NFPA 70®

National Electrical Code®

International Electrical Code® Series

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NFPA 70®

National Electrical Code®

2017 Edition

This edition of *NFPA 70, National Electrical Code*, was prepared by the National Electrical Code Committee and acted on by NFPA at its June Association Technical Meeting held June 13–16, 2016, in Las Vegas, NV. It was issued by the Standards Council on August 4, 2016, with an effective date of August 24, 2016, and supersedes all previous editions.

This document has been amended by one or more Tentative Interim Amendments (TIAs) and/or Errata. See "Codes & Standards" at www.nfpa.org for more information.

This edition of *NFPA 70* was approved as an American National Standard on August 24, 2016.

History and Development of the *National Electrical Code* ®

The National Fire Protection Association has acted as sponsor of the *National Electrical Code* since 1911. The original Code document was developed in 1897 as a result of the united efforts of various insurance, electrical, architectural, and allied interests.

In accordance with the Regulations Governing the Development of NFPA Standards, a National Electrical Code First Draft Report containing proposed amendments to the 2014 National Electrical Code was published by NFPA in July 2015. This report recorded the actions of the various Code-Making Panels and the Correlating Committee of the National Electrical Code Committee on each public input and first revision that had been made to revise the 2014 Code. The report was published at www.nfpa.org/70. Following the close of the public comment period, the Code-Making Panels met, acted on each comment, and created some second revisions, which were reported to the Correlating Committee. NFPA published the National Electrical Code Second Draft Report in April 2016, which recorded the actions of the Code-Making Panels and the Correlating Committee on each public comment on the National Electrical Code Committee First Draft Report. The National Electrical Code First Draft Report and the National Electrical Code Second Draft Report were presented to the 2016 June Association Technical Meeting for adoption.

NFPA has an Electrical Section that provides particular opportunity for NFPA members interested in electrical safety to become better informed and to contribute to the development of the National Electrical Code and other NFPA electrical standards. At the Electrical Section Codes and Standards Review Session held at the 2016 NFPA Conference and Expo, Section members had the opportunity to discuss and review the report of the National Electrical Code Committee prior to the adoption of this edition of the Code by the Association at its 2016 June Technical Session.

This 54th edition supersedes all other previous editions, supplements, and printings dated 1897, 1899, 1901, 1903, 1904, 1905, 1907, 1909, 1911, 1913, 1915, 1918, 1920, 1923, 1925, 1926, 1928, 1930, 1931, 1933, 1935, 1937, 1940, 1942, 1943, 1947, 1949, 1951, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1962, 1965, 1968, 1971, 1975, 1978, 1981, 1984, 1987, 1990, 1993, 1996, 1999, 2002, 2005, 2008, 2011, and 2014.

This Code is purely advisory as far as NFPA is concerned. It is made available for a wide variety of both public and private uses in the interest of life and property protection. These include both use in law and for regulatory purposes and use in private self-regulation and standardization activities such as insurance underwriting, building and facilities construction and management, and product testing and certification.

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These lists represent the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of this document.

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Samuel R. La Dart, City of Memphis, TN [L]
Rep. International Brotherhood of Electrical Workers

Charles David Mercier, Southwire Company, GA [M]
Rep. National Electrical Manufacturers Association

Ronald G. Nickson, National Multifamily Housing Council, NC [U]

Dennis A. Nielsen, Lawrence Berkeley National Laboratory, CA [U]
Rep. Institute of Electrical & Electronics Engineers, Inc.

John W. Ray, Duke Energy Corporation, NC [UT]
Rep. Electric Light & Power Group/EEI

Gregory L. Runyon, Eli Lilly and Company, IN [U]
Rep. American Chemistry Council

George A. Straniero, AFC Cable Systems, Inc., NJ [M]
Rep. Copper Development Association Inc.

