

ANSI/AWWA **C221-24**
(Revision of ANSI/AWWA C221-18)

AWWA Standard

Fabricated Steel Mechanical Slip-Type Expansion Joints

Effective date: July 1, 2024.

First edition approved by Board of Directors Feb. 2, 1997.

This edition approved Jan. 11, 2024.

Approved by American National Standards Institute Jan. 11, 2024.

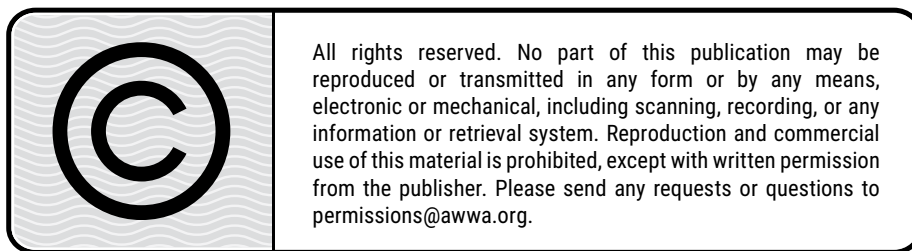
AWWA Standard

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 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 code of any governmental authority. AWWA standards are intended to represent a consensus of the water industry that the product described will provide satisfactory service. When AWWA revises or withdraws this standard, an official notice of action will be placed in the Official Notice 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 ANSI approval. Purchasers of American National Standards may receive current information on all standards by writing to the American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036; calling (212) 642-4900; or e-mailing info@ansi.org.



ISBN-13, print: 978-1-64717-178-0

ISBN-13, electronic: 978-1-61300-705-1

DOI: <http://dx.doi.org/10.12999/AWWA.C221.24>

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including scanning, recording, or any information or retrieval system. Reproduction and commercial use of this material is prohibited, except with written permission from the publisher.

Copyright © 2024 by American Water Works Association
Printed in USA

Committee Personnel

The Steel Water Pipe-Manufacturer's Technical Advisory Committee (SWMPTAC) Task Group for AWWA C221, which reviewed and revised this standard, had the following personnel at the time:

Jay Forni, Jr., *Chair*

S. Bradberry, Ford Meter Box Company, Pell City, Ala.
R.J. Card, Manufacturing Consultant, Houston, Tex.
J. Forni, Jr., Jifco Inc., Livermore, Calif.
J. Grocki, Advantage Resources Consulting, LLC, Enfield, Conn.
B.D. Keil, Northwest Pipe Company, Salt Lake City, Utah
A. Lemke, Romac Industries Inc., Bothell, Wash.
D. Pointek, Total Piping Solutions, Inc., Olean, N.Y.
J. Reinheimer, Robar Industries, Surrey, B.C.
G. Tate, Viking Johnson, Ipswich, Suffolk, U.K.

The AWWA Standards Committee on Steel Pipe, which reviewed and approved this standard, had the following personnel at the time of approval:

John H. Bambei, Jr., *Chair*

Robert J. Card, *Vice-Chair*

John L. Luka, *Secretary*

General Interest Members

S.A. Arnaout (*alternate*), Stantec, Plano, Tex.
J.H. Bambei, Jr., Bambei Engineering Services, Arvada, Colo.
R.J. Card, Lockwood, Andrews & Newnam, Inc., Suwanee, Ga.
R.L. Gibson, Freese and Nichols Inc., Fort Worth, Tex.
M.D. Gossett, HDR, Denver, Colo.
M.B. Horsley (*alternate*), Horsley Engineering LLC, Overland Park, Kans.
R. Issa, AECOM, McKinney, Tex.
C.H. Kirby (*alternate*), Lockwood, Andrews & Newnam, Inc., Houston, Tex.
R.A Kufaas, Norske Corrosion & Inspection Services Ltd., Abbotsford, B.C.
A.S. Maughn (*alternate*), Freese & Nichols Inc., Dallas, Tex.
D.L. McPherson (*alternate*), HDR, Charlotte, N.C.

A. Murdock, Jacobs, Holladay, Utah
R. Ortega, Aurora Technical Services, Houston, Tex.
E.S. Ralph (*liaison, nonvoting*), Standards Engineer Liaison, AWWA, Denver, Colo.
J.R. Snow, Stantec, Denver, Colo.
A.M. Stanton, Black & Veatch, Pasadena, Calif.
W.R. Whidden, Woolpert, Orlando, Fla.

Producer Members

H.H. Bardakjian, Consultant, Glendale, Calif.
D. Dechant, Dechant Infrastructure Service, Aurora, Colo.
D.W. Dunker, Thompson Pipe Group, Rialto, Calif.
B.D. Keil, Northwest Pipe Company, Salt Lake City, Utah
J.L. Luka, American SpiralWeld Pipe Company, Columbia, S.C.
R.D. Mielke (*alternate*), Northwest Pipe Company, Raleigh, N.C.
L. Prinsloo, Victaulic, Easton, Pa.
B.E. Ripley (*alternate*), Victaulic, Lexington, S.C.
G.F. Ruchti (*alternate*), Lan Inc., Punta Gorda, Fla.
B. Simpson (*alternate*), American Cast Iron Pipe Co., Birmingham, Ala.
R. Wu (*alternate*), Thompson Pipe Group, Grand Prairie, Tex.

