Report of the Committee on

Automatic Sprinkler Systems (AUT-AAC)

Technical Correlating Committee

John G. O'Neill, *Chair*
The Protection Engineering Group, PC, VA [SE]

Christian Dubay, *Nonvoting Secretary*
National Fire Protection Association, MA

Jose R. Baz, International Engineered Systems Ltd, Inc., FL [M]
Rep. NFPA Latin American Section
Kerry M. Bell, Underwriters Laboratories Inc., IL [RT]
Russell P. Fleming, National Fire Sprinkler Association, NY [M]
Rep. National Fire Sprinkler Association
Scott T. Franson, The Viking Corporation, MI [M]
Raymond A. Grill, The RJA Group, Inc., VA [SE]
James B. Harmes, Grand Blanc Fire Department, MI [E]
Rep. International Association of Fire Chiefs
Luke Hilton, Liberty Mutual Property, FL [I]
Alex Hoffman, Viking Fire Protection Inc., Canada [IM]
Rep. Canadian Automatic Sprinkler Association
Roland J. Huggins, American Fire Sprinkler Association, Inc., TX [IM]
Rep. American Fire Sprinkler Association
Sultan M. Javeri, SC Engineering, France [IM]
Andrew Kim, National Research Council of Canada, Canada [RT]
Joe W. Noble, Clark County Fire Department, NV [E]
Rep. International Fire Marshals Association
Eric Packard, Local 669 JATC Education Fund, MD [L]
Rep. United Assn of Journeymen & Apprentices of the Plumbing & Pipe Fitting Industry of the US & Canada
Chester W. Schirmer, Schirmer Engineering Corporation, NC [I]
Robert D. Spaulding, FM Global, MA [I]
Rep. FM Global
Lynn K. Underwood, Axis US Property, IL [I]

Alternates

Donald "Don" D. Becker, RJC & Associates, Inc., MO [IM]
(Alt. to Roland J. Huggins)
George Capko, Jr., FM Global, MA [I]
(Alt. to Robert D. Spaulding)
Randall S. Chaney, Liberty Mutual Property, CA [I]
(Alt. to Luke Hilton)
Kenneth E. Isman, National Fire Sprinkler Association, NY [M]
(Alt. to Russell P. Fleming)
George E. Laverick, Underwriters Laboratories Inc., IL [RT]
(Alt. to Kerry M. Bell)
Donald C. Moeller, The RJA Group, Inc., CA [SE]
(Alt. to Raymond A. Grill)
Garner A. Palenske, Schirmer Engineering Corporation, CA [I]
(Alt. to Chester W. Schirmer)
Donato A. Pirro, Electro Sistemas De Panama, S.A., Panama [M]
(Alt. to Jose R. Baz)
J. Michael Thompson, The Protection Engineering Group, PC, VA [SE]
(Alt. to John G. O'Neill)

Nonvoting

Antonio C. M. Braga, FM Global, CA [I]
Rep. TC on Hanging & Bracing of Water-Based Systems
Edward K. Budnick, Hughes Associates, Inc., MD [SE]
Rep. TC on Sprinkler System Discharge Criteria
Robert M. Gagnon, Gagnon Engineering, MD [SE]
Rep. TC on Foam-Water Sprinklers
William E. Koffel, Koffel Associates, Inc., MD [SE]
Rep. Safety to Life Correlating Committee
Kenneth W. Linder, GE Global Asset Protection Services, CT [I]
Rep. TC on Sprinkler System Installation Criteria
Daniel Madrzykowski, US National Institute of Standards & Technology, MD [RT]
Rep. TC on Residential Sprinkler Systems
J. William Sheppard, General Motors Corporation, MI [U]
Rep. TC on Private Water Supply Piping Systems
John J. Walsh, UA Joint Apprenticeship Committee, MD [SE]
(Member Emeritus)

Staff Liaison: **Christian Dubay**

Committee Scope: This Committee shall have overall responsibility for documents that pertain to the criteria for the design and installation of automatic, open and foam-water sprinkler systems including the character and adequacy of water supplies, and the selection of sprinklers, piping, valves, and all materials and accessories. This Committee does not cover the installation of tanks and towers, nor the installation, maintenance, and use of central station, proprietary, auxiliary, and local signaling systems for watchmen, fire alarm, supervisory service, nor the design of fire department hose connections.

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the front of this book.

Report of the Committee on

Hanging and Bracing of Water-Based Fire

Protection Systems (AUT-HBS)

Antonio C. M. Braga, *Chair*
FM Global, CA [I]
Rep. FM Global

Samuel S. Dannaway, ***Secretary***
S. S. Dannaway Associates, Inc., HI [SE]

James B. Biggins, Marsh Risk Consulting, IL [I]
Richard W. Bonds, Ductile Iron Pipe Research Association, AL [M]
James Dockrill, Troy Sprinkler Ltd., Canada [IM]
Rep. Canadian Automatic Sprinkler Association
Daniel C. Duggan, Fire Sprinkler Design, MO [M]
Thomas J. Forsythe, Hughes Associates, Inc., CA [SE]
John D. Gillengerten, State of California, CA [E]
Rep. Building Seismic Safety Council/Code Resource Support Committee
Luke Hilton, Liberty Mutual Property, FL [I]
Rep. Property Casualty Insurers Association of America
Terry Holst, Tyco/Grinnell Fire Protection Systems Co., CA [M]
Rep. National Fire Sprinkler Association
Tina Marie King, GE Global Asset Protection Services, CA [I]
Rep. GE Global Asset Protection Services
Kraig Kirschner, AFCON, CA [M]
Alan R. Laguna, Merit Sprinkler Company, Inc., LA [IM]
George E. Laverick, Underwriters Laboratories Inc., IL [RT]
Philip D. LeGrone, Risk Management Solutions, Inc., TN [SE]
Michael J. Madden, Gage-Babcock & Associates, Inc., CA [SE]
Wayne M. Martin, Wayne Martin & Associates Inc. (WMA), CA [SE]
J. Scott Mitchell, American Fire Sprinkler Association, TX [M]
Rep. American Fire Sprinkler Association
Donald C. Moeller, The RJA Group, Inc., CA [SE]
David S. Mowrer, HSB Professional Loss Control, TN [I]
Randy R. Nelson, PE, VFS Fire & Security Services, CA [IM]
Rep. American Fire Sprinkler Association
Janak B. Patel, Bechtel Savannah River Company, GA [U]
Michael A. Rothmier, UA Joint Apprenticeship Committee, CO [L]
Rep. United Assn of Journeymen & Apprentices of the Plumbing & Pipe Fitting Industry of the US & Canada
James Tauby, Mason Industries, Inc., NY [M]
Jack W. Thacker, Allan Automatic Sprinkler Corp. of So. California, CA [IM]
Rep. National Fire Sprinkler Association
Victoria B. Valentine, National Fire Sprinkler Association, NY [M]
Rep. National Fire Sprinkler Association

Alternates

Charles Bamford, Bamford Inc., WA [IM]
(Alt. to Randy R. Nelson)
Randall S. Chaney, Liberty Mutual Property, CA [I]
(Alt. to Luke Hilton)
Sheldon Dacus, Security Fire Protection Company, TN [M]
(Alt. to Victoria B. Valentine)
Christopher I. Deneff, FM Global, RI [I]
(Alt. to Antonio C. M. Braga)
Todd A. Dillon, GE Global Asset Protection Services, OH [I]
(Alt. to Tina Marie King)
Paul A. Hart, ERICO, Inc., OH [M]
(Alt. to J. Scott Mitchell)
Russell G. Hoeltzel, Marsh Risk Consulting, CA [I]
(Alt. to James B. Biggins)
Emil W. Misichko, Underwriters Laboratories Inc., IL [RT]
(Alt. to George E. Laverick)
Eric Packard, Local 669 JATC Education Fund, MD [L]
(Alt. to Michael A. Rothmier)
Allyn J. Vaughn, The RJA Group, Inc., NV [SE]
(Alt. to Donald C. Moeller)

George Von Gnatensky, Tolco, CA [M]
(Alt. to Terry Holst)
Ronald N. Webb, S.A. Comunale Company, Inc., OH [IM]
(Alt. to Jack W. Thacker)

Staff Liaison: **Christian Dubay**

Committee Scope: This Committee shall have the primary responsibility for those portions of NFPA 13 that pertain to the criteria for the use and installation of components and devices used for the support of water-based fire protection system piping including protection against seismic events.

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the front of this book.

Report of the Committee on

Private Water Supply Piping Systems (AUT-PRI)

J. William Sheppard, ***Chair***
General Motors Corporation, MI [U]
Rep. NFPA Industrial Fire Protection Section

Christian Dubay, *Nonvoting Secretary*
National Fire Protection Association, MA

James B. Biggins, Marsh Risk Consulting, IL [I]
Richard W. Bonds, Ductile Iron Pipe Research Association, AL [M]
Phillip A. Brown, American Fire Sprinkler Association, Inc., TX [IM]
Rep. American Fire Sprinkler Association
Richard R. Brown, Brown Sprinkler Corporation, KY [IM]
Rep. National Fire Sprinkler Association
Stephen A. Clark, Jr., Allianz Risk Consultants, GA [I]
Brandon W. Frakes, GE Global Asset Protection Services, NC [I]
Rep. GE Global Asset Protection Services
Robert M. Gagnon, Gagnon Engineering, MD [SE]
David M. Gough, Global Risk Consultants Corporation, CT [SE]
Luke Hilton, Liberty Mutual Property, FL [I]
Rep. Property Casualty Insurers Association of America
Gerald Kelliher, Westinghouse Savannah River Co., SC [U]
Kevin J. Kelly, National Fire Sprinkler Association, NY [M]
Rep. National Fire Sprinkler Association
Marshall A. Klein, Marshall A. Klein & Associates, Inc., MD [SE]
Alan R. Laguna, Merit Sprinkler Company, Inc., LA [IM]
John Lake, Marion County Fire Rescue, FL [E]
George E. Laverick, Underwriters Laboratories Inc., IL [RT]
James M. Maddry, James M. Maddry, P.E., GA [SE]
Kevin D. Maughan, Tyco Fire & Building Products, RI [M]
David S. Mowrer, HSB Professional Loss Control, TN [I]
Robert A. Panero, Pacific Gas and Electric Company, CA [U]
Rep. Edison Electric Institute
Sam (Sat) Salwan, Environmental Systems Design, Inc., IL [SE]
James R. Schifiliti, Fire Safety Consultants, Inc., IL [IM]
Rep. Illinois Fire Prevention Association
James W. Simms, The RJA Group, Inc., CA [SE]

Alternates

Mark A. Bowman, GE Global Asset Protection Services, OH [I]
(Alt. to Brandon W. Frakes)
James K. Clancy, The RJA Group, Inc., CA [SE]
(Alt. to James W. Simms)
W. Clark Gey, Wayne Automatic Fire Sprinklers, Inc., FL [IM]
(Alt. to Richard R. Brown)
David M. Hammerman, Marshall A. Klein and Associates, Inc., MD [SE]
(Alt. to Marshall A. Klein)
Charles F. Hill, Ryan Fire Protection, Inc., IN [M]
(Alt. to Kevin J. Kelly)
Blake M. Shugarman, Underwriters Laboratories Inc., IL [RT]
(Alt. to George E. Laverick)
Lawrence Thibodeau, Hampshire Fire Protection Company Inc., NH [IM]
(Alt. to Phillip A. Brown)

Nonvoting

Geoffrey N. Perkins, Bassett Consulting Engineers, Australia [SE]

Staff Liaison: **Christian Dubay**

Committee Scope: This Committee shall have the primary responsibility for documents on private piping systems supplying water for fire protection and for hydrants, hose houses, and valves. The Committee is also responsible for documents on fire flow testing and marking of hydrants.

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the front of this book.

Report of the Committee on

Residential Sprinkler Systems (AUT-RSS)

Daniel Madrzykowski, *Chair*
US National Institute of Standards & Technology, MD [RT]

Christian Dubay, *Nonvoting Secretary*
National Fire Protection Association, MA

George W. Baker, Mashpee Fire & Rescue Department, MA [E]
Rep. International Association of Fire Chiefs
Kerry M. Bell, Underwriters Laboratories Inc., IL [RT]
Fred Benn, Advanced Automatic Sprinkler, Inc., CA [IM]
Jonathan C. Bittenbender, REHAU Incorporated, VA [M]
Frederick C. Bradley, FCB Engineering, GA [SE]
Lawrence Brown, National Association of Home Builders, DC [U]
Rep. National Association of Home Builders
Phillip A. Brown, American Fire Sprinkler Association, Inc., TX [IM]
Rep. American Fire Sprinkler Association
Edward K. Budnick, Hughes Associates, Inc., MD [SE]
Thomas G. Deegan, The Viking Group, Inc., MI [M]
Rep. National Fire Sprinkler Association
Kenneth E. Isman, National Fire Sprinkler Association, NY [M]
Rep. National Fire Sprinkler Association
Gary L. Johnson, Noveon, Inc., VA [M]
Rep. Committee for Firesafe Dwellings
David Killey, Fire Busters Incorporated, Canada [IM]
Rep. Canadian Automatic Sprinkler Association
Alan G. Larson, Uponor Wirsbo Company Inc., MN [M]
M. L. "Larry" Maruskin, US Department of Homeland Security, MD [C] **Ronald G. Nickson,** National Multi Housing Council, DC [U]
Rep. National Multi Housing Council
Eric Packard, Local 669 JATC Education Fund, MD [L]
Rep. United Assn of Journeymen & Apprentices of the Plumbing & Pipe Fitting Industry of the US & Canada
Maurice M. Pilette, Mechanical Designs Ltd., MA [SE]
Steven R. Rians, Standard Automatic Fire Enterprises, Inc., TX [IM]
(Voting Alt. to AFSA Rep.)
Chester W. Schirmer, Schirmer Engineering Corporation, NC [I]
Harry Shaw, Fail Safe Safety Systems Inc., MD [M]
Sandra Stanek, Rural/Metro Fire Department, AZ [E]
George W. Stanley, Wiginton Fire Systems, FL [IM]
Rep. National Fire Sprinkler Association
Randolph W. Tucker, The RJA Group, Inc., TX [SE]
Ed Van Walraven, Aspen Fire Protection District, CO [E]
Terry L. Victor, Tyco/SimplexGrinnell, MD [M]
Hong-Zeng (Bert) Yu, FM Global, MA [I]
Rep. FM Global

Alternates

David W. Ash, Noveon, Inc., OH [M]
(Alt. to Gary L. Johnson)
James K. Clancy, The RJA Group, Inc., CA [SE]
(Alt. to Randolph W. Tucker)
Mark E. Fessenden, Tyco Fire & Building Products, RI [M]
(Alt. to Terry L. Victor)
Ron Fletcher, Aero Automatic Sprinkler Company, AZ [IM]
(Alt. to Phillip A. Brown)
David B. Fuller, FM Approvals, RI [I]
(Alt. to Hong-Zeng (Bert) Yu)
W. Clark Gey, Wayne Automatic Fire Sprinklers, Inc., FL [IM]
(Alt. to George W. Stanley)
Franz P. Haase, Uponor Wirsbo Company Inc., NH [M]
(Alt. to Alan G. Larson)
George E. Laverick, Underwriters Laboratories Inc., IL [RT]
(Alt. to Kerry M. Bell)
Thomas L. Multer, Reliable Automatic Sprinkler Company, GA [M]
(Alt. to Thomas G. Deegan)

Ron Murray, Plumbers and Steamfitters Local 290 (UA), OR [L]
(Alt. to Eric Packard)
David W. Stroup, US National Institute of Standards & Technology, MD [RT]
(Alt. to Daniel Madrzykowski)
Joseph E. Wiehagen, National Association of Home Builders, MD [U]
(Alt. to Lawrence Brown)
James V. C. Yates, West Windsor Emergency Services, NJ [E]
(Alt. to George W. Baker)

Nonvoting

Rohit Khanna, US Consumer Product Safety Commission, MD [C]

Staff Liaison: **Christian Dubay**

Committee Scope: This Committee shall have primary responsibility for documents on the design and installation of automatic sprinkler systems in dwellings and residential occupancies up to and including four stories in height, including the character and adequacy of water supplies, and the selection of sprinklers, piping, valves, and all materials and accessories.

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the front of this book.

