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# Ductile-Iron Pipe and Fittings

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**AWWA MANUAL M41**

*Third Edition*



**American Water Works  
Association**

Manual of Water Supply Practices — M41, Third Edition

## Ductile-Iron Pipe and Fittings

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### Library of Congress Cataloging-in-Publication Data

Ductile-iron pipe and fittings. — 3rd ed.  
p. cm. — (Manual of water supply practices ; M41)  
Includes bibliographical references and index.  
ISBN 978-1-58321-632-3

1. Water-pipes 2. Cast-iron pipe. 3. Pipe fittings I. American Water Works Association.

TH491.D84 2009  
628.1'5—dc22

2008038290

Printed in the United States of America  
American Water Works Association  
6666 West Quincy Avenue  
Denver, CO 80235-3098

ISBN 978-1-58321-632-3



Printed on recycled paper

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# Preface

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This is the third edition of AWWA M41, *Ductile-Iron Pipe and Fittings*. This manual provides the user with both technical and general information to aid in the design, specification, procurement, installation, and understanding of ductile-iron pipe and fittings. It is a discussion of recommended practice, not an AWWA standard calling for compliance with certain specifications. 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 ductile-iron pipe and fitting products. Design engineers and consultants may use this manual in preparing plans and specifications for new ductile-iron pipe projects.

The manual covers ductile-iron 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., AWWA, ASTM). Standards referenced in this manual refer to the latest editions.

Credit is extended to the Ductile Iron Pipe Research Association (DIPRA) for granting permission to reprint numerous graphics and tables found throughout this manual.

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# Acknowledgments

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This manual was prepared by the AWWA Standards Committee A21 on Ductile-Iron Pipe and Fittings. The membership of the committee at the time this manual was revised was as follows:

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## Chapter 1

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# General Information and History

This manual provides the user with both technical and general information to aid in the design, specification, procurement, installation, and understanding of ductile-iron pipe.

The manual describes ductile-iron pipe and fitting products, appurtenances, and their application to practical installations, whether of a standard or special nature.

## 1.1 HISTORY

---

### 1.1.1 General

The history of pipe parallels that of civilization. The earliest communities were established near water sources that later became inadequate as populations increased. Hydraulic engineering was born of the necessity to transport water closer to the point of use. From ancient Babylon's clay pipes, to the underground tunnels of ancient Greece, to the aqueducts of the Roman Empire, to the cast-iron mains of Versailles, France, to today's modern pipe, the search for an affordable piping material with reliable strength and durability evolved. Cast-iron pipe rapidly became the standard material for water distribution mains. Today, in the United States and Canada alone, there are more than 622 utilities that have had cast-iron distribution mains with continuous service records of more than 100 years, and 23 for 150 years or more.

The production of iron pipe most likely developed from or coincided with the manufacture of cannons as early as the year 1313. There is an official record of cast-iron pipe being manufactured at Siegerland, Germany, in 1455 for installation at the Dillenbergl Castle.

In 1664, King Louis XIV of France ordered the construction of a cast-iron pipe main to extend 15 mi (24 km) from a pumping station at Marly-on-Seine to Versailles to supply water for the fountains and town. This cast-iron pipe provided continuous service for more than 330 years. When the line was originated, the production of iron required the use of expensive charcoal for the reduction of the iron ore. By 1738, success