



**American Water Works
Association**

The Authoritative Resource on Safe Water®

ANSI/AWWA C150/A21.50-08
(Revision of ANSI/AWWA C150/A21.50-02)

AWWA Standard

Thickness Design of Ductile-Iron Pipe



Effective date: Dec. 1, 2008.

First edition approved by AWWA Board of Directors June 23, 1965.

This edition approved June 8, 2008.

Approved by American National Standards Institute Sept. 17, 2008.

AWWA Standard

This document is an American Water Works Association (AWWA) standard. It is not a specification. AWWA standards describe minimum requirements and do not contain all of the engineering and administrative information normally contained in specifications. The AWWA standards usually contain options that must be evaluated by the user of the standard. Until each optional feature is specified by the user, the product or service is not fully defined. AWWA publication of a standard does not constitute endorsement of any product or product type, nor does AWWA test, certify, or approve any product. The use of AWWA standards is entirely voluntary. This standard does not supersede or take precedence over or displace any applicable law, regulation, or codes of any governmental authority. AWWA standards are intended to represent a consensus of the water supply industry that the product described will provide satisfactory service. When AWWA revises or withdraws this standard, an official notice of action will be placed on the first page of the classified advertising section of *Journal AWWA*. The action becomes effective on the first day of the month following the month of *Journal AWWA* publication of the official notice.

American National Standard

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether that person has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review, and users are cautioned to obtain the latest editions. Producers of goods made in conformity with an American National Standard are encouraged to state on their own responsibility in advertising and promotional materials or on tags or labels that the goods are produced in conformity with particular American National Standards.

CAUTION NOTICE: The American National Standards Institute (ANSI) approval date on the front cover of this standard indicates completion of the ANSI approval process. This American National Standard may be revised or withdrawn at any time. ANSI procedures require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036; (212) 642-4900.

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information or retrieval system, except in the form of brief excerpts or quotations for review purposes, without the written permission of the publisher.

Copyright © 2008 by American Water Works Association
Printed in USA

Committee Personnel

Subcommittee No. 1, Pipe, which reviewed this standard, had the following personnel at the time:

Maury D. Gaston, *Chair*

Richard W. Bonds, *Vice-Chair*

General Interest Members

M.B. Horsley, Black & Veatch, Kansas City, Mo.	(AWWA)
T.J. McCandless,* Standards Engineer Liaison, AWWA, Denver, Colo.	(AWWA)
P.I. McGrath Jr., Consultant, Birmingham, Ala.	(AWWA)
E.W. Misichko, Underwriters Laboratories, Northbrook, Ill.	(AWWA)
J.R. Plattsmier, HDR Engineering Inc., Denver, Colo.	(AWWA)
C.R. Schwenker, Malcolm Pirnie Inc., Arlington, Va.	(AWWA)
P.A. Selig, American Cast Iron Pipe Company, Birmingham, Ala.	(DIPRA)
W.H. Smith, Consultant, Flora, Ill.	(AWWA)
K.E. Wilson, Post Buckley Schuh & Jernigan Inc., Tampa, Fla.	(AWWA)
L.C. Yates, McGoodwin Williams & Yates, Fayetteville, Ark.	(AWWA)

Producer Members

R.W. Bonds, Ductile Iron Pipe Research Association, Birmingham, Ala.	(DIPRA)
D.R. Charko, McWane Cast Iron Pipe Company, Birmingham, Ala.	(DIPRA)
L.R. Dunn, US Pipe & Foundry Company, Birmingham, Ala.	(DIPRA)
J.H. Eddings, McWane Cast Iron Pipe Company, Birmingham, Ala.	(DIPRA)
M.D. Gaston, American Cast Iron Pipe, Birmingham, Ala.	(AWWA)
H. Kennedy Jr., Harold Kennedy & Associates, Cary, N.C.	(AWWA)
T.J. Muntz, Fab Pipe Inc., Rogers, Minn.	(AWWA)
G. Oliver,† American Cast Iron Pipe Company, Birmingham, Ala.	(AWWA)

* Liaison, nonvoting

† Alternate

W.A. Stout, Griffin Pipe Products Company, Downers Grove, Ill. (AWWA)
T.B. Wright, National Association of Pipe Fabricators, Edmond, Okla. (AWWA)