Report of the Committee on

Sprinkler System Discharge Criteria (AUT-SSD)

Edward K. Budnick, *Chair*
Hughes Associates, Inc., MD [SE]

Christian Dubay, *Nonvoting Secretary*
National Fire Protection Association, MA

Charles O. Bauroth, Liberty Mutual Property, MA [I]
Rep. Property Casualty Insurers Association of America
Kerry M. Bell, Underwriters Laboratories Inc., IL [RT]
Michael H. Blumenthal, Rubber Manufacturers Association, DC [M]
Rep. Rubber Manufacturers Association
James C. Bollier, Road Sprinkler Fitters UA Local 483, CA [L]
Rep. United Assn of Journeymen & Apprentices of the Plumbing & Pipe Fitting Industry of the US & Canada
Thomas G. Deegan, The Viking Group, Inc., MI [M]
Russell P. Fleming, National Fire Sprinkler Association, NY [M]
Rep. National Fire Sprinkler Association
James G. Gallup, The RJA Group, Inc., AZ [SE]
James E. Golinveaux, Tyco Fire & Building Products, RI [M]
Joseph B. Hankins, Jr., FM Global Research, MA [I]
Rep. FM Global
Roland J. Huggins, American Fire Sprinkler Association, Inc., TX [IM]
Rep. American Fire Sprinkler Association
Sultan M. Javeri, SC Engineering, France [IM]
Larry Keeping, Vipond Fire Protection, Canada [IM]
Rep. Canadian Automatic Sprinkler Association
Andrew Kim, National Research Council of Canada, Canada [RT]
William E. Koffel, Koffel Associates, Inc., MD [SE]
Chris LaFleur, General Motors Corporation, MI [U]
Azarang (Ozzie) Mirkhah, Las Vegas Fire and Rescue, NV [E]
Richard Pehrson, Futrell Fire Consult and Design, Inc., MN [E]
Rep. International Fire Marshals Association
Chester W. Schirmer, Schirmer Engineering Corporation, NC [I]
Michael D. Sides, GE Global Asset Protection Services, FL [I]
Rep. GE Global Asset Protection Services
Peter A. Smith, International Paper Company, TN [U]
Sandra Stanek, Rural/Metro Fire Department, AZ [E]
David W. Stroup, US National Institute of Standards & Technology, MD [RT]
Willie R. Templin, American Automatic Sprinkler, Inc., TX [IM]
Rep. American Fire Sprinkler Association
Jack W. Thacker, Allan Automatic Sprinkler Corp. of So. California, CA [IM]
Rep. National Fire Sprinkler Association
William J. Tomes, TVA Fire and Life Safety, Inc., GA [U]
Rep. The Home Depot

Alternates

Carl P. Anderson, Tacoma Fire Department, WA [E]
(Alt. to Azarang (Ozzie) Mirkhah)
Weston C. Baker, Jr., FM Global, MA [I]
(Alt. to Joseph B. Hankins)
Gordon Bates, Minneapolis Fire Department, MN [E]
(Alt. to Richard Pehrson)
Richard Battista, Fire Protection Industries, Inc., NJ [M]
(Alt. to Russell P. Fleming)
Mark A. Bowman, GE Global Asset Protection Services, OH [I]
(Alt. to Michael D. Sides)
John August Denhardt, Strickland Fire Protection, Inc., MD [IM]
(Alt. to Willie R. Templin)
Pravinray D. Gandhi, Underwriters Laboratories Inc., IL [RT]
(Alt. to Kerry M. Bell)
Donald Hopkins, Jr., Hughes Associates, Inc., MD [SE]
(Alt. to Edward K. Budnick)
Daniel Madrzykowski, US National Institute of Standards & Technology, MD [RT]
(Alt. to David W. Stroup)
Jack A. Medovich, East Coast Fire Protection, Inc., MD [IM]
(Alt. to Roland J. Huggins)
Thomas L. Multer, Reliable Automatic Sprinkler Company, GA [M]
(Voting Alt. to NFSA Rep.)
Garner A. Palenske, Schirmer Engineering Corporation, CA [I]
(Alt. to Chester W. Schirmer)
Raymond P. Schmid, Koffel Associates, Inc., MD [SE]
(Alt. to William E. Koffel)
George W. Stanley, Wiginton Fire Systems, FL [IM]
(Alt. to Jack W. Thacker)
Peter W. Thomas, Tyco Fire & Building Products, RI [M]
(Alt. to James E. Golinveaux)
William P. Thomas, Jr., TVA Fire and Life Safety, Inc., IL [U]
(Alt. to William J. Tomes)
Tom Vincent, Life Safety Systems, Canada [IM]
(Alt. to Larry Keeping)
Martin H. Workman, The Viking Group, Inc., MI [M]
(Alt. to Thomas G. Deegan)

Nonvoting

Barry M. Lee, Tyco International, Australia [M]

Staff Liaison: **Christian Dubay**

Committee Scope: This Committee shall have primary responsibility for those portions of NFPA 13 that pertain to the classification of various fire hazards and the determination of associated discharge criteria for sprinkler systems employing automatic and open sprinklers.

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the front of this book.

Report of the Committee on

Sprinkler System Installation Criteria (AUT-SSI)

Kenneth W. Linder, *Chair*
GE Global Asset Protection Services, CT [I]
Rep. GE Global Asset Protection Services

Christian Dubay, *Nonvoting Secretary*
National Fire Protection Association, MA

Weston C. Baker, Jr., FM Global, MA [I]
Rep. FM Global
Edward K. Budnick, Hughes Associates, Inc., MD [SE]
Robert G. Caputo, Consolidated Fireprotection, Inc., CA [IM]
Rep. American Fire Sprinkler Association
Jean C. Carter, Jr., Louisiana Office of State Fire Marshal, LA [E]
Del Dornbos, The Viking Corporation, MI [M]
Rep. National Fire Sprinkler Association
Robert E. Duke, Fire Control Incorporated, IL [IM]
Randall Eberly, US Coast Guard, DC [E]
David L. Foster, Insurance Services Office, Inc., NJ [I]
Ralph Gerdes, Ralph Gerdes Consultants, LLC, IN [SE]
Rep. American Institute of Architects
Christopher M. Goddard, AstraZeneca, DE [U]
Rep. NFPA Industrial Fire Protection Section
Luke Hilton, Liberty Mutual Property, FL [I]
Kenneth E. Isman, National Fire Sprinkler Association, NY [M]
Rep. National Fire Sprinkler Association
Larry Keeping, Vipond Fire Protection, Canada [IM]
Rep. Canadian Automatic Sprinkler Association
Michael D. Kirn, Code Consultants, Inc., MO [SE]
George E. Laverick, Underwriters Laboratories Inc., IL [RT]
Ausmus S. Marburger, Fire Protection Industries, Inc., PA [IM]
Rep. National Fire Sprinkler Association

Rodney A. McPhee, Canadian Wood Council, Canada [U]
Peter J. McWilliams, Eastman Kodak Company, NY [U]
Michael F. Meehan, Virginia Sprinkler Company, Inc., VA [IM]
Rep. American Fire Sprinkler Association
David S. Mowrer, HSB Professional Loss Control, TN [I]
Joe W. Noble, Clark County Fire Department, NV [E]
Rep. International Fire Marshals Association
Eric Packard, Local 669 JATC Education Fund, MD [L]
Rep. United Assn of Journeymen & Apprentices of the Plumbing & Pipe Fitting Industry of the US & Canada
Chester W. Schirmer, Schirmer Engineering Corporation, NC [I]
Sandra Stanek, Rural/Metro Fire Department, AZ [E]
Craig R. Studer, The RJA Group, Inc., CA [SE]
Lynn K. Underwood, CSG Property, IL [I]
Terry L. Victor, Tyco/SimplexGrinnell, MD [M]

Voting Alternate

Michael A. Amar, Gage-Babcock & Associates, Inc., CA [SE]
(Voting Alt. to Gage-Babcock Rep.)
Thomas H. Miller, Varley-Campbell & Associates, Inc/Village of Glen Ellyn, IL [E]
(Voting Alt. to NFPA/FSS Rep.)

Alternate

Hamid R. Bahadori, Hughes Associates, Inc., FL [SE]
(Alt. to Edward K. Budnick)
Kerry M. Bell, Underwriters Laboratories Inc., IL [RT]
(Alt. to George E. Laverick)
Phillip A. Brown, American Fire Sprinkler Association, Inc., TX [IM]
(Alt. to Robert G. Caputo)
Randall S. Chaney, Liberty Mutual Property, CA [I]
(Alt. to Luke Hilton)
Todd A. Dillon, GE Global Asset Protection Services, OH [I]
(Alt. to Kenneth W. Linder)
James E. Golinveaux, Tyco Fire & Building Products, RI [M]
(Alt. to Terry L. Victor)
Stephen R. Ide, Victaulic Company of America, PA [M]
(Alt. to Del Dornbos)
Elwin G. Joyce, II, Eastern Kentucky University, KY [U]
(Alt. to Christopher M. Goddard)
Richard S. Malek, Eastman Kodak Company, NY [U]
(Alt. to Peter J. McWilliams)
Richard Oliver, Oliver Sprinkler Company, Inc., PA [IM]
(Alt. to Ausmus S. Marburger)
Michael A. Rothmier, UA Joint Apprenticeship Committee, CO [L]
(Alt. to Eric Packard)
Steven J. Scandaliato, Scandaliato Design Group, Inc., CO [IM]
(Alt. to Michael F. Meehan)
LeJay Slocum, Schirmer Engineering Corporation, MD [I]
(Alt. to Chester W. Schirmer)
Robert Vincent, Shambaugh & Son, L.P., IN [M]
(Alt. to Kenneth E. Isman)
Tom Vincent, Life Safety Systems, Canada [IM]
(Alt. to Larry Keeping)
Corey C. Weldon, The RJA Group, Inc., TX [SE]
(Alt. to Craig R. Studer)

Nonvoting

Barry M. Lee, Tyco International, Australia [M]

Staff Liaison**: Christian Dubay**

Committee Scope: This Committee shall have the primary responsibility for those portions of NFPA 13 that pertain to the criteria for the use and installation of sprinkler systems components (with the exception of those components used for supporting of piping), position of sprinklers, types of systems, plans and calculations, water supplies, and acceptance testing.

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the front of this book.

The Report of the Committee on **Automatic Sprinkler Systems** is presenting five Reports for adoption, as follows:

The Reports were prepared by the:

- Technical Correlating Committee on Automatic Sprinkler Systems (AUT-AAC)
- Technical Committee on Hanging and Bracing of Water-Based Fire Protection Systems (AUT-HBS)
- Technical Committee on Private Water Supply Piping Systems (AUT-PRI)
- Technical Committee on Residential Sprinkler Systems (AUT-RSS)
- Technical Committee on Sprinkler System Discharge Criteria (AUT-SSD)
- Technical Committee on Sprinkler System Installation Criteria ((AUT-SSI)

Report I: The Committee proposes for adoption, amendments to NFPA 13, **Standard for the Installation of Sprinkler Systems,** 2002 edition. NFPA 13-2002 is published in Volume 1 of the 2004/2005 National Fire Codes and in separate pamphlet form.

NFPA 13 has been submitted to letter ballot of the applicable **Automatic Sprinkler Systems Committees.** The results of the balloting, after circulation of any negative votes, can be found in the report.

NFPA 13 has also been submitted to letter ballot of the **Technical Correlating Committee on Automatic Sprinkler Systems**, which consists of 17 voting members; of whom 14 voted affirmatively, and 3 ballots were not returned (Harmes, Kim, Underwood)

Report II: The Committee proposes for adoption, a (complete revision or new document or amendments) to NFPA 13D, **Standard For the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes,** 2002 edition. NFPA 13D is published in Volume 1 of the 2004/2005 National Fire Codes and in separate pamphlet form.

NFPA 13D has been submitted to letter ballot of the **Technical Committee on Residential Sprinkler Systems**, which consists of 27 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.

NFPA 13D has also been submitted to letter ballot of the **Technical Correlating Committee on Automatic Sprinkler Systems,** which consists of 17 voting members; of whom 13 voted affirmatively, and 4 ballots were not returned (Baz, Harmes, Kim, and Schirmer).

Report III: The Technical Committee proposes for adoption, amendments to NFPA 13R, **Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height**, 2002 edition. NFPA 13R-2002 is published in Volume 1 of the 2004/2005 National Fire Codes and in separate pamphlet form.

NFPA 13R has been submitted to letter ballot of the **Technical Committee on Residential Sprinkler Systems**, which consists of 27 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.

NFPA 13R has also been submitted to letter ballot of the **Technical Correlating Committee on Automatic Sprinkler Systems**, which consists of 17 voting members; of whom 13 voted affirmatively, and 4 ballot(s) were not returned (Baz, Harmes, Kim, and Schirmer).

Report IV: The Technical Committee proposes for adoption, amendments to NFPA 24, **Standard for the Installation of Private Fire Service Mains and Their Appurtenances,** 2002 edition. NFPA 24-2002 is published in Volume 2 of the 2004/2005 National Fire Codes and in separate pamphlet form.

NFPA 24 has been submitted to letter ballot of the **Technical Committee on Private Water Supply Piping Systems**, which consists of 23 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.

NFPA 24 has also been submitted to letter ballot of the **Technical Correlating Committee on Automatic Sprinkler Systems**, which consists of 17 voting members; of whom 13 voted affirmatively, and 4 ballots were not returned (Baz, Harmes, Kim, Schirmer).

Report V: The Technical Committee proposes for adoption, a reconfirmation to NFPA 291, **Recommended Practice for Fire Flow Testing and Marking of Hydrants**, 2002 edition. NFPA 291-2002 is published in Volume 13 of the 2004/2005 National Fire Codes and in separate pamphlet form.

NFPA 291 has been submitted to letter ballot of the **Technical Committee on Private Water Piping Systems**, which consists of 23 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.

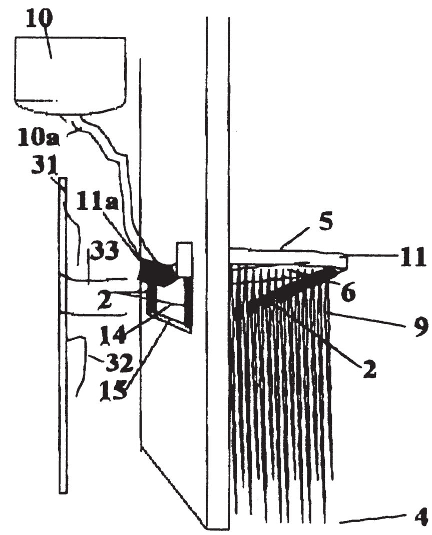
NFPA 291 has also been submitted to letter ballot of the **Technical Correlating Committee on Automatic Sprinkler Systems**, which consists of 17 voting members; of whom 13 voted affirmatively, and 4 ballots were not returned (Baz, Harmes, Kim, and Schirmer).

24-1 Log #26 AUT-PRI **Final Action: Reject**
(Entire Document)

SUBMITTER: Denyse DuBrucq, AirWars Defense
RECOMMENDATION: Revise text to read as follows:
Covers requirements for installation of private fire service mains and their appurtenances supplying automatic sprinkler systems, open sprinkler systems, water spray fixed systems, foam systems, Liquid Nitrogen fixed systems , private hydrants, monitor nozzles or standpipe systems with references to water supplies private hydrants and hose houses, and Liquid Nitrogen piping and cryogenic plumbing . Also applies to combined service mains used to carry water for both fire service and other use.
SUBSTANTIATION: Liquid Nitrogen applied appropriately generates inert gas, Nitrogen, displacing air containing Oxygen, and cooling air, liquids and solids, which stops fires.
Nitrogen fire fighting leaves no trace, not disturbing papers, records, art, furnishings, product or wrapping beyond what has been consumed and disfigured by the fire prior to application.
Plumbing a building for LN fire control speeds application in case of fire, flammable spill, or gas leak. It can end hostage crises by causing people to quickly pass out. Rescuers handcuff criminals and resuscitate all people and animals.
LN is recommended for tall buildings, storage of flammables, silos, manufacturing or servicing with fire hazards, banks, convenience stores, and buildings where destruction of equipment, papers, art and furnishings is unacceptable. Primary water states as Colorado, Utah, Nevada, New Mexico, Arizona, and California preserve water if they substitute Liquid Nitrogen for water in fire fighting.
Plumbing designs include a nozzle that supply tank or tank truck latches into feeding LN into an interior trough or semicircular pan with holes dispersing Liquid Nitrogen in evenly spaced droplet streams. The droplets evaporate releasing below the sieve location cryogenically cold, inert Nitrogen gas, which is drawn into the fire and floods the inner space.
COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee rejects the proposed changes as they are outside the scope of NFPA 24 and should be submitted to NFPA 2001.
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-2 Log #33 AUT-PRI **Final Action: Reject**
(Entire Document)

SUBMITTER: Denyse Dubrucq, AirWars Defense
RECOMMENDATION: Add new text as follows:
Liquid Nitrogen applied appropriately generates inert gas, Nitrogen, displacing air containing Oxygen, and cooling air, liquids and solids, which stops fires.
Nitrogen fire fighting leaves no trace, not disturbing papers, records, art, furnishings, product or wrapping beyond what has been consumed and disfigured by the fire prior to application.
Plumbing a building for LN fire control speeds application in case of fire, flammable spill, or gas leak. It can end hostage crises by causing people to quickly pass out. Rescuers handcuff criminals and resuscitate all people and animals.
LN is recommended for tall buildings, storage of flammables, silos, manufacturing or servicing with fire hazards, banks, convenience stores, and buildings where destruction of equipment, papers, art and furnishings is unacceptable. Primary water states as Colorado, Utah, Nevada, New Mexico, Arizona, and California preserve water if they substitute Liquid Nitrogen for water in fire fighting.
Plumbing designs include a nozzle that supply tank or tank truck latches into feeding LN into an interior trough or semi-circular pan with holes dispersing Liquid Nitrogen in evenly spaced droplet streams. The droplets evaporate releasing below the sieve location cryogenically cold, inert Nitrogen gas, which is drawn into the fire and floods the inner space.
SUBSTANTIATION:



This drawing of a unit system where 10 indicates a reservoir, 10a the transfer tubing, 11 the dispenser, and 14 the means to affix the dispenser to the window inset or wall. When the Liquid Nitrogen is dispersed it is liquid 2 and as it evaporates it is gaseous 4.
In the case of a Liquid Nitrogen (LN) fixed fire control system, the reservoir can hold one or more quantities to flood one or more living units with Nitrogen. Fire department LN supplies can add to the volume for multiple unit fires.
Liquid Nitrogen systems should be included with Water systems for the following reasons:
1. Both Nitrogen and water are major ingredients in the natural earth's atmosphere.
2. Both Liquid Nitrogen and liquid water are brought to the fire scene.
3. Both are fire retardants in their gaseous form.
4. Both provide cooling of the vicinity of the fire through evaporation.
5. Both in great volume do not pollute the atmosphere.
6. Both in great volume do not pollute the watershed.
In contrast, the foams, halon, and even vinegar and baking soda bring ingredients uncommon in our ecosystem into the act of fire control.
COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: See Committee Statement on Proposal 24-1 (Log #26).
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-2a Log #CP7 **Final Action: Accept**
(Entire Document)

SUBMITTER: Technical Correlating Committee on Automatic Sprinkler Systems
RECOMMENDATION: The TCC directs staff to editorially ensure that all logs are properly combined and correlated. Additionally, staff is directed to ensure compliance with the NFPA manual of style.
SUBSTANTIATION: It is the intent of the TCC that staff editorially ensures that all accepted materials comply with the NFPA Manual of Style and that all of the accepted changes are incorporated into NFPA 13. Additionally, the TCC wants to ensure that where multiple proposals affected a single section that the final text incorporates all of the accepted changes from the various proposals.
COMMITTEE MEETING ACTION: Accept
The TCC ballot results were 17 voting members; of whom 13 voted affirmatively and 4 ballots were not returned (Baz, Harmes, Kim, and Schirmer).

