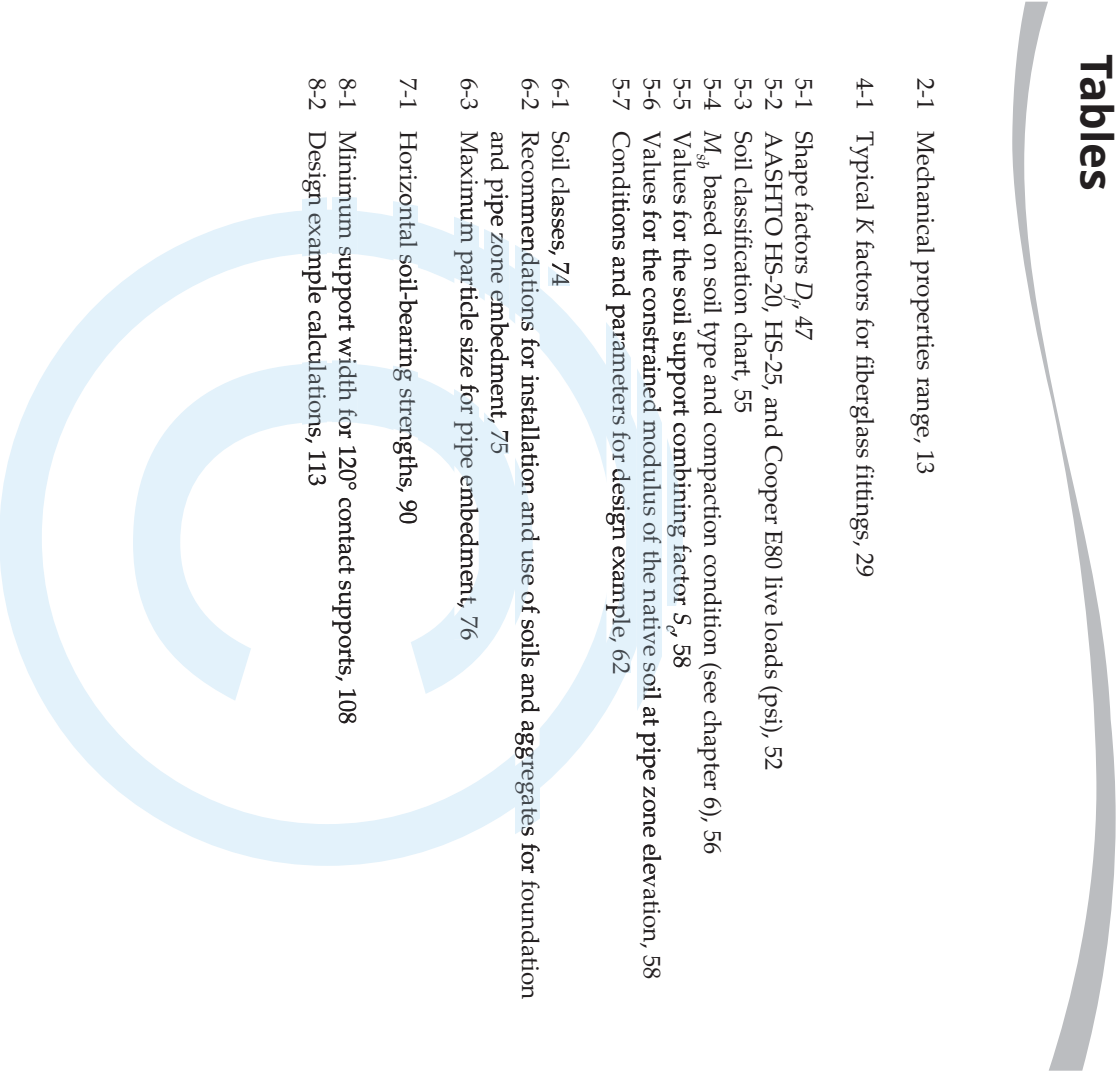
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Preface

This manual is the third edition of AWWA Manual M45, *Fiberglass Pipe Design*. It provides the reader with both technical and general information to aid in the design, specification, procurement, installation, and understanding of fiberglass pipe and fittings. The manual is a discussion of recommended practice, not an AWWA standard calling for compliance with certain requirements. It is intended for use by utilities and municipalities of all sizes, whether as a reference book or textbook for those not fully familiar with fiberglass pipe and fitting products. Design engineers and consultants may use this manual in preparing plans and specifications for new fiberglass pipe design projects.

The manual covers fiberglass pipe and fitting products and certain appurtenances and their application to practical installations, whether of a standard or special nature. For adequate knowledge of these products, the entire manual should be studied. Readers will also find the manual a useful source of information when assistance is needed with specific or unusual conditions. The manual contains a list of applicable national standards, which may be purchased from the respective standards organizations (e.g., American Water Works Association, American Society for Testing and Materials, etc.).

This third edition includes updates to soil classifications that unify the terminology for all piping materials, corrections to the pressure surge calculations, and editorial changes to improve understanding and clarity of content.

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The American Water Works Association (AWWA) *Fiberglass Pipe Design* Manual Subcommittee, which developed this edition of the M45 manual, had the following personnel at the time:

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History and Use

1.1 INTRODUCTION

Fiberglass pipe is made from glass fiber reinforcements embedded in, or surrounded by, cured thermosetting resin. This composite structure may also contain aggregate, granular, or platelet fillers; thixotropic agents; and pigments or dyes. By selecting the proper combination of resin, glass fibers, fillers, and design, the fabricator can create a product that offers a broad range of properties and performance characteristics. Over the years, the diversity and versatility of materials used to manufacture fiberglass pipe have led to a variety of names for fiberglass pipe. Among these are reinforced thermosetting resin pipe (RTRP), reinforced polymer mortar pipe (RPM[®]), fiberglass reinforced epoxy (FRE), glass reinforced plastic (GRP), and fiberglass reinforced plastic (FRP). Fiberglass pipes have also been categorized by the particular manufacturing process—filament winding or centrifugal casting. Frequently, the particular resin used to manufacture the fiberglass pipe—epoxy, polyester, or vinyl ester—has been used to classify or grade fiberglass pipes.

Regardless of the many possible combinations, the most common and useful designation is simply “fiberglass pipe.” This name encompasses all of the various available products and allows consideration as a unique and general class of engineering materials.

1.2 HISTORY

Fiberglass pipe was introduced in 1948. The earliest application for fiberglass piping, and still one of the most widely used, is in the oil industry. Fiberglass pipe was selected as a corrosion-resistant alternative to protected steel, stainless steel, and other more exotic metals. Product lines expanded to include applications of increasingly high pressure and down-hole tubing with threaded connections. In the late 1950s, larger diameters became