Wesley L. Wheeler, National Electrical Contractors Association, MD [IM]
Rep. National Electrical Contractors Association

Alternates

J. Richard Barker, General Cable Corporation, CA [M]
(Alt. to Christel K. Hunter)

Richard C. Bennett, Cerro Wire LLC, AL [M]
(Alt. to Charles David Mercier)

Timothy Earl, GBH International, MI [M]
(Alt. to Herman J. Hall)

Rachel E. Krepps, Baltimore Gas & Electric Company, MD [UT]
(Alt. to John W. Ray)

Keith Owensby, Chattanooga Electrical JATC, TN [L]
(Alt. to Samuel R. La Dart)

Kevin T. Porter, Encore Wire Corporation, TX [M]
(Alt. to George A. Straniero)

Irozenell Pruitt, The DuPont Company, Inc., TX [U]
(Alt. to Gregory L. Runyon)

Michael W. Smith, Schaeffer Electric Company, Inc., MO [IM]
(Alt. to Wesley L. Wheeler)

Susan L. Stene, UL LLC, CA [RT]
(Alt. to Thomas H. Cybula)

Allen R. Turner, James City County, Virginia, VA [E]
(Alt. to David A. Williams)

CODE-MAKING PANEL NO. 8

Articles 342, 344, 348, 350, 352, 353, 354, 355, 356, 358, 360, 362, 366, 368, 370, 372, 374, 376, 378, 380, 384, 386, 388, 390, 392, Chapter 9, Tables 1 through 4, Example D13, and Annex C

Larry D. Cogburn, *Chair*
Cogburn Bros., Inc., FL [IM]
Rep. National Electrical Contractors Association

David F. Allen, National Grid, MA [UT]
Rep. Electric Light & Power Group/EEI

David M. Campbell, AFC Cable Systems, Inc., MA [M]
Rep. The Aluminum Association, Inc.

David A. Gerstetter, UL LLC, IL [RT]
Rep. Underwriters Laboratories Inc.

Kenneth W. Hengst, Walker Engineering, Inc., TX [IM]
Rep. Independent Electrical Contractors, Inc.

Pete Jackson, City of Bakersfield, California, CA [E]
Rep. International Association of Electrical Inspectors

David H. Kendall, Thomas & Betts Corporation, TN [M]
Rep. The Vinyl Institute

Richard E. Loyd, R & N Associates, AZ [M]
Rep. Steel Tube Institute of North America

Michael C. Martin, ExxonMobil Research & Engineering, TX [U]
Rep. American Chemistry Council

Paul W. Myers, PCS Nitrogen, OH [U]
Rep. Institute of Electrical & Electronics Engineers, Inc.

Donald R. Offerdahl, Intertek Testing Services, ND [RT]

Rhett A. Roe, IBEW Local Union 26 JATC, MD [L]
Rep. International Brotherhood of Electrical Workers

Rodney J. West, Schneider Electric, OH [M]
Rep. National Electrical Manufacturers Association

Alternates

Richard J. Berman, UL LLC, IL [RT]
(Alt. to David A. Gerstetter)

Rachel Guenther, Thomas & Betts Corporation, TN [M]
(Alt. to David H. Kendall)

J. Grant Hammett, Colorado State Electrical Board, CO [E]
(Alt. to Pete Jackson)

Raymond W. Horner, Alliecd Tube & Conduit, IL [M]
(Alt. to Richard E. Loyd)

Gary K. Johnson, The Dow Chemical Company, LA [U]
(Alt. to Michael C. Martin)

Stephen P. Poholski, Newkirk Electric Associates, Inc., MI [IM]
(Alt. to Larry D. Cogburn)

Dan Rodriguez, IBEW Local Union 332, CA [L]
(Alt. to Rhett A. Roe)

Frederic F. Small, Hubbell Incorporated, CT [M]
(Alt. to Rodney J. West)

Raul L. Vasquez, Independent Electrical Contractors, TX [IM]
(Alt. to Kenneth W. Hengst)

Dave Watson, Southwire, GA [M]
(Alt. to David M. Campbell)