24-3 Log #3 AUT-PRI **Final Action: Accept**
(1.1.1)

SUBMITTER: Jon Nisja, Northcentral Regional Fire Code Development Committee
RECOMMENDATION: Change section 1.1.1 as follows:
1.1.1 This standard shall cover the minimum requirements for the installation of private fire service mains and their appurtenances supplying the following:
(1) Automatic sprinkler systems
(2) Open sprinkler systems
(3) Water spray fixed systems
(4) Foam systems
(5) Private hydrants
(6) Monitor nozzles or standpipe systems with reference to water supplies
~~(7) Private hydrants~~
~~(8)~~ <u>(7)</u> Hose houses
SUBSTANTIATION: It appears number 7 is a duplicate of number 5.
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-4 Log #5 AUT-PRI **Final Action: Accept in Principle**
(2.x)

SUBMITTER: Jim Everitt, Western Regional Fire Code Dev. Committee
RECOMMENDATION: Add a new definition to read:
2.xxx.x Private Fire Hydrant. A connection to a private water main for the purpose of supplying water to fire hose or other fire protection apparatus.

SUBSTANTIATION: Currently there is no definition for private fire hydrant within the standard. The definition has been taken from NFPA 25 with the addition of private.
COMMITTEE MEETING ACTION: Accept in Principle
Add a new definition for Private Fire Hydrant as follows:
3.3.2 <u>Private Fire Hydrant. A valved connection on a water supply system having one or more outlets and that is used to supply hose and fire department pumpers with water on private property. Where connected to a public water system, the private hydrants are supplied by a private service main that begins at the point of service designated by the AHJ, usually at a manually operated valve near the property line.</u>
COMMITTEE STATEMENT: The committee agrees with the proposed change, but further wanted to clarify the term.
The committee has formed a definitions task group to determine what additional terms should be defined within NFPA 24. Comments are encouraged to identify terms that should be defined by NFPA 24.
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-5 Log #22 AUT-PRI **Final Action: Accept**
(2.3.5)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.
RECOMMENDATION: Add the following new text:
AWWA C153 Ductile-iron Compact Fittings for Water Service 2000, AWWA C116 Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service 2003, and AWWA C600 Installation of Ductile-Iron Water mains and their Appurtenances 1999.
SUBSTANTIATION: These are manufacturing standards for underground pipe that are used for private fire service mains and are referenced in Table 10.1.1
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-6 Log #23 AUT-PRI **Final Action: Accept**
(2.3.5)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.
RECOMMENDATION: Update the standards' titles and revision years as follows:
AWWA C104, Cement Mortar Lining for Ductile Iron Pipe and Fittings ~~, 3 in. through 48-in.,~~ for Water, ~~1990~~ <u>2003</u>
AWWA C105, Polyethylene Encasement for Ductile Iron Pipe Systems, ~~1993~~ <u>1999</u>
AWWA C110, Ductile Iron and Gray Iron Fittings, 1 ~~990~~ <u>2003</u>
AWWA C111 Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings, 2000
AWWA C115, Flanged Ductile Iron pipe with Ductile Iron or Gray iron threaded Flangers, ~~1998~~ 1999
AWWA C150, Thickness Design of Ductile Iron Pipe, ~~1991~~ 2002
AWWA C151, Ductile Iron Pipe, Centrifugally Cast for Water, ~~1991~~ 2002
SUBSTANTIATION: The title of one standard has been changed and revision dates have been updated.
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-7 Log #9 AUT-PRI **Final Action: Accept in Principle**
(3.3.2 Private Fire Hydrant)

SUBMITTER: Robert Fash, Las Vegas Fire & Rescue
RECOMMENDATION: Add the following definition for Private Fire Hydrant:
3.3.2 Private Fire Hydrant. A valved connection on a water supply system having one or more outlets and that is used to supply hose and fire department pumpers with water on private property. Where connected to a public water system, the private hydrants are supplied by a private service main that begins at a point designated by the public water utility, usually at a manually operated valve near the property line.
SUBSTANTIATION: This proposed definition will delineate between a public and private fire hydrant. Although the flow characteristics between a private and public hydrant should not be noticeable there is a need to define them. The enforcement of maintenance requirements for private hydrants differs from that which are service by public water purveyors. The AHJ needs a definition in place to cite private hydrants differently from public hydrants. The term "Private Hydrant" appears in a number of NFPA standards, such as NFPA 1, 13, 24, 25 & 291. NFPA 14, Standard for the Installation of Standpipe and Hose Systems, 2003 edition has the term "Private Hydrant" indicated within its scope but it is not defined. I am submitting this definition for consideration to the NFPA 24 due to the title of the standard, "Standard for the Installation of Private Fire Service Mains and Their Appurtenances." I am also submitting this proposal to the NFPA 13 committee because the definition for "Private Fire Service Main" is controlled by the Standard for the Installation of Sprinkler Systems."
COMMITTEE MEETING ACTION: Accept in Principle
See Committee Action on Proposal 24-4 (Log#5).
COMMITTEE STATEMENT: See Committee Statement on Proposal 24-4 (Log#5).
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-8 Log #4 AUT-PRI **Final Action: Accept in Principle**
(4.1.3)

SUBMITTER: David M. Schwartz, aXiem
RECOMMENDATION: Add new text as follows:
4.1* Plans.
4.1.1 Working plans shall be submitted for approval to the authority having jurisdiction before any equipment is installed or remodeled.
4.1.2 Deviation from approved plans shall require permission of the authority having jurisdiction.
4.1.3 Working plans shall be drawn to an indicated scale on sheets of uniform size, with a plan of each floor, and shall include the following items that pertain to the design of the system:
(1) Size and location of all water supplies
(2) Size and location of standpipe risers, hose outlets, hand hose, monitor nozzles, and related equipment
(3) The following items that pertain to private fire service mains:

(a) Size
(b) Length
(c) Location
(d) Weight
(e) Material
(f) Point of connection to city main
(g) Sizes, types, and locations of valves, valve indicators, regulators, meters, and valve pits
(h) Depth at which the top of the pipe is laid below grade
(4) The following items that pertain to hydrants:
(a) Size and location, including size and number of outlets and whether outlets are equipped with independent gate valves
(b) Whether hose houses and equipment are to be provided, and by whom
(c) Static and residual hydrants used in flow
(5) Size, location, and piping arrangement of fire department connections
(6) Thrust block details, if provided
(7) Name of owner
(8) Location, including street address
(9) Point of compass
(10) A graphic representation of the scale used on all plans
(11) Name and address of contractor
(12) The manufacturer's installation instructions for any specially listed equipment, including descriptions, applications, and limitations for any devices, piping or fittings

SUBSTANTIATION: To bring it more in line with NFPA 13 - Section 14.1.
COMMITTEE MEETING ACTION: Accept in Principle
Accept changes and reword item number 6 as follows and renumber as item 3(i):
i) Method of restraint
Add the same item as a new 4(d) as follows:
d) Method of restraint
Reorder the items 7-11 to the top of the list.
Delete number 12 from the proposed list and add a new section as follows:
4.1.4 The working plan submittal shall include the manufacturer's installation instructions for any specially listed equipment, including descriptions, applications, and limitations for any, devices, piping, or fittings.
COMMITTEE STATEMENT: The committee agreed with the submitter but wanted to clarify that item 6 should just identify the method of restraint and should be located in items 3 and 4.
Additionally the committee wanted to correlate the working plan submittal requirements with NFPA 13.
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-9 Log #30 AUT-PRI **Final Action: Accept in Principle**
(4.1.3)

SUBMITTER: Phillip A. Brown, American Fire Sprinkler Corporation
RECOMMENDATION: Delete text as follows:
4.1.3 Working plans shall be drawn to an indicated scale on sheets of uniform size ~~, with a plan of each floor~~ , and shall include the following items that pertain to the design of the system:
SUBSTANTIATION: A floor plan of each floor is not relevant to an underground fire protection plan.
COMMITTEE MEETING ACTION: Accept in Principle
Reword proposed text as follows:
4.1.3 Working plans shall be drawn to an indicated scale on sheets of uniform size, with a plan of each floor as applicable, and shall include the following items that pertain to the design of the system:
COMMITTEE STATEMENT: The committee agreed with the submitter but wanted to clarify that the intent of the committee was to only require floor plans where there was private fire service main located on the floors.
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-10 Log #6 AUT-PRI **Final Action: Reject**
(5.2.1)

SUBMITTER: Eddie Phillips, Southern Fire Code Development Committee
RECOMMENDATION: Revise to read:
5.2.1 Private Fire Service Mains. Pipe smaller than 6 8 in. (152.4 mm) in diameter shall not be installed as a private service main supplying hydrants.

SUBSTANTIATION: The 6" pipe size is no longer adequate for fire service use. The 6" line can only be used to supply fire service water over very short lays. An 8" main is a more adequate minimum for private fire service mains.
COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The submitter did not provide technical substantiation as to why a 6 inch system would be unacceptable where it can hydraulically meet the fire protection demand. The submitter is encouraged to provide technical justification for the proposed limitation on pipe size.
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-11 Log #2 AUT-PRI **Final Action: Accept in Principle**
(5.9.5.5)

SUBMITTER: Curt Dowling Los Angeles, CA
RECOMMENDATION: Revise the reference in 5.9.5.5 from 5.9.5.3 to 5.9.5.4.
SUBSTANTIATION: As written, 5.9.5.5 eliminates the requirement for the "AUTOSPKR" sign altogether where system demand pressure < 150 psi.
COMMITTEE MEETING ACTION: Accept in Principle
Reword Section 5.9.5.4 as follows:
5.9.5.4 Where the system demand pressure exceeds 150 psi (10.3 bar) the sign required by Section 5.9.5.3 shall indicate the required design pressure.
Delete Section 5.9.5.5
COMMITTEE STATEMENT: The committee agreed with the submitter, but wanted to clarify the proposed text to ensure that a sign would be provided for all applications regardless of the design pressure. The intent of the committee is to only delete the signage addressing pressures where the required pressure exceeds 150 psi. Where the pressure required is less than or equal to 150 psi the intent of the committee is to only require the general sign required by Section 5.9.5.3.
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-12 Log #31 AUT-PRI **Final Action: Reject**
(6.3.3, and A.6.3.3)

SUBMITTER: Kevin J. Kelly, National Fire Sprinkler Association
RECOMMENDATION: Revise section 6.3.3 by deleting sections 6.3.3.1, 6.3.3.2, and A.6.3.3.2 and replace with the following text:
6.3.3 Location. Post-indicator valves of an approved type shall be located outside at a safe distance from the building protected and where it is readily accessible in case of fire and not subject to damage.
A.6.3.3 Post-indicator valves should be located a safe distance from the building. This safe distance should coordinate with the height of the building in the event of a collapse. When post-indicator valves cannot be placed at this distance, they are permitted to be located closer, or wall post-indicator valves can be used, provided they are set in locations by blank walls where the possibility of injury by falling walls is unlikely and from which people are not likely to be driven by smoke or heat. Usually, in crowded plant yards, they can be placed beside low buildings, near brick stair towers, or at angles formed by substantial brick walls that are not likely to fall.
SUBSTANTIATION: This modification will allow some flexibility in the location of the post-indicating valve. The location of PIVs needs to be coordinated between NFPA 13, 14, and 24.
COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The standard currently allows for the proposed issues. Where the PIV cannot be located 40 feet away from the building due to location, property lines or other reasons the contractor can utilize the requirements of Section 6.3.3.2 to provide the PIV in an alternative location.
Additionally, the committee wants to ensure that the PIV be listed and not approved.
The committee asks the Technical Correlating Committee to ensure that the requirements of NFPA 13, 24 and 14 remain consistent.
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-13 Log #1 AUT-PRI **Final Action: Reject**
(7.1.1.4 (New))

SUBMITTER: Jon Nisja, Northcentral Regional Fire Code Development Committee
RECOMMENDATION: Add a new 7.1.1.4 to read:
The color of the hydrant shall acceptable to the ahj.
SUBSTANTIATION: Many jurisdictions have specific hydrant coloring used throughout the community. Private hydrants should conform to those standards when the community has them.
COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: Color schemes are now covered in the proposed Annex D as well as NFPA 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants.

NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-14 Log #8 AUT-PRI **Final Action: Accept in Principle**
(7.3.9)

SUBMITTER: Robert Bourke, Northeastern Regional Fire Code Dev.
RECOMMENDATION: Add a new section to read:
7.3.9 The maintenance and testing of private fire mains, private fire hydrants and their appurtenances shall be in accordance with NFPA 25.
SUBSTANTIATION: NFPA 25, Chapter 7 has responsibility for the testing and maintenance of private fire service mains and their appurtenances. NFPA 24 should direct the user to the requirements for maintenance and testing in NFPA 25. These current requirements in NFPA 24 should correlate with those in NFPA 25.
COMMITTEE MEETING ACTION: Accept in Principle
Reword Chapter 14 as follows:
Chapter 14 System Inspection, Testing, and Maintenance
14.1 General. A private fire service main and its appurtenances installed in accordance with this standard shall be properly inspected, tested, and maintained in accordance with NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, to provide at least the same level of performance and protection as designed.
Reword 7.3 as follows:
7.3 Installation.
Delete Section 7.3.8
COMMITTEE STATEMENT: The committee agrees with the submitter and wanted to further ensure that inspection, testing and maintenance would be completed in accordance with NFPA 25.
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-15 Log #21 AUT-PRI **Final Action: Accept in Principle**
(Table 10.1.1)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.
RECOMMENDATION: Add the following new text:
AWWA C153, Ductile-iron Compact Fittings for Water Service and AWWA C116, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service .
SUBSTANTIATION: These are manufacturing standards for underground pipe that are used for private fire service mains.
COMMITTEE MEETING ACTION: Accept in Principle
Additionally, add:
AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,575 mm) for Water Distribution and Transport.
COMMITTEE STATEMENT: The committee agrees with the submitter, but additionally wanted to add a reference to HDPE piping.
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-16 Log #CP1 AUT-PRI **Final Action: Accept**
(10.6.8)

SUBMITTER: Technical Committee on Private Water Supply Piping Systems
RECOMMENDATION: Reword Section 10.6.8 as follows:
10.6.8 In no case shall the underground piping be used as a grounding electrode for electrical systems.
SUBSTANTIATION: Based upon input from NEC staff to ensure safety and coordination between the NEC, NFPA 13 and NFPA 24.
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-17 Log #11 AUT-PRI **Final Action: Accept**
(10.8.3)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.
RECOMMENDATION: Revise text as follows:
Fire mains utilizing restrained joint systems shall include one or more of the following:
SUBSTANTIATION: The current wording implies that all of the following thrust restraint systems (locking mechanical joints, mechanical joints utilizing setscrew retainer glands, etc. should be included; however, only one restraint joint system could be utilized.
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-18 Log #12 AUT-PRI **Final Action: Accept**
(10.8.3.1.2.7)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.
RECOMMENDATION: Revise text as follows:
When using combinations of rods ~~in numbers greater than two~~ , the rods shall be symmetrically spaced.
SUBSTANTIATION: The current wording implies that when two rods are utilized they do not need to be symmetrically spaced. This would not be a good design. No matter what the number of rods, they should be symmetrically spaced.
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-19 Log #27 AUT-PRI **Final Action: Accept in Principle**
(10.10.2.2.2, 10.10.2.2.4)

SUBMITTER: Robert M. Gagnon, Gagnon Engineering
RECOMMENDATION: In paragraph 10.10.2.2.2, delete “or visual leakage”.
In paragraph 10.10.2.2.4, delete paragraph or move to annex.
Either provide a step-by-step methodology for leakage test or move to annex, or delete.
SUBSTANTIATION: No contractor I know or have contacted has a procedure for conducting a leakage test, and no one I know can justify a leakage test in lieu of a hydro. In practice the hydro is done, not the leakage test, mainly because contractors need specific instruction on leakage test procedure.
COMMITTEE MEETING ACTION: Accept in Principle
Reword Section 10.10.2.2 as follows:
10.10.2.2 Hydrostatic Test.
10.10.2.2.1* All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi (13.8 bar) or 50 psi (3.5 bar) in excess of the system working pressure, whichever is greater, and shall maintain that pressure ± 5 psi for 2 hours.
10.10.2.2.2 Pressure loss shall be determined by a drop in gauge pressure or visual leakage.
10.10.2.2.3 The test pressure shall be read from one of the following, located at the lowest elevation of the system or the portion of the system being tested:
1) a gauge located at one of the hydrant outlets.
2) a gauge located at the lowest point where no hydrants are provided.
10.10.2.2.4* Hydrostatic Testing Allowance. Where additional water is added to the system to maintain the test pressures required by 10.10.2.2.1, the amount of water shall be measured and shall not exceed the limits of Table 10.10.2.2.4 which is based upon the following equation:
US Customary Units:

$$L = \frac{SD\sqrt{P}}{148,000}$$

L = testing allowance (makeup water), in gallons per hour
S = length of pipe tested, feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

Metric Units:

$$L = \frac{SD\sqrt{P}}{794,797}$$

L = testing allowance (makeup water), in liters per hour
S = length of pipe tested, meters
D = nominal diameter of the pipe, in millimeters
P = average test pressure during the hydrostatic test, in kPa

Table 10.10.2.2.4 Hydrostatic Testing Allowance at 200 psi per 100 Feet of Pipe.[1, 2]

Nominal Pipe Diameter (in.)	Testing Allowance in gallons per hour (gph) per 100 feet of pipe.
2	0.019
4	0.038
6	0.057
8	0.076
10	0.096
12	0.115
14	0.134
16	0.153
18	0.172
20	0.191
24	0.229

Notes:
1. For other length, diameters, and pressures Equation 10.10.2.2.4 shall be permitted to be utilized to determine the appropriate testing allowance.