User Members

T.E. Coughran, City of Santa Ana, Santa Ana, Calif. (AWWA)
A.J. DeBoy, Indiana American Water, Greenwood, Ind. (AWWA)

AWWA Standards Committee A21, Ductile-Iron Pipe and Fittings, which reviewed and approved this standard, had the following personnel at the time of approval:

John R. Plattsmier, *Chair*

General Interest Members

H.E. Holcomb, Jordan Jones and Goulding Inc., Loganville, Ga. (AWWA)
M.B. Horsley, Black & Veatch, Kansas City, Mo. (AWWA)
D.H. Kroon, Corrpro Companies Inc., Houston, Texas (AWWA)
D.D. Lary*, Wright-Pierce, Topsham, Maine (NEWWA)
G.E. Laverick, Underwriters Laboratories, Northbrook, Ill. (AWWA)
T.J. McCandless,† Standards Engineer Liaison, AWWA, Denver, Colo. (AWWA)
P.I. McGrath Jr., Consultant, Birmingham, Ala. (AWWA)
C.L. McLain,† Standards Council Liaison, Moorehead Public Service,
Moorehead, Minn. (AWWA)
P.J. Mourt, Hatch Mott MacDonald, Millburn, N.J. (AWWA)
J.R. Plattsmier, HDR Engineering Inc., Denver, Colo. (AWWA)
C.R. Schwenker, Malcolm Pirnie Inc., Arlington, Va. (AWWA)
W.H. Smith, Consultant, Flora, Ill. (AWWA)
T.M. Stinson, SEA Consultants Inc., Cambridge, Mass. (NEWWA)
L.C. Yates, McGoodwin Williams & Yates, Fayetteville, Ark. (AWWA)
K. Zastrow*, Underwriters Laboratories Inc., Northbrook, Ill. (AWWA)

*Alternate

†Liaison, nonvoting

Producer Members

R.W. Bonds, Ductile Iron Pipe Research Association, Birmingham, Ala.	(DIPRA)
L.R. Dunn, US Pipe & Foundry Company, Birmingham, Ala.	(DIPRA)
J.H. Eddings, McWane Cast Iron Pipe Company, Birmingham, Ala.	(DIPRA)
M.D. Gaston, American Cast Iron Pipe, Birmingham, Ala.	(AWWA)
J.C. Jones, S&B Technical Products, Fort Worth, Texas	(AWWA)
H. Kennedy Jr., Harold Kennedy & Assoc., Cary, N.C.	(AWWA)
T.J. Muntz, Fab Pipe Inc., Rogers, Minn.	(AWWA)
G. Oliver,* American Cast Iron Pipe Company, Birmingham, Ala.	(DIPRA)
W.A. Stout, Griffin Pipe Products Company, Downers Grove, Ill.	(AWWA)

User Members

D.T. Bradley, Oak Lodge Water District, Portland, Ore.	(AWWA)
T.E. Coughran, City of Santa Ana, Santa Ana, Calif.	(AWWA)
A.J. DeBoy, American Water—Central Region, Creve Coeur, Mo.	(AWWA)
R.R. Goold, City of Kansas City, Kansas City, Mo.	(AWWA)
J.M. Kennedy, Tampa Bay Water, Clearwater, Fla.	(AWWA)
D.D. Montgomery, Independence Water Department, Independence, Mo.	(AWWA)
C.J. Patla, Connecticut Water Service Inc., Clinton, Conn.	(NEWWA)
R.L. Worden, Guadalupe–Blanco River Authority, Seguin, Texas	(AWWA)

*Alternate

This page intentionally blank.

Contents

All AWWA standards follow the general format indicated subsequently. Some variations from this format may be found in a particular standard.