Nonvoting

Stephen W. Douglas, QPS Evaluation Services Inc., Canada [SE]
Rep. CSA/Canadian Electrical Code Committee

CODE-MAKING PANEL NO. 9

Articles 312, 314, 404, 408, 450, 490

David G. Humphrey, *Chair*
County of Henrico, Virginia, VA [E]
Rep. International Association of Electrical Inspectors

Rodney D. Belisle, NECA-IBEW Electrical Training Trust, OR [L]
Rep. International Brotherhood of Electrical Workers

Kevin J. Breen, Breen Electrical Contractors Inc., NY [IM]
Rep. Independent Electrical Contractors, Inc.

Billy Breitkreutz, Fluor Corporation, TX [U]
Rep. Associated Builders & Contractors

Wayne Brinkmeyer, Britain Electric Company, TX [IM]
Rep. National Electrical Contractors Association

Frederic P. Hartwell, Hartwell Electrical Services, Inc., MA [SE]

Barry N. Hornberger, PECO Energy Company, PA [UT]
Rep. Electric Light & Power Group/EEI

Kevin R. Miller, Intertek Testing Services, WA [RT]

Robert D. Osborne, UL LLC, NC [RT]

Bradford D. Rupp, Allied Moulded Products, Inc., OH [M]
Rep. National Electrical Manufacturers Association

Ralph H. Young, Eastman Chemical Company, TN [U]
Rep. American Chemistry Council

Alternates

Gregory A. Bowman, NABCO Electric, TN [IM]
(Alt. to Wayne Brinkmeyer)

Kenneth S. Crawford, Chemours Company, WV [U]
(Alt. to Ralph H. Young)

Ken Filips, Bergelectric, OR [IM]
(Alt. to Kevin J. Breen)

L. Keith Lofland, International Association of Electrical Inspectors (IAEI), TX [E]
(Alt. to David G. Humphrey)

Kenneth L. McKinney, Jr., UL LLC, NC [RT]
(Alt. to Robert D. Osborne)

Michael O'Connell, Joint Apprentice & Training Committee of Greater Boston, MA [L]
(Alt. to Rodney D. Belisle)

Ronnie H. Ridgeway, Siemens Industry, Inc., TX [M]
(Alt. to Bradford D. Rupp)

David Santa Maria, Eversource Energy, CT [UT]
(Alt. to Barry N. Hornberger)

CODE-MAKING PANEL NO. 10

Article 240

Julian R. Burns, *Chair*
Quality Power Solutions, Inc., NC [IM]
Rep. Independent Electrical Contractors, Inc.

Scott A. Blizard, American Electrical Testing Company, Inc., MA [IM]
Rep. InterNational Electrical Testing Association

Dennis M. Darling, Stantec, Canada [U]
Rep. Institute of Electrical & Electronics Engineers, Inc.

James T. Dollard, Jr., IBEW Local Union 98, PA [L]
Rep. International Brotherhood of Electrical Workers

Carl Fredericks, The Dow Chemical Company, TX [U]
Rep. American Chemistry Council

Jeffrey H. Hidaka, UL LLC, WA [RT]

Robert J. Kauer, Building Inspection Underwriters, Inc., PA [E]
Rep. International Association of Electrical Inspectors

Kenneth J. Rempe, Siemens Industry Inc., GA [M]
Rep. National Electrical Manufacturers Association

Vincent J. Saporita, Eaton's Bussmann Business, MO [M]

Richard Sobel, Quantum Electric Corporation, NY [IM]
Rep. National Electrical Contractors Association

Christopher R. Vance, National Grid, NY [UT]
Rep. Electric Light & Power Group/EEI

Alternates

Christopher M. Jensen, North Logan City, UT [E]
(Alt. to Robert J. Kauer)

Kevin J. Lippert, Eaton Corporation, PA [M]
(Alt. to Vincent J. Saporita)

Richard E. Lofton, II, IBEW Local Union 280, OR [L]
(Alt. to James T. Dollard, Jr.)