2. For test sections that contain various sizes and sections of pipe the testing allowance shall be based upon the sum of the testing allowances for each size and section.

10.10.2.3 Other Means of Hydrostatic Tests. Where required by the AHJ, hydrostatic tests shall be permitted to be completed in accordance with the requirements of AWWA C600, AWWA C602, AWWA C603, AWWA C900.

A.10.10.2.2.4 One acceptable means of completing this test is to utilize a pressure pump that draws its water supply from a full container. At the completion of the 2 hour test the amount of water to refill the container can be measured to determine the amount of makeup water. In order to minimize pressure loss the piping should be flushed to remove any trapped air. Additionally, the piping should be pressurized for 1 day prior to the hydrostatic test to account for expansion, absorption, entrapped air, etc…

Modify current A.10.10.2.2.1 as shown in Proposal 24 -34 (Log CP6).

Delete current A.10.10.2.2.4(1)

Reword 10.7.1 as follows:

10.7.1 Pipes, valves, hydrants, gaskets, and fittings shall be inspected for damage when received and shall be inspected prior to installation.

(See Figure 10.10.1 on the following pages.)

COMMITTEE STATEMENT: The committee believes that the improvements in pipe manufacturing processes and improved installation methods have improved to the point where leakage is no longer a concern for private fire service mains. However, such items as expansion, absorption, entrapped air produce results that could be interpreted as leakage. The committee has proposed to add the allowances to address these concerns.

NUMBER ELIGIBLE TO VOTE: 23

BALLOT RESULTS: Affirmative: 19 Negative: 2

BALLOT NOT RETURNED: 2 BROWN, SALWAN

EXPLANATION OF NEGATIVE:

MOWRER: In Section 10.10.2.2.3, I believe the test pressure should be read at the "highest" elevation of the system being tested, not the "lowest" elevation. In order to ensure all portions of the piping system are tested to at least 200 psig, the test pressure must be read at the highest elevation.

SHEPPARD: I agree with Mr. Mowrer's assessment.

COMMENT ON AFFIRMATIVE

KLEIN: I have read Dave Mowrer's negative vote and agree that the Committee made a mistake noting the "lowest" elevation for the pressure reading instead of the "highest" elevation. I recommend making the corrections to the code text as Dave has noted in his negative ballot.

24-20 Log #10 AUT-PRI **Final Action: Accept in Principle**
(10.10.2.2.3)

SUBMITTER: Robert Fash, Las Vegas Fire & Rescue

RECOMMENDATION: Change gauge location from low point of the system being tested to the highest point.

10.10.2.2.3 The test pressure shall be read from a gauge located at the ~~low~~ high elevation point of the system or portion being tested.

SUBSTANTIATION: The requirement to have the gauge at the low elevation point could be construed to having a gauge at the lowest level of the system, which may require the gauge to at the level of the pipe in the ground. The code proposal would allow the test gauge to be placed on a hydrant of the system being tested and at a higher elevation. This would ensure that the complete system is being tested as intended in 10.10.2.2.1.

COMMITTEE MEETING ACTION: Accept in Principle

See Committee Action on Proposal 24-19 (Log #27).

COMMITTEE STATEMENT: See Committee Statement on Proposal 24-19 (Log #27).

NUMBER ELIGIBLE TO VOTE: 23

BALLOT RESULTS: Affirmative: 21

BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-21 Log #CP5 AUT-PRI **Final Action: Accept**
(10.10.2.3, 10.10.2.4 (New))

SUBMITTER: Technical Committee on Private Water Supply Piping Systems

RECOMMENDATION: Insert a new 10.10.2.3 and 10.10.2.4 as follows:

10.10.2.3 Operating Test.

10.10.2.3.1 Each hydrant shall be fully opened and closed under system water pressure.

10.10.2.3.2 Dry barrel hydrants shall be checked for proper drainage.

10.10.2.3.3 All control valves shall be fully closed and opened under system water pressure to ensure proper operation.

10.10.2.3.4 Where fire pumps are available, the operating tests required by Section 10.10.2.3 shall be completed with the pumps running.

10.10.2.4 Backflow Prevention Assemblies.

10.10.2.4.1 The backflow prevention assembly shall be forward flow tested to ensure proper operation.

10.10.2.4.2 The minimum flow rate required by Section 10.10.2.4.1 shall be the system demand, including hose stream demand where applicable.

SUBSTANTIATION: The committee wanted to ensure that proper acceptance testing requirements were in NFPA 24 for Chapter 10 addressing underground piping and private fire service mains.

COMMITTEE MEETING ACTION: Accept

NUMBER ELIGIBLE TO VOTE: 23

BALLOT RESULTS: Affirmative: 21

BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-22 Log #CP4 AUT-PRI **Final Action: Accept**
(10.10.2.5, A.10.10.2.5, 10.2.2.6, 10.10.2.7 (New))

SUBMITTER: Technical Committee on Private Water Supply Piping Systems

RECOMMENDATION: Add the following new sections:

10.10.2.5* The trench shall be backfilled between joints before testing to prevent movement of pipe.

A.10.10.2.5 Hydrostatic tests should be made before the joints are covered so that any leaks can be readily detected. Thrust blocks should be sufficiently hardened before hydrostatic testing is begun. If the joints are covered with backfill prior to testing, the contractor remains responsible for locating and correcting any leakage in excess of that permitted.

10.10.2.6 Where required for safety measures presented by the hazards of open trenches, the pipe and joints shall be permitted to be backfilled provided the installing contractor takes the responsibility for locating and correcting leakage.

10.10.2.7 Provision shall be made for the proper disposal of water used for flushing or testing.

SUBSTANTIATION: These sections were omitted from the 2002 edition and were located only in Chapter 16 of NFPA 13. This relocates the requirements to Chapter 10.

COMMITTEE MEETING ACTION: Accept

NUMBER ELIGIBLE TO VOTE: 23

BALLOT RESULTS: Affirmative: 21

BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-23 Log #24 AUT-PRI **Final Action: Accept**
(A.10.1.6)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.

RECOMMENDATION: Add AWWA C116, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and gray iron Fittings for Water Supply Service.

SUBSTANTIATION: This coating is being used in private fire service mains.

COMMITTEE MEETING ACTION: Accept

NUMBER ELIGIBLE TO VOTE: 23

BALLOT RESULTS: Affirmative: 21

BALLOT NOT RETURNED: 2 BROWN, SALWAN

Contractor's Material and Test Certificate for Underground Piping

PROCEDURE
Upon completion of work, inspection and tests shall be made by the contractor's representative and witnessed by an owner's representative. All defects shall be corrected and system left in service before contractor's personnel finally leave the job.

A certificate shall be filled out and signed by both representatives. Copies shall be prepared for approving authorities, owners, and contractor. It is understood the owner's representative's signature in no way prejudices any claim against contractor for faulty material, poor workmanship, or failure to comply with approving authority's requirements or local ordinances.

Property name	Date
Property address	

Plans	Accepted by approving authorities (names)		
	Address		
	Installation conforms to accepted plans	☐ Yes	☐ No
	Equipment used is approved If no, state deviations	☐ Yes	☐ No
Instructions	Has person in charge of fire equipment been instructed as to location of control valves and care and maintenance of this new equipment? If no, explain	☐ Yes	☐ No
	Have copies of appropriate instructions and care and maintenance charts been left on premises? If no, explain	☐ Yes	☐ No
Location	Supplies buildings		
Underground pipes and joints	Pipe types and class / Type joint		
	Pipe conforms to ______ standard	☐ Yes	☐ No
	Fittings conforms to ______ standard If no, explain	☐ Yes	☐ No
	Joints needed anchorage clamped, strapped, or blocked in accordance with ______ standard If no, explain	☐ Yes	☐ No

Test description

Flushing: Flow the required rate until water is clear as indicated by no collection of foreign material in burlap bags at outlets such as hydrants and blow-offs. Flush at flows not less than 390 gpm (1476 L/min) for 4-in. pipe, 880 gpm (3331 L/min) for 6-in. pipe, 1560 gpm (5905 L/min) for 8-in. pipe, 2440 gpm (9235 L/min) for 10-in. pipe, and 3520 gpm (13,323 L/min) for 12-in. pipe. When supply cannot produce stipulated flow rates, obtain maximum available.
Hydrostatic: All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi (13.8 bar) or 50 psi (3.4 bar) in excess of the system working pressure, whichever is greater, and shall maintain that pressure ± 5 psi for 2 hours.
Hydrostatic Testing Allowance: Where additional water is added to the system to maintain the test pressures required by 10.10.2.2.1, the amount of water shall be measured and shall not exceed the limits of the following equation (For Metric Equation See Section 10.10.2.2.4):

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

L = testing allowance (makeup water), in gallons per hour
S = length of pipe tested, feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

Flushing tests

New underground piping flushed according to ______ standard by (company) If no, explain	☐ Yes	☐ No
How flushing flow was obtained: ☐ Public water ☐ Tank or reservoir ☐ Fire pump	Through what type opening: ☐ Hydrant butt ☐ Open pipe	
Lead-ins flushed according to ______ standard by (company) If no, explain	☐ Yes	☐ No
How flushing flow was obtained: ☐ Public water ☐ Tank or reservoir ☐ Fire pump	Through what type opening: ☐ Y connection to flange and spigot ☐ Open pipe	

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Hydrostatic test	All new underground piping hydrostatically tested at ______ psi for ______ hours		Joints covered ☐ Yes ☐ No
Leakage test	Total amount of leakage measured ______ gallons ______ hours		
	Allowable leakage ______ gallons ______ hours		
Hydrants	Number installed	Type and make	All operate satisfactorily ☐ Yes ☐ No
Control valves	Water control valves left wide open If no, state reason		☐ Yes ☐ No
	Hose threads of fire department connections and hydrants interchangeable with		☐ Yes ☐ No
Remarks	Date left in service		
Signatures	Name of installing contractor		
	Tests witnessed by		
	For property owner (signed)	Title	Date
	For installing contractor (signed)	Title	Date

Additional explanation and notes

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Figure 10.10.1 (continued)

24-24 Log #32 AUT-PRI **Final Action: Accept in Principle**
(A.10.1.6)

SUBMITTER: Kevin J. Kelly, National Fire Sprinkler Association
RECOMMENDATION: Add a new table to annex A.10.1.6 for internal diameter dimensions for lined ductile iron pipe. (See Table A.10.1.6 on the following page.)
SUBSTANTIATION: The exact internal diameter (ID) dimension for cement lined ductile iron pipe is needed to correctly calculate the friction loss through the pipe. The ID for cement lined ductile iron pipe is not usually available from the manufacturer. Instead the ID has to be calculated by subtracting the thickness of the pipe and lining from the OD of the pipe. This table will provide the user with a quick reference for these IDs. If this calculation is not performed it will result in an inaccurate larger ID. This information needs to be located in chapter 10 so it will also appear in NFPA 13 as well.
COMMITTEE MEETING ACTION: Accept in Principle
Add table note to indicate that linings are minimums.
(See table on the following page.)
COMMITTEE STATEMENT: The committee agrees with the submitter, but wanted to properly reflect the pressure classes and special thickness class of the pipe.
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-25 Log #7 AUT-PRI **Final Action: Reject**
(A.10.4.1)

SUBMITTER: Robert Bourke, Northeastern Regional Fire Code Dev.
RECOMMENDATION: Revise to read:
As there is normally no circulation of water in private fire mains, they require greater depth of covering than do public mains. Greater depth is required in a loose gravely soil (or in rock) than in compact soil containing large quantities of clay. <u>Earthen cover is the preferred method of providing cover to private fire service mains. When other materials with a lesser insulating value is used (i.e. concrete) the depth may need to be increased to ensure that the same level of insulation is provided.</u> The recommended depth of cover above the top of underground yard mains is shown in Figure A.10.4.1.
SUBSTANTIATION: The proposed language provides guidance to the type of fill cover the standards is requiring to be installed over piping to prevent freezing. Many times cement, loose stone, or other items are used as fill that does not have the same insulation properties that earth does. This will not provide the same protection and in many instances freezing has occurred.
COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: The committee is not aware of any history of freezing problems associated with the current requirements. The submitter is encouraged to provide supporting data that substantiates the proposed changes.
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-26 Log #16 AUT-PRI **Final Action: Accept**
(A.10.8.1.1)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.
RECOMMENDATION: Refer to ~~A.10.1.1~~ A.10.8.3 for a list of references for use in calculating and determining joint restraint systems.
SUBSTANTIATION: Section A.10.1.1 does not include a list of references for calculating joint restraint. The new proposed section A.10.8.3 Restrained Joint Systems includes such a list.
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-27 Log #13 AUT-PRI **Final Action: Accept**
(A.10.8.2)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.
RECOMMENDATION: Revise text as follows:
Concrete thrust blocks are one of the ~~most common~~ methods of restraint now in use, provided that stable soil conditions prevail and space requirements permit placement.
SUBSTANTIATION: There are only two general methods of addressing thrust restraint (thrust blocks and restrained joints). If there are only two general methods, it is inappropriate to state that thrust blocks are one of the most common methods. Also, today restrained joints are more common.
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

ID for Cement Lined Ductile Iron Pipe					
Pipe Size (Inch)	OD (inch)	Thickness Class	Wall Thickness	Minimum Lining Thickness	ID (Inch) with lining
3	3.96	51	0.25	1/16	3.34
3	3.96	52	0.28	1/16	3.28
3	3.96	53	0.31	1/16	3.22
3	3.96	54	0.34	1/16	3.16
3	3.96	55	0.37	1/16	3.10
3	3.96	56	0.40	1/16	3.04
4	4.80	51	0.26	1/16	4.16
4	4.80	52	0.29	1/16	4.10
4	4.80	53	0.32	1/16	4.04
4	4.80	54	0.35	1/16	3.98
4	4.80	55	0.38	1/16	3.92
4	4.80	56	0.41	1/16	3.86
6	6.90	50	0.25	1/16	6.28
6	6.90	51	0.28	1/16	6.22
6	6.90	52	0.31	1/16	6.16
6	6.90	53	0.34	1/16	6.10
6	6.90	54	0.37	1/16	6.04
6	6.90	55	0.40	1/16	5.98
6	6.90	56	0.43	1/16	5.92
8	9.05	50	0.27	1/16	8.39
8	9.05	51	0.30	1/16	8.33
8	9.05	52	0.33	1/16	8.27
8	9.05	53	0.36	1/16	8.21
8	9.05	54	0.39	1/16	8.15
8	9.05	55	0.42	1/16	8.09
8	9.05	56	045	1/16	8.03
10	11.10	50	0.29	1/16	10.40
10	11.10	51	0.32	1/16	10.34
10	11.10	52	0.35	1/16	10.28
10	11.10	53	0.38	1/16	10.22
10	11.10	54	0.41	1/16	10.16
10	11.10	55	0.44	1/16	10.10
10	11.10	56	0.47	1/16	10.04
12	13.20	50	0.31	1/16	12.46
12	13.20	51	0.34	1/16	12.40
12	13.20	52	0.37	1/16	12.34
12	13.20	53	0.40	1/16	12.28
12	13.20	54	0.43	1/16	12.22
12	13.20	55	0.46	1/16	12.16
12	13.20	56	0.49	1/16	12.10
14	15.30	50	0.33	3/32	14.45
14	15.30	51	0.36	3/32	14.39
14	15.30	52	0.39	3/32	14.33
14	15.30	53	0.42	3/32	14.27
14	15.30	54	0.45	3/32	14.21
14	15.30	55	0.48	3/32	14.15
14	15.30	56	0.51	3/32	14.09
16	17.40	50	0.34	3/32	16.53
16	17.40	51	0.37	3/32	16.47
16	17.40	52	0.40	3/32	16.41
16	17.40	53	0.43	3/32	16.35
16	17.40	54	0.46	3/32	16.29
16	17.40	55	0.49	3/32	16.23
16	17.40	56	0.52	3/32	16.17
18	19.50	50	0.35	3/32	18.61
18	19.50	51	0.35	3/32	18.61
18	19.50	52	0.41	3/32	18.49
18	19.50	53	0.44	3/32	18.43
18	19.50	54	0.47	3/32	18.37
18	19.50	55	0.50	3/32	18.31
18	19.50	56	0.53	3/32	18.25
20	21.60	50	0.36	3/32	20.69
20	21.60	51	0.39	3/32	20.63
20	21.60	52	0.42	3/32	20.57
20	21.60	53	0.45	3/32	20.51
20	21.60	54	0.48	3/32	20.45
20	21.60	55	0.51	3/32	20.39
20	21.60	56	0.54	3/32	20.33