User Members

L. Adams, US Bureau of Reclamation, Denver, Colo.
G.A. Andersen, New York City Bureau of Water Supply, Little Neck, N.Y.
B. Cheng, Metro Vancouver, Burnaby, B.C.
B. Fountain, San Diego County Water Authority, San Diego, Calif.
J. Fox, Tampa Bay Water, Clearwater, Fla.
J. Garcia (*alternate*), Metropolitan Water District of S. California, LaVerne, Calif.
S. Hattan, Tarrant Regional Water District, Fort Worth, Tex.
M. Lobik, Springfield Water and Sewer Commission, Agawam, Mass.
T. Peng, Metropolitan Water District of Southern California, Los Angeles, Calif.
G. Ramon (*liaison, nonvoting*), Standards Council Liaison, Little Rock Water Reclamation Authority, Little Rock, Ark.
V. Scutelnicu, Los Angeles Water & Power, Los Angeles, Calif.
J. Shieh (*alternate*), Los Angeles Water & Power, Los Angeles, Calif.
M. Turney (*alternate*), Denver Water, Denver, Colo.

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
<i>Foreword</i>		4	Requirements
I	vii	4.1	Materials 6
I.A	vii	4.2	Design..... 8
I.B	vii	4.3	Fabrication 10
I.C	vii	4.4	Coatings..... 11
II	viii	4.5	Installation Instructions..... 12
II.A.1		5	Verification
	viii	5.1	Inspection 12
II.A.2	ix	5.2	Quality Assurance 12
III	ix	5.3	Test Procedures..... 13
III.A		5.4	Nonconformance 13
	ix	6	Delivery
III.B	x	6.1	Marking 14
IV	x	6.2	Packaging and Shipping 14
V	x	6.3	Affidavit of Compliance 14
<i>Standard</i>		<i>Figures</i>	
1	General	1	Typical Expansion Joint with Limit Rods..... 4
1.1	Scope..... 1	2	Typical Expansion Joint Configurations 4
1.2	Purpose 1		
1.3	Application..... 1	<i>Tables</i>	
2	References 2	1	Minimum Physical Properties of Elastomeric Sealing Rings 7
3	Definitions 3	2	Pipe-End Diameter Tolerance..... 7

This page intentionally blank.

Foreword

This foreword is for information only and is not a part of ANSI/AWWA C221.*

I. Introduction

I.A. *Background.* Fabricated steel mechanical slip-type expansion joints have been used since the early 1900s to accommodate thermal movement in nonburied, aboveground pipelines, penstocks, and other conduits where expansion and contraction of more than ½ in. (13 mm) need to be addressed. Though details differ, expansion joints of this type work in the same way and have similar components: a slip pipe, body, gland, packing chamber (with alternate rings of elastomeric material and lubricating rings), and follower ring. The expansion joints may also have a limit ring and limit rods and threaded fasteners (bolts and nuts) that, when tightened, compress the packing in the packing chamber to make a watertight seal while allowing the anticipated axial movement.

I.B. *History.* The first edition of ANSI/AWWA C221 was approved by the AWWA Board of Directors on Feb. 2, 1997. Subsequent revisions to ANSI/AWWA C221 were approved on Jan. 21, 2001; June 24, 2007; June 10, 2012; and Jan. 20, 2018. This edition was approved on Jan. 11, 2024.

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 Water Research Foundation (formerly AwwaRF) and the Conference of State Health and Environmental Managers (COSHEM). 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. Specific policies of the state or local agency.

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

[†] Persons outside the United States should contact the appropriate authority having jurisdiction.

2. Four standards developed under the direction of NSF[‡]: NSF/ANSI/CAN[§] 60, Drinking Water Treatment Chemicals—Health Effects, NSF/ANSI/CAN 61, Drinking Water System Components—Health Effects, NSF/ANSI/CAN 372, Drinking Water System Components—Lead Content, and NSF/ANSI/CAN 600, Health Effects Evaluation and Criteria for Chemicals in Drinking Water.

3. 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/CAN 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.

NSF/ANSI/CAN 600 (which formerly appeared in NSF/ANSI/CAN 60 and 61 as Annex A, “Toxicology Review and Evaluation Procedures”) 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 NSF/ANSI/CAN 600 procedures may not always be identical, depending on the certifier.