Alan Manche, Schneider Electric, KY [M]
(Alt. to Kenneth J. Rempe)

Kathleen McKitish, Baltimore Gas & Electric, MD [UT]
(Alt. to Christopher R. Vance)

Bruce M. Rockwell, American Electrical Testing Company, Inc., NJ [IM]
(Alt. to Scott A. Blizard)

Roy K. Sparks, III, Eli Lilly and Company, IN [U]
(Alt. to Carl Fredericks)

Steve A. Struble, Freeman's Electric Service, Inc., SD [IM]
(Alt. to Julian R. Burns)

Steven E. Townsend, General Motors Company, MI [U]
(Alt. to Dennis M. Darling)

CODE-MAKING PANEL NO. 11

Articles 409, 430, 440, 460, 470, Annex D, Example D8

John M. Thompson, *Chair*
UL LLC, NC [RT]

Luis M. Bas, Intertek Testing Services, FL [RT]
Terry D. Cole, Hamer Electric, Inc., WA [IM]
Rep. Independent Electrical Contractors, Inc.
Zivorad Cosic, ABB Inc., WI [M]
Robert G. Fahey, City of Janesville, WI [E]
Rep. International Association of Electrical Inspectors
James M. Fahey, IBEW Local Union 103, MA [L]
Rep. International Brotherhood of Electrical Workers
Stanley J. Folz, Morse Electric Company, NV [IM]
Rep. National Electrical Contractors Association
Paul E. Guidry, Fluor Enterprises, Inc., TX [U]
Rep. Associated Builders & Contractors
Stephen M. Jackson, Southern Company, GA [UT]
Rep. Electric Light & Power Group/EEI
Arthur S. Neubauer, Arseal Technologies, GA [U]
Rep. American Petroleum Institute
George J. Ockuly, Technical Marketing Consultants, MO [M]
Charles L. Powell, Eastman Chemical Company, TN [U]
Rep. American Chemistry Council
Arthur J. Smith, III, Waldemar S. Nelson & Company, Inc., LA [U]
Rep. Institute of Electrical & Electronics Engineers, Inc.
Ron Widup, Shermco Industries, TX [IM]
Rep. InterNational Electrical Testing Association
James R. Wright, Siemens Industry, Inc., IL [M]
Rep. National Electrical Manufacturers Association

Alternates

John E. Cabaniss, Eastman Chemical Company, TN [U]
(Alt. to Charles L. Powell)
Seth J. Carlton, UL LLC, IL [RT]
(Alt. to John M. Thompson)
Gregory J. Clement, Fluor Enterprises, Inc., TX [U]
(Alt. to Paul E. Guidry)
Eric Gesualdi, Shell Oil Company, TX [U]
(Alt. to Arthur S. Neubauer)
Tim Hinson, Miller Electric Company, FL [IM]
(Alt. to Stanley J. Folz)
Rodney B. Jones, Clackamas County, Oregon, OR [E]
(Alt. to Robert G. Fahey)
Tim LaLonde, Haskin Electric, Inc., WA [IM]
(Alt. to Terry D. Cole)
Ed Larsen, Schneider Electric USA, IA [M]
(Alt. to James R. Wright)
Jebediah J. Novak, Cedar Rapids Electrical JATC, IA [L]
(Alt. to James M. Fahey)
Vincent J. Saporita, Eaton's Bussmann Business, MO [M]
(Alt. to George J. Ockuly)
Carl Timothy Wall, Alabama Power Company, AL [UT]
(Alt. to Stephen M. Jackson)
Bobby A. Walton, Intertek, TX [RT]
(Alt. to Luis M. Bas)

CODE-MAKING PANEL NO. 12

Articles 610, 620, 625, 626, 630, 640, 645, 647, 650, 660, 665, 668, 669, 670, 685, and Annex D, Examples D9 and D10

Scott Cline, *Chair*
McMurtrey Electric, Inc., CA [IM]
Rep. National Electrical Contractors Association