Proposal 24-24 (Log #32) Recommendation

ID for Cement Lined Ductile Iron Pipe						
Pipe Size (Inch)	OD (inch)	Pressure Class	Thickness Class	Wall Thickness	Minimum Lining Thickness*	ID (Inch) with lining
3	3.96	350		0.25	1/16	3.34
3	3.96		51	0.25	1/16	3.34
3	3.96		52	0.28	1/16	3.28
3	3.96		53	0.31	1/16	3.22
3	3.96		54	0.34	1/16	3.16
3	3.96		55	0.37	1/16	3.10
3	3.96		56	0.40	1/16	3.04
4	4.80	350		0.25	1/16	4.18
4	4.80		51	0.26	1/16	4.16
4	4.80		52	0.29	1/16	4.10
4	4.80		53	0.32	1/16	4.04
4	4.80		54	0.35	1/16	3.98
4	4.80		55	0.38	1/16	3.92
4	4.80		56	0.41	1/16	3.86
6	6.90	350		0.25	1/16	6.28
6	6.90		50	0.25	1/16	6.28
6	6.90		51	0.28	1/16	6.22
6	6.90		52	0.31	1/16	6.16
6	6.90		53	0.34	1/16	6.10
6	6.90		54	0.37	1/16	6.04
6	6.90		55	0.40	1/16	5.98
6	6.90		56	0.43	1/16	5.92
8	9.05	350		0.25	1/16	8.43
8	9.05		50	0.27	1/16	8.39
8	9.05		51	0.30	1/16	8.33
8	9.05		52	0.33	1/16	8.27
8	9.05		53	0.36	1/16	8.21
8	9.05		54	0.39	1/16	8.15
8	9.05		55	0.42	1/16	8.09
8	9.05		56	0.45	1/16	8.03
10	11.10	350		0.26	1/16	10.46
10	11.10		50	0.29	1/16	10.40
10	11.10		51	0.32	1/16	10.34
10	11.10		52	0.35	1/16	10.28
10	11.10		53	0.38	1/16	10.22
10	11.10		54	0.41	1/16	10.16
10	11.10		55	0.44	1/16	10.10
10	11.10		56	0.47	1/16	10.04
12	13.20	350		0.28	1/16	12.52
12	13.20		50	0.31	1/16	12.46
12	13.20		51	0.34	1/16	12.40
12	13.20		52	0.37	1/16	12.34
12	13.20		53	0.40	1/16	12.28
12	13.20		54	0.43	1/16	12.22
12	13.20		55	0.46	1/16	12.16
12	13.20		56	0.49	1/16	12.10

Proposal 24-24 (Log #32) Committee Action

14	15.30	250		0.28	3/32	14.55
14	15.30	300		0.30	3/32	14.51
14	15.30	350		0.31	3/32	14.49
14	15.30		50	0.33	3/32	14.45
14	15.30		51	0.36	3/32	14.39
14	15.30		52	0.39	3/32	14.33
14	15.30		53	0.42	3/32	14.27
14	15.30		54	0.45	3/32	14.21
14	15.30		55	0.48	3/32	14.15
14	15.30		56	0.51	3/32	14.09
16	17.40	250		0.30	3/32	16.61
16	17.40	300		0.32	3/32	16.57
16	17.40	350		0.34	3/32	16.53
16	17.40		50	0.34	3/32	16.53
16	17.40		51	0.37	3/32	16.47
16	17.40		52	0.40	3/32	16.41
16	17.40		53	0.43	3/32	16.35
16	17.40		54	0.46	3/32	16.29
16	17.40		55	0.49	3/32	16.23
16	17.40		56	0.52	3/32	16.17
18	19.50	250		0.31	3/32	18.69
18	19.50	300		0.34	3/32	18.63
18	19.50	350		0.36	3/32	18.59
18	19.50		50	0.35	3/32	18.61
18	19.50		51	0.35	3/32	18.61
18	19.50		52	0.41	3/32	18.49
18	19.50		53	0.44	3/32	18.43
18	19.50		54	0.47	3/32	18.37
18	19.50		55	0.50	3/32	18.31
18	19.50		56	0.53	3/32	18.25
20	21.60	250		0.33	3/32	20.75
20	21.60	300		0.36	3/32	20.69
20	21.60	350		0.38	3/32	20.65
20	21.60		50	0.36	3/32	20.69
20	21.60		51	0.39	3/32	20.63
20	21.60		52	0.42	3/32	20.57
20	21.60		53	0.45	3/32	20.51
20	21.60		54	0.48	3/32	20.45
20	21.60		55	0.51	3/32	20.39
20	21.60		56	0.54	3/32	20.33
24	25.80	200		0.33	3/32	24.95
24	25.80	250		0.37	3/32	24.87
24	25.80	300		0.40	3/32	24.81
24	25.80	350		0.43	3/32	24.75
24	25.80		50	0.38	3/32	24.85
24	25.80		51	0.41	3/32	24.79
24	25.80		52	0.44	3/32	24.73
24	25.80		53	0.47	3/32	24.67
24	25.80		54	0.50	3/32	24.61
24	25.80		55	0.53	3/32	24.55
24	25.80		56	0.56	3/32	24.49

*Note: This Table is appropriate for single lining thickness only.
The actual lining thickness should be obtained from the manufacturer.

Proposal 24-24 (Log #32) Committee Action continued

24-28 Log #15 AUT-PRI **Final Action: Accept in Principle**
(A.10.8.2)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.
RECOMMENDATION: Delete the last sentence in the third paragraph: ~~Figure A10.8.2(b) shows an example of a typical connection to a fire protection system riser.~~ Revise Figure A.10.8.2(b) to reflect restrained joints rather than tie rods and move it to a new section to read as follows:

A.10.8.3 Restrained Joint Systems. An alternative method to thrust blocks of providing thrust restraint is the use of restrained joints. A restrained joint is a special type of joint that is designed to provide longitudinal restraint. Restrained joint systems function in a manner similar to thrust blocks, insofar as the reaction of the entire restrained unit of piping with the soil balances the thrust forces.

The objective in designing a restrained joint thrust restraint system is to determine the length of pipe that must be restrained on each side of the focus of the thrust force. This will be a function of the pipe size, the internal pressure, depth of cover, and the characteristics of the soild surrounding the pipe.

The following documents apply to the design, calculating and determining restrained joint systems:

(1) Thrust Restraint Design for Ductile Iron Pipe, Ductile Iron Pipe Research Association
(2) AWWA M41, Ductile Iron Pipe and Fittings
(3) AWWA M9, Concrete Pressure Pipe
(4) AWWA M11, Steel Pipe – A Guide for Design and Installation
(5) Thrust Restraint Design Equations and Tables for Ductile Iron and PVC Pipe, EBBA Iron, Inc.

Figure A.10.8.3(a) shows an example of a typical connection to a fire protection systems riser utilizing restrained joint pipe.

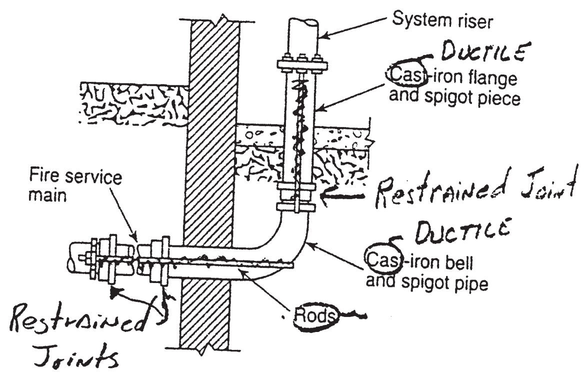


FIGURE A.10.8.2(b) Typical Connection to a Fire Protection System Riser. ,3(a)

Figure 1A10.8. ~~2(b)~~ 3(a)

SUBSTANTIATION: Figure A.10.8.2(b) is a restrained joint system; however, it is shown in Section A.10.8.2 Thrust Blocks. Move the Figure to a new section (A.10.8.3 Restrained Joint Systems). Revise the figure to show restrained joints rather than tie rods since restrained joints are more common.
COMMITTEE MEETING ACTION: Accept in Principle

Delete the last sentence in the third paragraph: ~~Figure A10.8.2(b) shows an example of a typical connection to a fire protection system riser.~~

Revise Figure A.10.8.2(b) to reflect restrained joints rather than tie rods. In the figure delete all references to "rods" and remove the rods from the figure as shown in proposed figure and move it to a new section to read as follows:

A.10.8.3 Restrained Joint Systems. A method for providing thrust restraint is the use of restrained joints. A restrained joint is a special type of joint that is designed to provide longitudinal restraint. Restrained joint systems function in a manner similar to thrust blocks, insofar as the reaction of the entire restrained unit of piping with the soil balances the thrust forces.

The objective in designing a restrained joint thrust restraint system is to determine the length of pipe that must be restrained on each side of the focus of the thrust force. This will be a function of the pipe size, the internal pressure, depth of cover, and the characteristics of the solid surrounding the pipe.

The following documents apply to the design, calculating and determining restrained joint systems:

(1) Thrust Restraint Design for Ductile Iron Pipe, Ductile Iron Pipe Research Association
(2) AWWA M41, Ductile Iron Pipe and Fittings
(3) AWWA M9, Concrete Pressure Pipe
(4) AWWA M11, Steel Pipe – A Guide for Design and Installation
(5) Thrust Restraint Design Equations and Tables for Ductile Iron and PVC Pipe, EBBA Iron, Inc.

Figure A.10.8.3(a) shows an example of a typical connection to a fire protection systems riser utilizing restrained joint pipe.

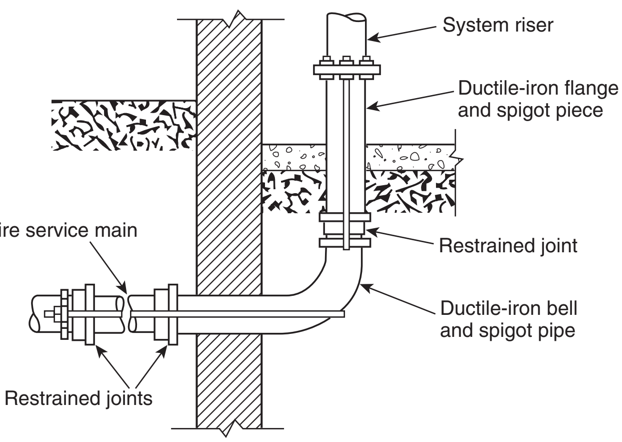


Figure A.10.8. ~~2(b)~~ 3(a) Typical Connection to a Fire Protection System Riser Illustrating Restrained Joints

COMMITTEE STATEMENT: The committee agrees with the proposed changes, but wanted to clarify the text and figure proposed.
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-29 Log #17 AUT-PRI **Final Action: Accept**
(A.10.8.2)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.
RECOMMENDATION: Add a new Table A.10.8.2(c) Required Horizontal Bearing Block Area, with notes, before Figure A.10.8.2(d) as follows:

Table A.10.8.2(c) Required Horizontal Bearing Block Area*

Nominal Pipe Diameter (in.)	Bearing Block Area* (ft^2)	Nominal Pipe Diameter (in)	Bearing Block Area* (ft^2)	Nominal Pipe Diameter (in)	Bearing Block Area* (ft^2)
3	2.6	**12**	29.0	**24**	110.9
4	3.8	**14**	39.0	**30**	170.6
6	7.9	**16**	50.4	**36**	244.4
8	13.6	**18**	63.3	**42**	329.9
10	20.5	**20**	77.7	**48**	430.0

*Note:
1. Values listed are based on a 90 degree horizontal bend, an internal pressure of 100 psi, a soil horizontal bearing strength of 1,000 lb/ft², a safety factor of 1.5, and ductile iron pipe outside diameters.
a. For other horizontal bends multiply by the following coefficients: 45° - 0.414; 22 1/2° - 0.199; 11 1/4° - 0.098
b. For other internal pressures multiply by ratio to 100 psi
c. For other soil horizontal bearing strengths divide by ratio to 1,000 lb/ft²
d. For other safety factors multiply by ratio to 1.5
Example: Using Table A.10.8.2(c), find the horizontal bearing block area for a 6-in. diameter, 45 degree bend with an internal pressure of 150 psi. The soil bearing strength is 3,000 lb/ft² and safety factor is 1.5.
From Table A.10.8.2(c), the required bearing block area for a 6-in. diameter 90 degree bend with an internal pressure of 100 psi and a soil horizontal bearing strength of 1,000 psi is 7.9 ft².
For our problem:

$$Area = \frac{7.9ft^2(0.414)(150/100)}{(3{,}000/1{,}000)} = 1.64ft^2$$

SUBSTANTIATION: A table showing the required bearing area for horizontal thrust blocks would be useful to the user. New proposed table is attached.
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-30 Log #18 AUT-PRI **Final Action: Accept**
(A.10.8.2)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.
RECOMMENDATION: Change Note 2 under Table A.10.8.2(b) to a separate paragraph and place the table directly following Figure A.10.8.2(d).
SUBSTANTIATION: Note 2 on gravity thrust blocks does not belong under the Horizontal Bearing Strengths table. It pertains to Figure A.10.8.2(d) Gravity Thrust Blocks.
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-31 Log #19 AUT-PRI **Final Action: Accept**
(A.10.8.2)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.
RECOMMENDATION: Include units (ft., etc.) for the variables in the required thrust block area formula.
The required block area (A_b) is as follows:

$$A_b = (h)(b) = \frac{T(S_f)}{S_b}$$

where:
A_b = required block area (ft²)
h = block height (ft)
b = calculated block width (ft)
T = thrust force (lbf)
S_f = safety factor (usually 1.5)
S_b = bearing strength (lb/ft²)

Then, for a horizontal bend, the following formula is used:

$$b = \frac{2(S_f)(P)(A)\sin(\theta/2)}{(h)(S_b)}$$

where:

S_f = safety factor (usually 1.5 for thrust block design)
P = water pressure (lb/in²)
A = cross sectional area of the pipe based on outside diameter
H = block height (ft)
S_b = horizontal bearing strength of the soil (lb/ft²) (in²)

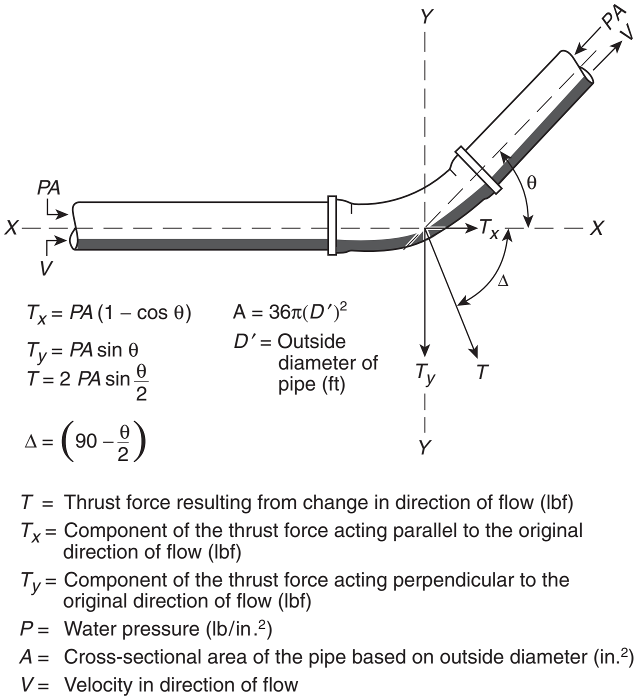
SUBSTANTIATION: Units of the variables for the required thrust block area equation are not presently included. The inclusion of these units would be of help to the user.
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-32 Log #20 AUT-PRI **Final Action: Accept**
(A.10.8.2)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.
RECOMMENDATION: Under Figure A.10.8.2(d), revise the sentence as follows: it can be easily shown that T_y = PA sin ø
Insert ø after "sin".
SUBSTANTIATION: The present equation is incorrect.
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-33 Log #14 AUT-PRI **Final Action: Accept**
(A.10.8.2(a))

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.
RECOMMENDATION: Include units (ibf, in., etc.) for the variables for the thrust restraint equation.



SUBSTANTIATION: Units of the variables for the thrust restraint equation are not presently included. The inclusion of these units would be of help to the user.
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-34 Log #CP6 AUT-PRI **Final Action: Accept**
(A.10.10.2.2.1)

SUBMITTER: Technical Committee on Private Water Supply Piping Systems
RECOMMENDATION: Delete the last sentence of A.10.10.2.2.1.
SUBSTANTIATION: Utilizing compressed noncombustible gases is an unacceptable process for increasing the pressure on a private fire service main due to the requirements to measure makeup water utilized during hydrostatic testing of the private fire service main.
COMMITTEE MEETING ACTION: Accept
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-35 Log #29 AUT-PRI **Final Action: Accept in Principle**
(Annex C)

SUBMITTER: James B. Biggins, Marsh Risk Consulting
RECOMMENDATION: Add Annex C to NFPA 24 to include recommended practice for fire flow testing. This proposal is derived from NFPA 291 and is the result of the work of a task group of the Technical Committee on Private Water Supply Piping Systems comprised of J. Biggins, J. Lake, D. Mowrer and J. Schifiliti.

ANNEX C

Recommended Practice for Fire Flow Testing

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

C.1.1 Scope.

The scope of this annex is to provide guidance on fire flow testing of hydrants.

C.1.2 Purpose.

Fire flow tests are conducted on water distribution systems to determine the rate of flow available at various locations for fire-fighting purposes.

C.1.3 Application.

C.1.3.1 A certain residual pressure in the mains is specified at which the rate of flow should be available.

C.1.3.2Additional benefit is derived from fire flow tests by the indication of possible deficiencies, such as tuberculation of piping or closed valves or both, which could be corrected to ensure adequate fire flows as needed.