SEC.	PAGE	SEC.	PAGE
Foreword			
I	Introduction.....	ix	
I.A	Background.....	ix	
I.B	History.....	ix	
I.C	Acceptance.....	x	
II	Special Issues.....	xi	
III	Use of This Standard.....	xi	
III.A	Purchaser Options and Alternatives.....	xi	
III.B	Modification to Standard.....	xii	
IV	Major Revisions.....	xii	
V	Comments.....	xii	
Standard			
1	General		
1.1	Scope.....	1	
1.2	Purpose.....	2	
1.3	Application.....	2	
2	References	2	
3	Definitions	3	
4	Requirements		
4.1	Procedure for Calculating Thickness.....	3	
4.2	Design Example for Calculating Thickness.....	5	
4.3	Design Method.....	6	
4.4	Explanation of Symbols Used in Design Equations.....	8	
4.5	Special Thickness Classes.....	9	
5	Verification	9	
6	Delivery	9	
Figure			
1	Standard Pipe Laying Conditions....	13	
Tables			
1	Earth Loads P_e , Truck Loads P_p and Trench Loads P_v —psi.....	10	
2	Design Values for Standard Laying Conditions.....	12	
3	Allowances for Casting Tolerance....	12	
4	Reduction Factors R for Truck Load Calculations.....	14	
5	Nominal Thicknesses for Standard Pressure Classes of Ductile-Iron Pipe.....	14	
6	Surface Load Factors for Single Truck on Unpaved Road.....	15	
7	Diameter–Thickness Ratios for Laying Condition Type 1.....	16	

SEC.		PAGE	SEC.		PAGE
8	Diameter–Thickness Ratios for		12	Thickness for Earth Load Plus	
	Laying Condition Type 2	19		Truck Load.....	36
9	Diameter–Thickness Ratios for		13	Thickness for Internal Pressure.....	45
	Laying Condition Type 3	22	14	Rated Working Pressure and	
10	Diameter–Thickness Ratios for			Maximum Depth of Cover.....	46
	Laying Condition Type 4	26	15	Special Thickness Classes of	
11	Diameter–Thickness Ratios for			Ductile-Iron Pipe.....	49
	Laying Condition Type 5	30			

Foreword

This foreword is for information only and is not a part of ANSI/AWWA C150/A21.50.

I. Introduction.

I.A. *Background.* The purpose of this standard is to provide pipeline designers with a recommended design procedure and associated tabular data necessary to establish the wall thickness(es) required for buried ductile-iron pipe based on the type of pipe embedment, depths of trench cover, live load conditions, internal working pressures, and surge conditions appropriate for the specific pipeline project. Once the required wall thickness(es) are established, the ductile-iron pipe should be specified to be manufactured in accordance with ANSI*/AWWA C151/A21.51. ANSI/AWWA C151/A21.51 contains options that must be addressed by the purchaser in response to site-specific project requirements.

Although ANSI/AWWA C150/A21.50 is commonly used for designing ductile-iron pipe for services other than water, users are also directed to ASTM† A746, Standard Specification for Ductile Iron Gravity Sewer Pipe, and ASTM A716, Standard Specification for Ductile Iron Culvert Pipe.

I.B. *History.* American National Standards Committee A21, Cast-Iron Pipe and Fittings, was organized in 1926 under the sponsorship of the American Gas Association (AGA), the ASTM International (ASTM), the American Water Works Association (AWWA), and the New England Water Works Association (NEWWA). Between 1972 and 1984, the co-secretariats were AGA, AWWA, and NEWWA, with AWWA serving as administrative secretariat. In 1984, the committee became an AWWA committee with the name of American Water Works Association Standards Committee A21 on Ductile-Iron Pipe and Fittings. In 1988, NEWWA withdrew as a separate secretariat; however, it continues to maintain its representation on the AWWA Committee A21.

The present scope of AWWA Committee A21 activity is the development of standards and manuals addressing ductile-iron pressure pipe for water and other liquids, and ductile-iron and gray-iron fittings for use with this pipe. These standards and manuals include design, dimensions, materials, coatings, linings, joints, accessories, and methods of inspection and testing.

*American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

†ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

The work of AWWA Committee A21 is conducted by subcommittees. The scope of Subcommittee 1, Pipe, includes the periodic review of current A21 standards for pipe, the preparation of revisions and new standards when needed, as well as other matters pertaining to pipe standards.

The first edition of C150/A21.50, American National Standard for the Thickness Design of Ductile-Iron Pipe, was issued in 1965, and revisions were issued in 1971, 1976, 1981, 1991, 1996, and 2002. The standard was reaffirmed without revision in 1986. Subcommittee 1 reviewed the 1996 edition and submitted a proposed revision to AWWA Standards Committee A21 in 2001. This edition was approved on June 8, 2008.