Frank Anthony Belio, International Union of Elevator Constructors, CA [L]

Jeffrey W. Blain, Schindler Elevator Corporation, NY [M]
Rep. National Elevator Industry Inc.
(VL to 610, 620, 630)

Thomas R. Brown, Intertek Testing Services, NY [RT]

James L. Brown, DTE Energy, MI [UT]
Rep. Electric Light & Power Group/EEI

Philip Clark, City of Southfield, MI [E]
Rep. International Association of Electrical Inspectors

Karl M. Cunningham, Alcoa, Inc., PA [M]
Rep. The Aluminum Association, Inc.
(VL to 610, 625, 630, 645, 660, 665, 668, 669, 685)

Joel Goergen, Cisco Systems, Inc., CA [M]

Jeffrey L. Holmes, IBEW Local Union 1 JATC, MO [L]
Rep. International Brotherhood of Electrical Workers

Angelo G. Horiates, Navy Crane Center, VA [U]
(VL to 610)

Robert E. Johnson, ITE Safety, MA [U]
Rep. Information Technology Industry Council
(VL to 640, 645, 647, 685)

Stanley Kaufman, CableSafe, Inc./OFS, GA [M]
Rep. Society of the Plastics Industry, Inc.
(VL to 640, 645, 646, 650)

John R. Kovacik, UL LLC, IL [RT]

Todd F. Lottmann, Easton's Bussmann Business, MO [M]
Rep. National Electrical Manufacturers Association

Jeffrey S. Menig, General Motors Company, MI [U]
Rep. SAE Hybrid/EV Technical Standards Committee

Duke W. Schamel, Electrical Service Solutions, Inc., CA [IM]
Rep. Independent Electrical Contractors, Inc.

Arthur E. Schlueter, Jr., A. E. Schlueter Pipe Organ Company, GA [M]
Rep. American Pipe Organ Builders
(VL to 640, 650)

Robert C. Turner, Inductotherm Corporation, PA [M]
(VL to 610, 630, 665, 668, 669)

Alternates

Joseph M. Bablo, UL LLC, IL [RT]
(Alt. to John R. Kovacik)

William B. Crist, Jr., IES Residential Inc., TX [IM]
(Alt. to Duke W. Schamel)

Vincent Della Croce, eti Conformity Services, FL [L]
(Alt. to Jeffrey L. Holmes)

Jody B. Greenwood, Navy Crane Center, VA [U]
(VL to 610)
(Alt. to Angelo G. Horiates)

Jacob Haney, General Cable Corporation, IN [M]
(VL to 610, 625, 630, 645, 660, 665, 668, 669, 685)
(Alt. to Karl M. Cunningham)

John D. (Doug) Henderson, ThyssenKrupp Elevator Manufacturing Inc., TN [M]
(VL to 610, 620, 630)
(Alt. to Jeffrey W. Blain)

Todd R. Konieczny, Intertek Testing Services, MA [RT]
(Alt. to Thomas R. Brown)

Michael Owen, White Electrical, TN [IM]
(Alt. to Scott Cline)

Joseph F. Prisco, IBM Corporation, MN [U]
(VL to 640, 645, 647, 685)
(Alt. to Robert E. Johnson)

Emad Tabatabaei, Inductotherm Corporation, NJ [M]
(VL to 610, 630, 665, 668, 669)
(Alt. to Robert C. Turner)

James E. Tarchinski, General Motors Company, MI [U]
(Alt. to Jeffrey S. Menig)

Frank Tse, Leviton Manufacturing Company, Inc., NY [M]
(Alt. to Todd F. Lottmann)

Phillip J. Yehl, City of Peoria, IL [E]
(Alt. to Philip Clark)

Nonvoting

Andre R. Cartal, Yardley, PA [E]
(Member Emeritus)

CODE-MAKING PANEL NO. 13

Articles 445, 455, 480, 695, 700, 701, 702, 706, 708, 712, 750, Annex F, and Annex G