C.1.4 Units.

Metric units of measurement in this recommended practice are in accordance with the modernized metric system known as the International System of Units (SI). Two units (liter and bar), outside of but recognized by SI, are commonly used in international fire protection. These units are listed in Table C.1.4 with conversion factors.

Table C.1.4

SI Units and Conversion Factors

Unit Name	Unit Symbol	Conversion Factor
Liter	L	1 gal = 3.785 L
Liter per minute per square meter	(L/min)/m^2	1 gpm ft^2 = (40.746 L/min)/m^2
Cubic decimeter	dm^3	1 gal = 3.785 dm^3
Pascal	Pa	1 psi = 6894.757 bar
Bar	bar	1 psi = 0.0689 bar
Bar	bar	1 bar = 105 Pa

Note: For additional conversions and information, see ASTM E 380, Standard for Metric Practice, 1989.

C.1.4.1 If a value for measurement as given in this recommended practice is followed by an equivalent value in other units, the first value stated is to be regarded as the recommendation. A given equivalent value might be approximate.

C.2.1 Referenced Publications

The documents or portions thereof listed in this chapter are referenced within this annex and should be considered part of the recommendations of this document.

C.2.2 NFPA Publications. (Reserved)

C2.3 Other Publications.

C.2.3.1 ASTM Publication.

American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.
ASTM E 380, Standard for Metric Practice, 1989.

C.3.1 Definitions

The definitions contained in this annex apply to the terms used in this annex practice. Where terms are not included, common usage of the terms applies.

C.3.2 NFPA Official Definitions.

C.3.2.1* Authority Having Jurisdiction (AHJ). The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.

C.3.2.2* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

C.3.2.3 Should. Indicates a recommendation or that which is advised but not required.

C.3.3 General Definitions.

C.3.3.1 Rated Capacity. The flow available from a hydrant at the designated residual pressure (rated pressure) either measured or calculated.

C.3.3.2 Residual Pressure. The pressure that exists in the distribution system, measured at the residual hydrant at the time the flow readings are taken at the flow hydrants.

C.3.3.3 Static Pressure. The pressure that exists at a given point under normal distribution system conditions measured at the residual hydrant with no hydrants flowing.

C.4.1 Flow Testing

C.4.1.1 Rating Pressure.

C.4.1.1.1 For the purpose of uniform marking of fire hydrants, the ratings should be based on a residual pressure of 1.4 bar (20 psi) for all hydrants having a static pressure in excess of 2.8 bar (40 psi).

C.4.1.1.2 Hydrants having a static pressure of less than 2.8 bar (40 psi) should be rated at one-half of the static pressure.

C.4.1.1.3 It is generally recommended that a minimum residual pressure of 1.4 bar (20 psi) should be maintained at hydrants when delivering the fire flow. Fire department pumpers can be operated where hydrant pressures are less, but with difficulty.

C.4.1.1.4 Where hydrants are well distributed and of the proper size and type (so that friction losses in the hydrant and suction line are not excessive), it might be possible to set a lesser pressure as the minimum pressure.

C.4.1.1.5 A primary concern should be the ability to maintain sufficient residual pressure to prevent developing a negative pressure at any point in the street mains, which could result in the collapse of the mains or other water system components or back-siphonage of polluted water from some other interconnected source.

C.4.1.1.6 It should be noted that the use of residual pressures of less than 1.4 bar (20 psi) is not permitted by many state health departments.

C.4.1.2 Test Procedure.

C.4.1.2.1 Tests should be made during a period of ordinary demand.

C.4.1.2.2 The procedure consists of discharging water at a measured rate of flow from the system at a given location and observing the corresponding pressure drop in the mains.

C.4.1.3 Test Layout.

C.4.1.3.1 After the location where the test is to be run has been determined, a group of test hydrants in the vicinity is selected.

C.4.1.3.2 Once selected, due consideration should be given to potential interference with traffic flow patterns, damage to surroundings (e.g., roadways, sidewalks, landscapes, vehicles, and pedestrians), and potential flooding problems both local and remote from the test site.

C.4.1.3.3 One hydrant, designated the residual hydrant, is chosen to be the hydrant where the normal static pressure will be observed with the other hydrants in the group closed, and where the residual pressure will be observed with the other hydrants flowing.

C.4.1.3.4 This hydrant is chosen so it will be located between the hydrant to be flowed and the large mains that constitute the immediate sources of water supply in the area. In Figure C.4.1.3.4, test layouts are indicated showing the residual hydrant designated with the letter R and hydrants to be flowed with the lett

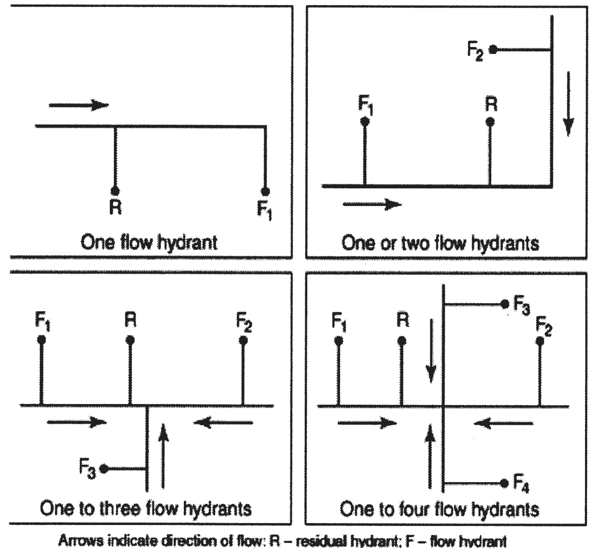


Figure C.4.1.3.4 Suggested Test Layout for Hydrants.

C.4.1.3.5 The number of hydrants to be used in any test depends upon the strength of the distribution system in the vicinity of the test location.

C.4.1.3.6 To obtain satisfactory test results of theoretical calculation of expected flows or rated capacities, sufficient discharge should be achieved to cause a drop in pressure at the residual hydrant of at least 25 percent, or to flow the total demand necessary for fire-fighting purposes.

C.4.1.3.7 If the mains are small and the system weak, only one or two hydrants need to be flowed.

C.4.1.3.8 If, on the other hand, the mains are large and the system strong, it may be necessary to flow as many as seven or eight hydrants.

C.4.1.4 Equipment.

C.4.1.4.1 The equipment necessary for field work consists of the following:

(1) A single 14 bar (200 psi) bourdon pressure gauge with 0.0689 bar (1 psi) graduations

(2) A number of pitot tubes

(3) Hydrant wrenches

(4) 3.5 or 4.0 bar (50 or 60 psi) bourdon pressure gauges with 0.0689 bar (1 psi) graduations, and scales with 1.6 mm ($^{1}/_{16}$ in.) graduations [One pitot tube, a 3.5 or 4.0 bar (50 or 60 psi) gauge, a hydrant wrench, a scale for each hydrant to be flowed]

(5) A special hydrant cap tapped with a hole into which a short length of 6.35 mm (¼ in.) brass pipe is fitted; this pipe is provided with a T connection for the 14 bar (200 psi) gauge and a cock at the end for relieving air pressure.

C.4.1.4.2 All pressure gauges should be calibrated at least every 12 months, or more frequently depending on use.

C.4.1.4.3 When more than one hydrant is flowed, it is desirable and could be necessary to use portable radios to facilitate communication between team members.

C.4.1.4.4 It is preferred to use stream straightener with a known coefficient of discharge when testing hydrants due to a more streamlined flow and more accurate pitot reading.

C.4.1.5 Test Procedure.

C.4.1.5.1 In a typical test, the 14 bar (200 psi) gauge is attached to one of the 6.4 cm (2½ in.) outlets of the residual hydrant using the special cap.

C.4.1.5.2 The cock on the gauge piping is opened, and the hydrant valve is opened full.

C.4.1.5.3 As soon as the air is exhausted from the barrel, the cock is closed.

C.4.1.5.4 A reading (static pressure) is taken when the needle comes to rest.

C.4.1.5.5 At a given signal, each of the other hydrants is opened in succession, with discharge taking place directly from the open hydrant butts.

C.4.1.5.6 Hydrants should be opened one at a time.

C.4.1.5.7 With all hydrants flowing, water should be allowed to flow for a sufficient time to clear all debris and foreign substances from the stream(s).

C.4.1.5.8 At that time, a signal is given to the people at the hydrants to read the pitot pressure of the streams simultaneously while the residual pressure is being read.

C.4.1.5.9 The final magnitude of the pressure drop can be controlled by the number of hydrants used and the number of outlets opened on each.

C.4.1.5.10 After the readings have been taken, hydrants should be shut down slowly, one at a time, to prevent undue surges in the system.

C.4.6 Pitot Readings.

C.4.6.1 When measuring discharge from open hydrant butts, it is always preferable from the standpoint of accuracy to use 6.4 mm (2½ in.) outlets rather than pumper outlets.

C.4.6.2 In practically all cases, the 6.4 cm (2½ in.) outlets are filled across the entire cross section during flow, while in the case of the larger outlets there is very frequently a void near the bottom.

C.4.6.3 When measuring the pitot pressure of a stream of practically uniform velocity, the orifice in the pitot tube is held downstream approximately one-half the diameter of the hydrant outlet or nozzle opening, and in the center of the stream.

C.4.6.4 The center line of the orifice should be at right angles to the plane of the face of the hydrant outlet.

C.4.6.5 The air chamber on the pitot tube should be kept elevated.

C.4.6.6 Pitot readings of less than 0.7 bar (10 psi) and more than 2.0 bar (30 psi) should be avoided, if possible.

C.4.6.7 Opening additional hydrant outlets will aid in controlling the pitot reading.

C.4.6.8 With dry barrel hydrants, the hydrant valve should be wide open to minimize problems with underground drain valves.

C.4.6.9 With wet barrel hydrants, the valve for the flowing outlet should be wide open to give a more streamlined flow and a more accurate pitot reading. (See Figure C.4.6.9.)

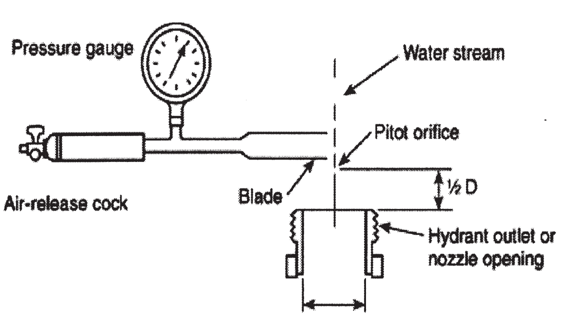


Figure C.4.6.9 Pitot Tube Position.

C.4.7 Determination of Discharge.

C.4.7.1 At the hydrants used for flow during the test, the discharges from the open butts are determined from measurements of the diameter of the outlets flowed, the pitot pressure (velocity head) of the streams as indicated by the pitot gauge readings, and the coefficient of the outlet being flowed as determined from Figure C.4.7.1.

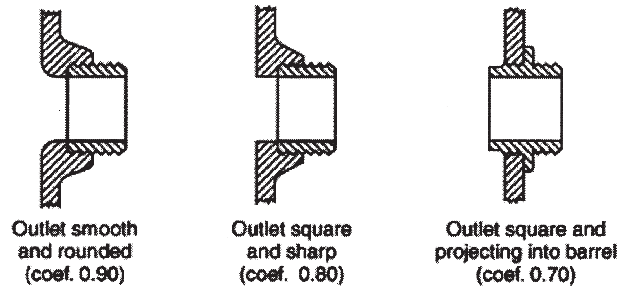


Figure C.4.7.1 Three General Types of Hydrant Outlets and Their Coefficients of Discharge.

C.4.7.2 If flow tubes (stream straighteners) are being utilized, a coefficient of 0.95 is suggested unless the coefficient of the tube is known.

C.4.7.3 The formula used to compute the discharge, Q, in gpm from these measurements is as follows:

$$Q=cd^2\sqrt{p}$$

where:
c = coefficient of discharge (see Figure 4.7.1)
d = diameter of the outlet in inches
p = pitot pressure (velocity head) in psi

C.4.8 Use of Pumper Outlets.

C.4.8.1 If it is necessary to use a pumper outlet, and flow tubes (stream straighteners) are not available, the best results are obtained with the pitot pressure (velocity head) maintained between 0.3 bar and 0.7 bar (5 psi and 10 psi).

C.4.8.2 For pumper outlets, the approximate discharge can be computed from Equation C.4.1 using the pitot pressure (velocity head) at the center of the stream and multiplying the result by one of the coefficients in Table C.4.8.2, depending upon the pitot pressure (velocity head).

Table C.4.8.2 Pumper Outlet Coefficients Pitot Pressure

Velocity Head		Coefficient
psi	bar	
2	0.14	0.97
3	0.21	0.92
4	0.28	0.89
5	0.35	0.86
6	0.41	0.84
7 and over	0.48 and over	0.83

C.4.8.3 These coefficients are applied in addition to the coefficient in Equation C.4.1 and are for average type hydrants.

C.4.9 Determination of Discharge Without a Pitot.

C.4.9.1 If a pitot tube is not available for use to measure the hydrant discharge, a 3.5 or 4.0 bar (50 or 60 psi) gauge tapped into a hydrant cap can be used.

C.4.9.2 The hydrant cap with gauge attached is placed on one outlet, and the flow is allowed to take place through the other outlet at the same elevation.

C.4.9.3 The readings obtained from a gauge so located, and the readings obtained from a gauge on a pitot tube held in the stream, are approximately the same.

C.4.10 Calculation Results.

C.4.10.1 The discharge in L/min (gpm) for each outlet flowed is obtained from Table C.4.10.1(a) and Table C.4.10.1(b) or by the use of Equation C.4.1.
(See Tables C.4.10..1(a) and Table C.4.10.1(b) on the following pages.

C.4.10.1.1 If more than one outlet is used, the discharges from all are added to obtain the total discharge.

C.4.10.1.2 The formula that is generally used to compute the discharge at the specified residual pressure or for any desired pressure drop is Equation C.4.2:

$$Q_R = Q_F \text{ x } h_r^{0.54}/h_f^{0.54}$$

where:
Q_R = flow predicted at desired residual pressure
Q_F = total flow measured during test
h_r = pressure drop to desired residual pressure
h_f = pressure drop measured during test

C.4.10.1.3 In this equation, any units of discharge or pressure drop may be used as long as the same units are used for each value of the same variable.

C.4.10.1.4 In other words, if Q_R is expressed in gpm, Q_F must be in gpm, and if h_r is expressed in psi, h_f must be expressed in psi.

C.4.10.1.5 These are the units that are normally used in applying Equation 4.2 to fire flow test computations.

C.4.10.2 Discharge Calculations from Table.

C.4.10.2.1 One means of solving this equation without the use of logarithms is by using Table C.4.10.2, which gives the values of the 0.54 power of the numbers from 1 to 175.

C.4.10.2.2 Knowing the values of h_f, h_r, and Q_F, the values of $h_f^{0.54}$ and $h_r^{0.54}$ can be read from the table and Equation C.4.2 solved for Q_R.

C.4.10.2.3 Results are usually carried to the nearest 380 L/min (100 gpm) for discharges of 3800 L/min (1000 gpm) or more, and to the nearest 190 L/min (50 gpm) for smaller discharges, which is as close as can be justified by the degree of accuracy of the field observations.

C.4.10.2.4 Insert in Equation C.4.2 the values of $h_r^{0.54}$ and $h_f^{0.54}$ determined from the table and the value of Q_F, and solve the equation for Q_R.

C.4.11 Data Sheet.

C.4.11.1 The data secured during the testing of hydrants for uniform marking can be valuable for other purposes.