I.C. *Acceptance.* In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF International (NSF) to develop voluntary third-party consensus standards and a certification program for direct and indirect drinking water additives. Other members of the original consortium included the American Water Works Association Research Foundation (AwwaRF) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association (AWWA) and the Association of State Drinking Water Administrators (ASDWA) joined later.

In the United States, authority to regulate products for use in, or in contact with, drinking water rests with individual states.* Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate the health effects of products and drinking water additives from such products, state and local agencies may use various references, including

1. An advisory program formerly administered by USEPA, Office of Drinking Water, discontinued on Apr. 7, 1990.
2. Specific policies of the state or local agency.
3. Two standards developed under the direction of NSF, NSF[†]/ANSI 60, Drinking Water Treatment Chemicals—Health Effects, and NSF/ANSI 61, Drinking Water System Components—Health Effects.

*Persons outside the United States should contact the appropriate authority having jurisdiction.

†NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48113.

4. Other references, including AWWA standards, *Food Chemicals Codex*, *Water Chemicals Codex*,* and other standards considered appropriate by the state or local agency.

Various certification organizations may be involved in certifying products in accordance with NSF/ANSI 61. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdiction. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Annex A, "Toxicology Review and Evaluation Procedures," to NSF/ANSI 61 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The MALs of an unspecified list of "unregulated contaminants" are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Annex A procedures may not always be identical, depending on the certifier.

ANSI/AWWA C150 does not address additives requirements. Thus, users of this standard should consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements, including applicable standards.
2. Determine the status of certifications by parties offering to certify products for contact with, or treatment of, drinking water.
3. Determine current information on product certification.

II. Special Issues. Currently, there are no special issues related to this standard.

III. Use of This Standard. It is the responsibility of the user of an AWWA standard to determine that the products described in that standard are suitable for use in the particular application being considered.

III.A. *Purchaser Options and Alternatives.* The following items should be provided by the purchaser:

1. Standard used—that is, ANSI/AWWA C150/A21.50, Standard for Thickness Design of Ductile-Iron Pipe, of latest revision.
2. As noted in Sec. I.A of the foreword, ANSI/AWWA C151/A21.51 contains options that must be addressed by the purchaser in response to site-specific requirements for ductile-iron pipe.

*Both publications available from National Academy of Sciences, 500 Fifth Street, N.W., Washington, DC 20001.

III.B. *Modification to Standard.* Any modification to the provisions, definitions, or terminology in this standard must be provided by the purchaser.

IV. Major Revisions. Major revisions made to the standard in this edition include the following:

1. Added definitions for casting and service allowances, working pressures, and surge pressures.

V. Comments. If you have any comments or questions about this standard, please call the AWWA Volunteer and Technical Support Group at 303.794.7711, FAX at 303.795.7603, write to the group at 6666 West Quincy Avenue, Denver, CO 80235-3098, or e-mail the group at standards@awwa.org.



American Water Works
Association

ANSI/AWWA C150/A21.50-08
(Revision of ANSI/AWWA C150/A21/50-02)

AWWA Standard

Thickness Design of Ductile-Iron Pipe

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes the thickness design of ductile-iron pipe complying with the requirements of ANSI^{*}/AWWA C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water. Sec. 4.1 outlines the design procedure, and Sec. 4.2 gives a design example. Sec. 4.3 explains the basis of design. As opposed to using procedures in Sec. 4.1 or Sec. 4.3, the designer may reference Tables 12 through 14 directly.

Table 12 lists thicknesses for standard laying conditions and certain depths of cover. Table 13 lists thicknesses for 150 psi–350 psi (1,034 kPa–2,413 kPa)[†] water working pressure.

The greater thickness from Table 12 or Table 13 for given trench load or internal pressure should be used.

Table 14 lists working pressures and maximum depths of cover for standard laying conditions and standard pressure classes. Table 15 lists special thickness classes of ductile-iron pipe.

^{*}American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

[†]Metric conversions given in this standard are direct conversions of US customary units and are not those specified in International Organization for Standardization (ISO) standards.