ANSI/AWWA C221 does not address additive requirements. 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

II.A.1. *Chlorine and Chloramine Degradation of Elastomers*. The selection of materials is critical for water service and distribution piping in locations where there is a possibility that elastomers will be in contact with chlorine or chloramines. Documented research has shown that elastomers such as gaskets, seals, valve seats, and encapsulations may be degraded when exposed to chlorine or chloramines. The impact of degradation is a function of the type of elastomeric material, chemical concentration,

[‡] NSF International, 789 North Dixboro Road, Ann Arbor, MI 48105.

[§] Standards Council of Canada, 55 Metcalfe Street, Suite 600, Ottawa, ON K1P 6L5 Canada.

[¶] Both publications available from National Academies Press, 500 Fifth Street, NW, Washington, DC 20001.

contact surface area, elastomer cross section, environmental conditions as well as temperature. Careful selection of and specifications for elastomeric materials and the specifics of their application for each water system component should be considered to provide long-term usefulness and minimum degradation (swelling, loss of elasticity, or softening) of the elastomer specified.

II.A.2. *Gasket Degradation Study.* A pipe gasket, having the hardness of a compressed elastomer with a large mass relative to the small exposed surface area, thus experiences minimal degradation. This was validated in a research paper reported in *Journal AWWA*,** where the pipe gasket degradation in a 110 mg/L chloramine solution was found to degrade just the exposed surface.

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 included by the purchaser:

1. Standard used—that is, ANSI/AWWA C221, Fabricated Steel Mechanical Slip-Type Expansion Joints, of latest revision.
2. Whether compliance with NSF/ANSI/CAN 61, Drinking Water System Components—Health Effects, is required.
3. Quantity.
4. Wall thickness, schedule, or class.
5. Actual outside diameter(s) of pipe ends, including any coatings (Sec. 3[1]).
6. Nominal pipe size(s) (Sec. 3[9]).
7. Rated pressure, transient pressure, and test pressure (Sec. 3[16, 19] and Sec. 5.3.1).
8. Details of federal, state, provincial, territorial, and local requirements (Sec. 4.1.1).
9. Slip pipe finish (Sec. 4.1.2).
10. Type of steel (Sec. 4.1.2.1).
11. Bolt, rod, and nut materials (Sec. 4.1.3).
12. Operating temperature range and packing material (Sec. 4.1.4).
13. Tolerances of pipe ends (Sec. 4.1.4.3).

** Bonds, R.W. 2004. "Effect of Chloramines on Ductile-Iron Pipe Gaskets of Various Elastomer Compounds." *Journal AWWA*. 96(4):153–160.

14. Design requirements and length and thickness of body and slip pipe where special performance or installation requirements exist (Sec. 4.2.1).
15. Anticipated axial movement (Sec. 4.2.1 and Sec. 4.2.3.3).
16. Special type of bolting (Sec. 4.2.2.5).
17. Type of pipe(s), including specification to which it is made; or specification, tolerance, and preparation of pipe ends (Sec. 4.2.3.2).
18. Shop and optional coatings (Sec. 4.4).
19. Material certifications (Sec. 5.1.1.2).
20. Purchaser's inspection requirements (Sec. 5.1.2).
21. Purchaser shall specify if a certified welding inspector is required (Sec. 5.2).
22. Purchaser's proof test requirements (Sec. 5.3.1).
23. Hydrostatic test requirements (Sec. 5.3.2.2).
24. Additional nondestructive weld evaluation (Sec. 5.3.3).
25. Affidavit of compliance (Sec. 6.3).

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. The major changes made to the standard in this edition include the following:

1. Updated Sec. I.C. Acceptance in the Foreword with the latest Standards Council language reflecting the addition of reference to NSF/ANSI/CAN 372 and NSF/ANSI/CAN 600.
2. Updated Sec. 4.1.1 Materials with the latest Standards Council boilerplate language.

V. Comments. If you have any comments or questions about this standard, please call AWWA Engineering and Technical Services at 303.794.7711; write to the department at 6666 West Quincy Avenue, Denver, CO 80235-3098; or e-mail at standards@awwa.org.



**American Water Works
Association**

Dedicated to the World's Most Vital Resource®

ANSI/AWWA C221-24
(Revision of ANSI/AWWA C221-18)

AWWA Standard

Fabricated Steel Mechanical Slip-Type Expansion Joints

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes fabricated steel mechanical slip-type expansion joints having packing chambers for use on pipe with plain, flanged, grooved, or shouldered ends in nominal pipe sizes 3 in. (75 mm)* and larger. The joints shall be manufactured from steel and are intended for use in systems conveying water. Mechanical expansion joints are not intended for use in buried conditions.

Sec. 1.2 Purpose

The purpose of this standard is to provide the minimum requirements for fabricated steel mechanical slip-type expansion joints, including system components, testing, and marking requirements.

Sec. 1.3 Application

This standard can be referenced in documents for purchasing and receiving fabricated steel mechanical slip-type expansion joints and can be used as a guide for inspection and testing. This standard or sections of this standard apply when

* Metric conversions given in this standard are direct conversions of US customary units and are not those specified in International Organization for Standardization standards.