Table C.4.10.2 Values of h to the 0.54 Power

h	$h^{0.54}$	*h*	$h^{0.54}$	*h*	$h^{0.54}$	*h*	$h^{0.54}$	*h*	$h^{0.54}$
1	1.00	36	6.93	71	9.99	106	12.41	141	14.47
2	1.45	37	7.03	72	10.07	107	12.47	142	14.53
3	1.81	38	7.13	73	10.14	108	12.53	143	14.58
4	2.11	39	7.23	74	10.22	109	12.60	144	14.64
5	2.39	40	7.33	75	10.29	110	12.66	145	14.69
6	2.63	41	7.43	76	10.37	111	12.72	146	14.75
7	2.86	42	7.53	77	10.44	112	12.78	147	14.80
8	3.07	43	7.62	78	10.51	113	12.84	148	14.86
9	3.28	44	7.72	79	10.59	114	12.90	149	14.91
10	3.47	45	7.81	80	10.66	115	12.96	150	14.97
11	3.65	46	7.91	81	10.73	116	13.03	151	15.02
12	3.83	47	8.00	82	10.80	117	13.09	152	15.07
13	4.00	48	8.09	83	10.87	118	13.15	153	15.13
14	4.16	49	8.18	84	10.94	119	13.21	154	15.18
15	4.32	50	8.27	85	11.01	120	13.27	155	15.23
16	4.48	51	8.36	86	11.08	121	13.33	156	15.29
17	4.62	52	8.44	87	11.15	122	13.39	157	15.34
18	4.76	53	8.53	88	11.22	123	13.44	158	15.39
19	4.90	54	8.62	89	11.29	124	13.50	159	15.44
20	5.04	55	8.71	90	11.36	125	13.56	160	15.50
21	5.18	56	8.79	91	11.43	126	13.62	161	15.55
22	5.31	57	8.88	92	11.49	127	13.68	162	15.60
23	5.44	58	8.96	93	11.56	128	13.74	163	15.65
24	5.56	59	9.04	94	11.63	129	13.80	164	15.70
25	5.69	60	9.12	95	11.69	130	13.85	165	15.76
26	5.81	61	9.21	96	11.76	131	13.91	166	15.81
27	5.93	62	9.29	97	11.83	132	13.97	167	15.86
28	6.05	63	9.37	98	11.89	133	14.02	168	15.91
29	6.16	64	9.45	99	11.96	134	14.08	169	15.96
30	6.28	65	9.53	100	12.02	135	14.14	170	16.01
31	6.39	66	9.61	101	12.09	136	14.19	171	16.06
32	6.50	67	9.69	102	12.15	137	14.25	172	16.11
33	6.61	68	9.76	103	12.22	138	14.31	173	16.16
34	6.71	69	9.84	104	12.28	139	14.36	174	16.21
35	6.82	70	9.92	105	12.34	140	14.42	175	16.26

Table C.4.10.1(a) Theoretical Discharge Through Circular Orifices (U.S. Gallons of Water per Minute)

Pitot Presssure* (psi)	Feet†	Velocity Discharge (ft/sec)	Orifice Size (in.)											
			2	2.25	2.375	2.5	2.625	2.75	3	3.25	3.5	3.75	4	4.5
1	2.31	12.20	119	151	168	187	206	226	269	315	366	420	477	604
2	4.61	17.25	169	214	238	264	291	319	380	446	517	593	675	855
3	6.92	21.13	207	262	292	323	356	391	465	546	633	727	827	1047
4	9.23	24.39	239	302	337	373	411	451	537	630	731	839	955	1209
5	11.54	27.26	267	338	376	417	460	505	601	705	817	938	1068	1351
6	13.84	29.87	292	370	412	457	504	553	658	772	895	1028	1169	1480
7	16.15	32.26	316	400	445	493	544	597	711	834	967	1110	1263	1599
8	18.46	34.49	338	427	476	528	582	638	760	891	1034	1187	1350	1709
9	20.76	36.58	358	453	505	560	617	677	806	946	1097	1259	1432	1813
10	23.07	38.56	377	478	532	590	650	714	849	997	1156	1327	1510	1911
11	25.38	40.45	396	501	558	619	682	748	891	1045	1212	1392	1583	2004
12	27.68	42.24	413	523	583	646	712	782	930	1092	1266	1454	1654	2093
13	29.99	43.97	430	545	607	672	741	814	968	1136	1318	1513	1721	2179
14	32.30	45.63	447	565	630	698	769	844	1005	1179	1368	1570	1786	2261
15	34.61	47.22	462	585	652	722	796	874	1040	1221	1416	1625	1849	2340
16	36.91	48.78	477	604	673	746	822	903	1074	1261	1462	1679	1910	2417
17	39.22	50.28	492	623	694	769	848	930	1107	1300	1507	1730	1969	2491
18	41.53	51.73	506	641	714	791	872	957	1139	1337	1551	1780	2026	2564
19	43.83	53.15	520	658	734	813	896	984	1171	1374	1593	1829	2081	2634
20	46.14	54.54	534	676	753	834	920	1009	1201	1410	1635	1877	2135	2702
22	50.75	57.19	560	709	789	875	964	1058	1260	1478	1715	1968	2239	2834
24	55.37	59.74	585	740	825	914	1007	1106	1316	1544	1791	2056	2339	2960
26	59.98	62.18	609	770	858	951	1048	1151	1369	1607	1864	2140	2434	3081
28	64.60	64.52	632	799	891	987	1088	1194	1421	1668	1934	2220	2526	3197
30	69.21	66.79	654	827	922	1022	1126	1236	1471	1726	2002	2298	2615	3310
32	73.82	68.98	675	855	952	1055	1163	1277	1519	1783	2068	2374	2701	3418
34	78.44	71.10	696	881	981	1087	1199	1316	1566	1838	2131	2447	2784	3523
36	83.05	73.16	716	906	1010	1119	1234	1354	1611	1891	2193	2518	2865	3626
38	87.67	75.17	736	931	1038	1150	1268	1391	1656	1943	2253	2587	2943	3725
40	92.28	77.11	755	955	1065	1180	1300	1427	1699	1993	2312	2654	3020	3822
42	96.89	79.03	774	979	1091	1209	1333	1462	1740	2043	2369	2719	3094	3916
44	101.51	80.88	792	1002	1116	1237	1364	1497	1781	2091	2425	2783	3167	4008
46	106.12	82.70	810	1025	1142	1265	1395	1531	1821	2138	2479	2846	3238	4098
48	110.74	84.48	827	1047	1166	1292	1425	1563	1861	2184	2533	2907	3308	4186
50	115.35	86.22	844	1068	1190	1319	1454	1596	1899	2229	2585	2967	3376	4273
52	119.96	87.93	861	1089	1214	1345	1483	1627	1937	2273	2636	3026	3443	4357
54	124.58	89.61	877	1110	1237	1370	1511	1658	1974	2316	2686	3084	3508	4440
56	129.19	91.20	893	1130	1260	1396	1539	1689	2010	2359	2735	3140	3573	4522
58	133.81	92.87	909	1150	1282	1420	1566	1719	2045	2400	2784	3196	3636	4602

Table C.4.10.1(a) Theoretical Discharge Through Circular Orifices (U.S. Gallons of Water per Minute) continued

58	133.81	92.87	909	1150	1282	1420	1566	1719	2045	2400	2784	3196	3636	4602
60	138.42	94.45	925	1170	1304	1445	1593	1748	2080	2441	2831	3250	3698	4681
62	143.03	96.01	940	1189	1325	1469	1619	1777	2115	2482	2878	3304	3759	4758
64	147.65	97.55	955	1209	1347	1492	1645	1805	2148	2521	2924	3357	3820	4834
66	152.26	99.07	970	1227	1367	1515	1670	1833	2182	2561	2970	3409	3879	4909
68	156.88	100.55	984	1246	1388	1538	1696	1861	2215	2599	3014	3460	3937	4983
70	161.49	102.03	999	1264	1408	1560	1720	1888	2247	2637	3058	3511	3995	5056
72	166.10	103.47	1013	1282	1428	1583	1745	1915	2279	2674	3102	3561	4051	5127
74	170.72	104.90	1027	1300	1448	1604	1769	1941	2310	2711	3144	3610	4107	5198
76	175.33	106.30	1041	1317	1467	1626	1793	1967	2341	2748	3187	3658	4162	5268
78	179.95	107.69	1054	1334	1487	1647	1816	1993	2372	2784	3228	3706	4217	5337
80	184.56	109.08	1068	1351	1505	1668	1839	2018	2402	2819	3269	3753	4270	5405
82	189.17	110.42	1081	1368	1524	1689	1862	2043	2432	2854	3310	3800	4323	5472
84	193.79	111.76	1094	1385	1543	1709	1885	2068	2461	2889	3350	3846	4376	5538
86	198.40	113.08	1107	1401	1561	1730	1907	2093	2491	2923	3390	3891	4428	5604
88	203.02	114.39	1120	1417	1579	1750	1929	2117	2519	2957	3429	3936	4479	5668
90	207.63	115.68	1132	1433	1597	1769	1951	2141	2548	2990	3468	3981	4529	5733
92	212.24	116.96	1145	1449	1614	1789	1972	2165	2576	3023	3506	4025	4579	5796
94	216.86	118.23	1157	1465	1632	1808	1994	2188	2604	3056	3544	4068	4629	5859
96	221.47	119.48	1169	1480	1649	1827	2015	2211	2631	3088	3582	4111	4678	5921
98	226.09	120.71	1182	1495	1666	1846	2035	2234	2659	3120	3619	4154	4726	5982
100	230.70	121.94	1194	1511	1683	1865	2056	2257	2686	3152	3655	4196	4774	6043
102	235.31	123.15	1205	1526	1700	1884	2077	2279	2712	3183	3692	4238	4822	6103
104	239.93	124.35	1217	1541	1716	1902	2097	2301	2739	3214	3728	4279	4869	6162
106	244.54	125.55	1229	1555	1733	1920	2117	2323	2765	3245	3763	4320	4916	6221
108	249.16	126.73	1240	1570	1749	1938	2137	2345	2791	3275	3799	4361	4962	6280
110	253.77	127.89	1252	1584	1765	1956	2157	2367	2817	3306	3834	4401	5007	6338
112	258.38	129.05	1263	1599	1781	1974	2176	2388	2842	3336	3869	4441	5053	6395
114	263.00	130.20	1274	1613	1797	1991	2195	2409	2867	3365	3903	4480	5098	6452
116	267.61	131.33	1286	1627	1813	2009	2215	2430	2892	3395	3937	4519	5142	6508
118	272.23	132.46	1297	1641	1828	2026	2234	2451	2917	3424	3971	4558	5186	6564
120	276.84	133.57	1308	1655	1844	2043	2252	2472	2942	3453	4004	4597	5230	6619

Table C.4.10.1(a) Theoretical Discharge Through Circular Orifices (U.S. Gallons of Water per Minute) continued

122	281.45	134.69	1318	1669	1859	2060	2271	2493	2966	3481	4038	4635	5273	6674
124	286.07	135.79	1329	1682	1874	2077	2290	2513	2991	3510	4070	4673	5317	6729
126	290.68	136.88	1340	1696	1889	2093	2308	2533	3015	3538	4103	4710	5359	6783
128	295.30	137.96	1350	1709	1904	2110	2326	2553	3038	3566	4136	4748	5402	6836
130	299.91	139.03	1361	1722	1919	2126	2344	2573	3062	3594	4168	4784	5444	6890
132	304.52	140.10	1371	1736	1934	2143	2362	2593	3086	3621	4200	4821	5485	6942
134	309.14	141.16	1382	1749	1948	2159	2380	2612	3109	3649	4231	4858	5527	6995
136	313.75	142.21	1392	1762	1963	2175	2398	2632	3132	3676	4263	4894	5568	7047

Notes:

(1) This table is computed from the formula with c = 1.00. The theoretical discharge of sea water, as from fireboat nozzles, can be found by subtracting 1 percent from the figures in Table 4.10.2, or from the formula

(2) Appropriate coefficient should be applied where it is read from hydrant outlet. Where more accurate results are required, a coefficient appropriate on the particular nozzle must be selected and applied to the figures of the table. The discharge from circular openings of sizes other than those in the table can readily be computed by applying the principle that quantity discharged under a given head varies as the square of the diameter of the opening.

*This pressure corresponds to velocity head.

†1 psi—2.307 ft of water. For pressure in bars, multiply by 0.01.

Table C.4.10.1(b) Theoretical Discharge Through Circular Orifices (Liters of Water per Minute)

Pilot Pressure* (kPa)	Meters†	Velocity Discharge (m/sec)	Orifice Size (mm)											
			51	57	60	64	67	70	76	83	89	95	101	114
6.89	0.70	3.72	455	568	629	716	785	857	1010	1204	1385	1578	1783	2272
13.8	1.41	5.26	644	804	891	1013	1111	1212	1429	1704	1960	2233	2524	3215
20.7	2.11	6.44	788	984	1091	1241	1360	1485	1750	2087	2400	2735	3091	3938
27.6	2.81	7.43	910	1137	1260	1433	1571	1714	2021	2410	2771	3158	3569	4547
34.5	3.52	8.31	1017	1271	1408	1602	1756	1917	2259	2695	3099	3530	3990	5084
41.4	4.22	9.10	1115	1392	1543	1755	1924	2100	2475	2952	3394	3867	4371	5569
48.3	4.92	9.83	1204	1504	1666	1896	2078	2268	2673	3189	3666	4177	4722	6015
55.2	5.63	10.51	1287	1608	1781	2027	2221	2425	2858	3409	3919	4466	5048	6431
62.0	6.33	11.15	1364	1704	1888	2148	2354	2570	3029	3613	4154	4733	5349	6815
68.9	7.03	11.75	1438	1796	1990	2264	2482	2709	3193	3808	4379	4989	5639	7184
75.8	7.73	12.33	1508	1884	2087	2375	2603	2841	3349	3995	4593	5233	5915	7536
82.7	8.44	12.87	1575	1968	2180	2481	2719	2968	3498	4172	4797	5466	6178	7871
89.6	9.14	13.40	1640	2048	2270	2582	2830	3089	3641	4343	4994	5690	6431	8193
96.5	9.84	13.91	1702	2126	2355	2680	2937	3206	3779	4507	5182	5905	6674	8503
103	10.55	14.39	1758	2196	2433	2769	3034	3312	3904	4656	5354	6100	6895	8784
110	11.25	14.87	1817	2269	2515	2861	3136	3423	4035	4812	5533	6304	7125	9078
117	11.95	15.33	1874	2341	2593	2951	3234	3530	4161	4963	5706	6502	7349	9362
124	12.66	15.77	1929	2410	2670	3038	3329	3634	4284	5109	5874	6693	7565	9638
131	13.36	16.20	1983	2477	2744	3122	3422	3735	4403	5251	6038	6880	7776	9906
138	14.06	16.62	2035	2542	2817	3205	3512	3834	4519	5390	6197	7061	7981	10168
152	15.47	17.43	2136	2668	2956	3363	3686	4023	4743	5657	6504	7410	8376	10671
165	16.88	18.21	2225	2779	3080	3504	3840	4192	4941	5893	6776	7721	8727	11118
179	18.28	18.95	2318	2895	3208	3650	4000	4366	5147	6138	7058	8042	9090	11580
193	19.69	19.67	2407	3006	3331	3790	4153	4534	5344	6374	7329	8350	9438	12024
207	21.10	20.36	2492	3113	3450	3925	4301	4695	5535	6601	7590	8648	9775	12453
221	22.50	21.03	2575	3217	3564	4055	4444	4851	5719	6821	7842	8935	10100	12867
234	23.91	21.67	2650	3310	3668	4173	4573	4992	5884	7018	8070	9195	10393	13240
248	25.31	22.30	2728	3408	3776	4296	4708	5139	6058	7225	8308	9466	10699	13630
262	26.72	22.91	2804	3502	3881	4416	4839	5282	6227	7426	8539	9729	10997	14010
276	28.13	23.50	2878	3595	3983	4532	4967	5422	6391	7622	8764	9986	11287	14379
290	29.53	24.09	2950	3685	4083	4646	5091	5557	6551	7813	8984	10236	11570	14740
303	30.94	24.65	3015	3767	4173	4748	5204	5681	6696	7986	9183	10463	11826	15066
317	32.35	25.21	3084	3853	4269	4857	5323	5810	6849	8169	9393	10702	12096	15410
331	33.75	25.75	3152	3937	4362	4963	5439	5937	6999	8347	9598	10935	12360	15747
345	35.16	26.28	3218	4019	4453	5067	5553	6061	7145	8522	9799	11164	12619	16077
358	36.57	26.80	3278	4094	4536	5161	5657	6175	7279	8681	9981	11373	12855	16377
372	37.97	27.31	3341	4173	4624	5261	5766	6294	7419	8849	10175	11593	13104	16694
386	39.38	27.80	3403	4251	4711	5360	5874	6412	7558	9014	10364	11809	13348	17005
400	40.78	28.31	3465	4328	4795	5456	5979	6527	7694	9176	10551	12021	13588	17311
414	42.19	28.79	3525	4403	4878	5551	6083	6640	7827	9335	10734	12230	13823	17611
427	43.60	29.26	3580	4471	4954	5637	6178	6743	7949	9481	10901	12420	14039	17885
441	45.00	29.73	3638	4544	5035	5729	6278	6853	8078	9635	11078	12622	14267	18176
455	46.41	30.20	3695	4616	5114	5819	6377	6961	8206	9787	11253	12821	14492	18462
469	47.82	30.65	3751	4686	5192	5908	6475	7067	8331	9936	11425	13017	14713	18744
483	49.22	31.10	3807	4756	5269	5995	6570	7172	8454	10083	11594	13210	14931	19022
496	50.63	31.54	3858	4819	5340	6075	6658	7268	8567	10218	11749	13386	15131	19276
510	52.03	31.97	3912	4887	5415	6161	6752	7370	8687	10361	11913	13574	15343	19547

Table C.4.10.1(b) Theoretical Discharge Through Circular Orifices (Liters of Water per Minute) (continued)

524	53.44	32.71	3965	4953	5488	6245	6844	7470	8806	10503	12076	13759	15552	19813
538	54.85	32.82	4018	5019	5561	6327	6934	7569	8923	10642	12236	13942	15758	20076
552	56.25	33.25	4070	5084	5633	6409	7024	7667	9038	10780	12394	14122	15962	20335
565	57.66	33.66	4118	5143	5699	6484	7106	7757	9144	10906	12539	14287	16149	20573
579	59.07	34.06	4168	5207	5769	6564	7194	7853	9256	11040	12694	14463	16348	20827
593	60.47	34.47	4218	5269	5839	6643	7280	7947	9368	11173	12846	14637	16544	21077
607	61.88	34.87	4268	5331	5907	6721	7366	8040	9478	11304	12997	14809	16738	21324
620	63.29	35.26	4313	5388	5970	6793	7444	8126	9578	11424	13136	14966	16917	21552
634	64.69	35.65	4362	5448	6037	6869	7528	8217	9686	11552	13283	15134	17107	21794
648	66.10	36.04	4410	5508	6103	6944	7610	8307	9792	11679	13429	15301	17294	22033
662	67.50	36.42	4457	5567	6169	7019	7692	8397	9898	11805	13573	15465	17480	22270
676	68.91	36.79	4504	5626	6234	7093	7773	8485	10002	11929	13716	15628	17664	22504
689	70.32	37.17	4547	5680	6293	7161	7848	8566	10097	12043	13847	15777	17833	22719
703	71.72	37.54	4593	5737	6357	7233	7927	8653	10200	12165	13987	15937	18013	22949
717	73.13	37.90	4638	5794	6420	7305	8005	8738	10301	12285	14126	16095	18192	23176
731	74.54	38.27	4684	5850	6482	7376	8083	8823	10401	12405	14263	16251	18369	23401
745	75.94	38.63	4728	5906	6544	7446	8160	8907	10500	12523	14399	16406	18544	23624
758	77.35	38.98	4769	5957	6601	7510	8231	8985	10591	12632	14524	16548	18705	23830
772	78.76	39.33	4813	6012	6662	7580	8307	9067	10688	12748	14658	16701	18877	24049
786	80.16	39.68	4857	6066	6722	7648	8382	9149	10785	12863	14790	16851	19047	24266
800	81.57	40.03	4900	6120	6781	7716	8456	9230	10880	12977	14921	17001	19216	24481
813	82.97	40.37	4939	6170	6836	7778	8525	9305	10968	13082	15042	17138	19371	24679
827	84.38	40.71	4982	6223	6895	7845	8598	9385	11063	13194	15171	17285	19538	24891
841	85.79	41.05	5024	6275	6953	7911	8670	9464	11156	13305	15299	17431	19702	25100
855	87.19	41.39	5065	6327	7011	7977	8742	9542	11248	13416	15425	17575	19866	25309
869	88.60	41.72	5107	6379	7068	8042	8813	9620	11340	13525	15551	17719	20028	25515
882	90.01	42.05	5145	6426	7121	8102	8879	9692	11424	13626	15667	17851	20177	25705
896	91.41	42.38	5185	6477	7177	8166	8949	9768	11515	13734	15791	17992	20336	25908
910	92.82	42.70	5226	6527	7233	8229	9019	9844	11604	13840	15914	18132	20495	26110
924	94.23	43.03	5266	6577	7288	8292	9088	9920	11693	13947	16036	18271	20652	26310
938	95.63	43.35	5305	6627	7343	8355	9156	9995	11782	14052	16157	18409	20807	26509

Notes:

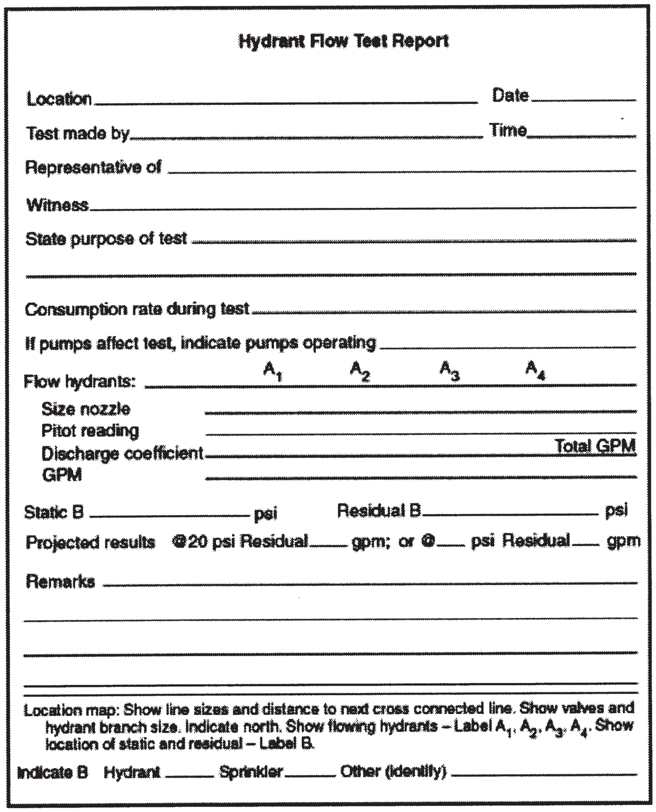
(1) This table is computed from the formula with c = 1.00. The theoretical discharge of sea water, as from fireboat nozzles, can be found by subtracting 1 percent from the figures in Table 4.10.2, or from the formula

(2) Appropriate coefficient should be applied where it is read from hydrant outlet. Where more accurate results are required, a coefficient appropriate on the particular nozzle must be selected and applied to the figures of the table. The discharge from circular openings of sizes other than those in the table can readily be computed by applying the principle that quantity discharged under a given head varies as the square of the diameter of the opening.

*This pressure corresponds to velocity head.

†1 kPa—0.102 m of water. For pressure in bars, multiply by 0.01.

C.4.11.2 With this in mind, it is suggested that the form shown in Figure C.4.11.2 be used to record information that is taken.



Hydrant Flow Test Report

Location ______ Date ______

Test made by ______ Time ______

Representative of ______

Witness ______

State purpose of test ______

Consumption rate during test ______

If pumps affect test, indicate pumps operating ______

Flow hydrants: A_1 A_2 A_3 A_4

Size nozzle ______

Pitot reading ______

Discharge coefficient ______ Total GPM

GPM ______

Static B ______ psi Residual B ______ psi

Projected results @20 psi Residual ____ gpm; or @ ____ psi Residual ____ gpm

Remarks ______

Location map: Show line sizes and distance to next cross connected line. Show valves and hydrant branch size. Indicate north. Show flowing hydrants – Label A_1, A_2, A_3, A_4. Show location of static and residual – Label B.

Indicate B Hydrant ____ Sprinkler ____ Other (identify) ______

Figure C.4.11.2 Sample Report of a Hydrant Flow Test.

C.4.11.3 The back of the form should include a location sketch.

C.4.11.4 Results of the flow test should be indicated on a hydraulic graph, such as the one shown in Figure C.4.11.4. (See Figure C.4.11.4 on the following page.)

C.4.11.5 When the tests are complete, the forms should be filed for future reference by interested parties.

C.4.12 System Corrections.

C.4.12.1 It must be remembered that flow test results show the strength of the distribution system and do not necessarily indicate the degree of adequacy of the entire water works system.

C.4.12.2 Consider a system supplied by pumps at one location and having no elevated storage.

C.4.12.3 If the pressure at the pump station drops during the test, it is an indication that the distribution system is capable of delivering more than the pumps can deliver at their normal operating pressure.

C.4.12.4 It is necessary to use a value for the drop in pressure for the test that is equal to the actual drop obtained in the field during the test, minus the drop in discharge pressure at the pumping station.

C.4.12.5 If sufficient pumping capacity is available at the station and the discharge pressure could be maintained by operating additional pumps, the water system as a whole could deliver the computed quantity.

C.4.12.6 If, however, additional pumping units are not available, the distribution system would be capable of delivering the computed quantity, but the water system as a whole would be limited by the pumping capacity.

C.4.12.7 The portion of the pressure drop for which a correction can be made for tests on systems with storage is generally estimated upon the basis of a study of all the tests made and the pressure drops observed on the recording gauge at the station for each.

C.4.12.8 The corrections may vary from very substantial portions of the observed pressure drops for tests near the pumping station, to zero for tests remote from the station.

SUBSTANTIATION: The recommended practice for fire flow testing is currently in a separate document that is often not noted. Bringing the recommended practice into an Annex of NFPA 24 will give them greater exposure and improve ease of use.

COMMITTEE MEETING ACTION: Accept in Principle

Add an opening section to Annex C stating the following:

Annex C was developed based upon the procedures contained in NFPA 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants. For additional information on Fire Flow Testing see NFPA 291, Chapter 4, Flow Testing.

COMMITTEE STATEMENT: The committee agreed with the submitter, but wanted to add the opening section detailing the origin of the new material.

NUMBER ELIGIBLE TO VOTE: 23

BALLOT RESULTS: Affirmative: 21

BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-36 Log #25 AUT-PRI **Final Action: Accept**
(C.1.2.4)

SUBMITTER: Richard W. Bonds, Ductile Iron Pipe Research Assn.

RECOMMENDATION: Add AWWA C116, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and gray iron Fittings for Water Supply Service.

SUBSTANTIATION: This coating is being used in private fire service mains and is referenced in the standard.

COMMITTEE MEETING ACTION: Accept

NUMBER ELIGIBLE TO VOTE: 23

BALLOT RESULTS: Affirmative: 21

BALLOT NOT RETURNED: 2 BROWN, SALWAN

24-37 Log #28 AUT-PRI **Final Action: Accept in Principle**
(Annex D)

SUBMITTER: James B. Biggins, Marsh Risk Consulting

RECOMMENDATION: Add Annex D to NFPA 24 to include recommended practices for marking of fire hydrants. This proposal is derived from NFPA 291 and is the result of the work of a task group of the Technical Committee on Private Water Supply Piping Systems comprised of J. Biggins, J. Lake, D. Mowrer and J. Schifiliti.

NFPA 24

Annex D

Recommended Practice for Marking of Hydrants

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

D.1.1 Scope.

The scope of this annex is to provide guidance on marking of hydrants.

D.1.2 Purpose.

Fire flow tests are conducted on water distribution systems to determine the rate of flow available at various locations for fire-fighting purposes.

D.1.3 Application.

D.1.3.1 A certain residual pressure in the mains is specified at which the rate of flow should be available.

D.1.3.2 Additional benefit is derived from fire flow tests by the indication of possible deficiencies, such as tuberculation of piping or closed valves or both, which could be corrected to ensure adequate fire flows as needed.

D.1.4 Units.

Metric units of measurement in this recommended practice are in accordance with the modernized metric system known as the International System of Units (SI). Two units (liter and bar), outside of but recognized by SI, are commonly used in international fire protection. These units are listed in Table D.1.4 with conversion factors.

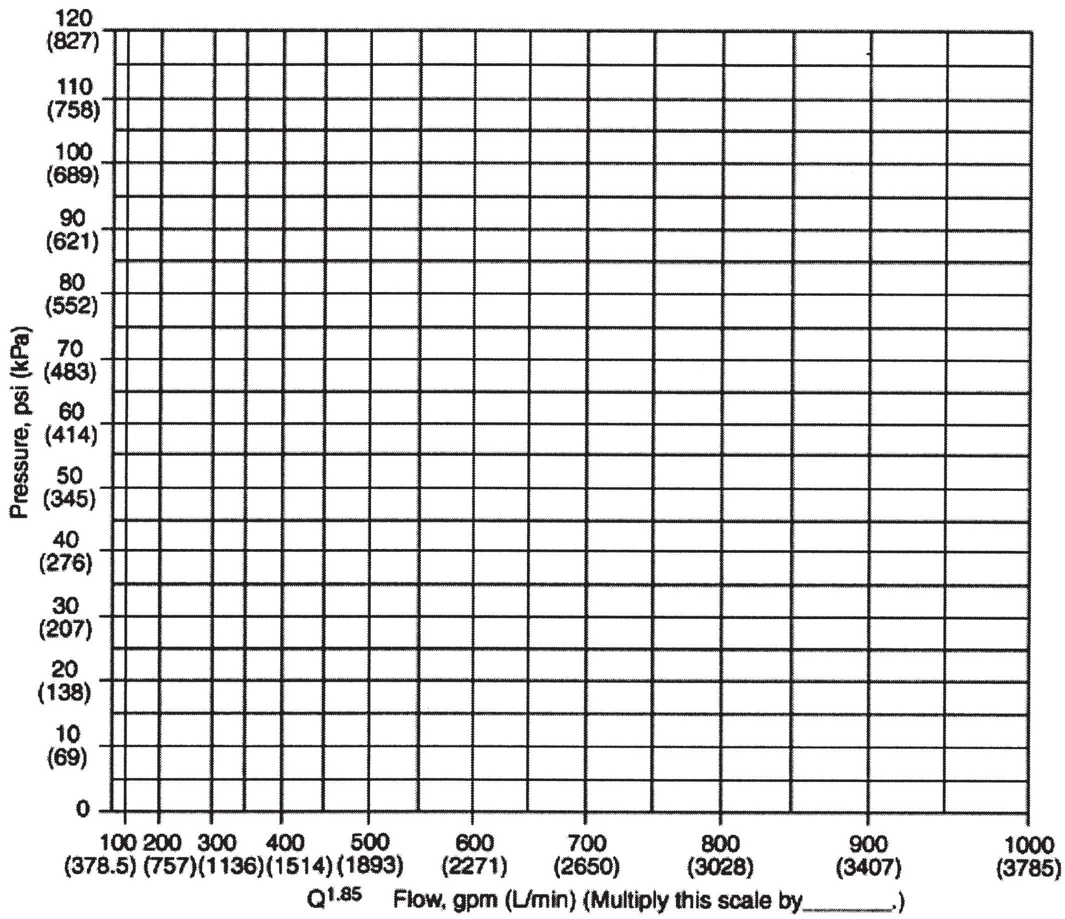


Figure C.4.11.4 Sample Graph Sheet.

Table D.1.4

SI Units and Conversion Factors

Unit Name	Unit Symbol	Conversion Factor
Liter	L	1 gal = 3.785 L
Liter per minute per square meter	$(L/min)/m^2$	1 gpm ft^2 = (40.746 $L/min)/m^2$
Cubic decimeter	dm^3	1 gal = 3.785 dm^3
Pascal	Pa	1 psi = 6894.757 bar
Bar	bar	1 psi = 0.0689 bar
Bar	bar	1 bar = 105 Pa

Note: For additional conversions and information, see ASTM E 380, Standard for Metric Practice, 1989.

D.1.4.1 If a value for measurement as given in this recommended practice is followed by an equivalent value in other units, the first value stated is to be regarded as the recommendation. A given equivalent value might be approximate.

D.2.1 Referenced Publications

The documents or portions thereof listed in this chapter are referenced within this annex and should be considered part of the recommendations of this document.

D.2.2 NFPA Publications. (Reserved)

D2.3 Other Publications.

D.2.3.1 ASTM Publication.

American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.
ASTM E 380, Standard for Metric Practice, 1989.

D.3.1Definitions

The definitions contained in this annex apply to the terms used in this annex practice. Where terms are not included, common usage of the terms applies.

D.3.2 NFPA Official Definitions.

D.3.2.1* Authority Having Jurisdiction (AHJ). The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.

D.3.2.2* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

D.3.2.3 Should. Indicates a recommendation or that which is advised but not required.

D.3.3 General Definitions.

D.3.3.1 Rated Capacity. The flow available from a hydrant at the designated residual pressure (rated pressure), either measured or calculated.

D.4.1 Classification of Hydrants.

D.4.1 Hydrants should be classified in accordance with their rated capacities [at 1.4 bar (20 psi) residual pressure or other designated value] as follows:

(1) Class AA — Rated capacity of 5680 L/min (1500 gpm) or greater
(2) Class A — Rated capacity of 3785 to 5675 L/min (1000 to 1499 gpm)
(3) Class B — Rated capacity of 1900 to 3780 L/min (500 to 999 gpm)
(4) Class C — Rated capacity of less than 1900 L/min (500 gpm)

D.5.2 Marking of Hydrants.

D.5.2.1 Public Hydrants.

D.5.2.1.1 All barrels are to be chrome yellow except in cases where another color has already been adopted.

D.5.2.1.2 The tops and nozzle caps should be painted with the following capacity-indicating color scheme to provide simplicity and consistency with colors used in signal work for safety, danger, and intermediate condition:

(1) Class AA — Light blue
(2) Class A — Green
(3) Class B — Orange
(4) Class C — Red

D.5.2.1.3 For rapid identification at night, it is recommended that the capacity colors be of a reflective-type paint.

D.5.2.1.4 Hydrants rated at less than 1.4 bar (20 psi) should have the rated pressure stenciled in black on the hydrant top.

D.5.2.1.5 In addition to the painted top and nozzle caps, it can be advantageous to stencil the rated capacity of high volume hydrants on the top.

D.5.2.1.6 The classification and marking of hydrants provided for in this chapter anticipate determination based on individual flow test.

D.5.2.1.7 Where a group of hydrants can be used at the time of a fire, some special marking designating group-flow capacity may be desirable.

D.5.2.2 Permanently Inoperative Hydrants. Fire hydrants that are permanently inoperative or unusable should be removed.

D.5.2.3 Temporarily Inoperative Hydrants. Fire hydrants that are temporarily inoperative or unusable should be wrapped or otherwise provided with temporary indication of their condition.

D.5.2.4 Flush Hydrants. Location markers for flush hydrants should carry the same background color as stated above for class indication, with such other data stenciled thereon as deemed necessary.

D.5.2.5 Private Hydrants.

D.5.2.5.1 Marking on private hydrants within private enclosures is to be at the owner's discretion.

D.5.2.5.2 When private hydrants are located on public streets, they should be painted red, or some other color, to distinguish them from public hydrants.
SUBSTANTIATION: The recommended practice for marking of fire hydrants is currently in a separate document that is often not noted. Bringing the recommended practice into an Annex of NFPA 24 will give them greater exposure and improve ease of use.
COMMITTEE MEETING ACTION: Accept in Principle
Accept the proposed new annex material with the following edits:
Add an opening section to Annex D stating the following:
Annex D was developed based upon the procedures contained in NFPA 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants. For additional information on Marking of Hydrants see NFPA 291, Chapter 5, Marking of Hydrants.
Reword D.5.2.1 to read as follows:
D.5.2.1 Recommended Hydrant Color Schemes.
Reword title of D.5.2.5 to read as follows:
D.5.2.5 Marking of Hydrants Within Private Enclosures.
Delete current D.5.2.5.1.
Reword D.5.2.5.2 to become new D.5.2.5.1 to read as follows:
D.5.2.5.1 When private hydrants are located on public streets, they should be marked in accordance with the requirements of the authority having jurisdiction.
COMMITTEE STATEMENT: The committee agreed with the submitter, but wanted to add the opening section detailing the origin of the new material.
Additionally, the committee additionally wanted to remove the references to Public Hydrants as it is still addressed in NFPA 291.
NUMBER ELIGIBLE TO VOTE: 23
BALLOT RESULTS: Affirmative: 21
BALLOT NOT RETURNED: 2 BROWN, SALWAN