Linda J. Little, *Chair*
IBEW Local 1 Electricians JATC, MO [L]

Martin D. Adams, Adams Electric, Inc., CO [IM]
Rep. National Electrical Contractors Association

George M. Brandon, One World Technologies, SC [M]
Rep. Portable Generator Manufacturers' Association

Daniel J. Caron, Bard, Rao + Athanas Consulting Engineers, LLC, MA [SE]

Timothy M. Croushore, FirstEnergy Technologies, PA [UT]
Rep. Electric Light & Power Group/EEI

Richard D. Currin, Jr., North Carolina State University, NC [U]
Rep. American Society of Agricultural & Biological Engineers

Neil A. Czarnecki, Reliance Controls Corporation, WI [M]
Rep. National Electrical Manufacturers Association

James E. Degnan, Stantec, WA [U]
Rep. American Society for Healthcare Engineering

Steven F. Froemming, City of Franklin, WI [E]
Rep. International Association of Electrical Inspectors

Ronald A. Keenan, M. C. Dean, Inc., VA [IM]
Rep. Independent Electrical Contractors, Inc.

Daniel R. Neeser, Eaton's Bussmann Division, MO [M]

Mark C. Ode, UL LLC, AZ [RT]

Shawn Paulsen, CSA Group, Canada [RT]

Arnoldo L. Rodriguez, LyondellBasell Industries, TX [U]
Rep. American Chemistry Council

Michael L. Savage, Sr., City of Rio Rancho, NM [E]

Mario C. Spina, Verizon Wireless, OH [U]
Rep. Institute of Electrical & Electronics Engineers, Inc.

David Tobias, Jr., Intertek Testing Services, OH [RT]

Kendall M. Waterman, Draka Cableteq, MA [M]
Rep. Copper Development Association Inc.

James R. White, Shermco Industries, Inc., TX [IM]
Rep. InterNational Electrical Testing Association

Herbert V. Whittall, Electrical Generating Systems Association, FL [M]
Rep. Electrical Generating Systems Association

Timothy P. Windey, Cummins Power Generation, MN [M]

Alternates

Lawrence S. Ayer, Biz Com Electric, Inc., OH [IM]
(Alt. to Ronald A. Keenan)

Barry S. Bauman, Alliant Energy, WI [U]
(Alt. to Richard D. Currin, Jr.)

Krista McDonald Biason, HGA Architects and Engineers, MN [U]
(Alt. to James E. Degnan)

William P. Cantor, TPI Corporation, PA [U]
(Alt. to Mario C. Spina)

James S. Conrad, RSCC Wire & Cable, CT [M]
(Alt. to Kendall M. Waterman)

Timothy Crnko, Eaton's Bussmann Business, MO [M]
(Alt. to Daniel R. Neeser)

Herbert H. Daugherty, Electric Generating Systems Association, FL [M]
(Alt. to Herbert V. Whittall)

James T. Dollard, Jr., IBEW Local Union 98, PA [L]
(Alt. to Linda J. Little)

Lawrence W. Forshner, Bard, Rao + Athanas Consulting Engineers, LLC, MA [SE]
(Alt. to Daniel J. Caron)

Travis Foster, Shell Oil Company, TX [U]
(Alt. to Arnoldo L. Rodriguez)

Robert E. Jordan, Alabama Power Company, AL [UT]
(Alt. to Timothy M. Croushore)

Chad Kennedy, Schneider Electric, SC [M]
(Alt. to Neil A. Czarnecki)

John R. Kovacik, UL LLC, IL [RT]
(Alt. to Mark C. Ode)

Greg Marchand, Briggs & Stratton, [M]
(Alt. to George M. Brandon)

Rich Scroggins, Cummins Power Generation, MN [M]
(Alt. to Timothy P. Windey)

Michael Wilson, CSA Group, Canada [RT]
(Alt. to Shawn Paulsen)

CODE-MAKING PANEL NO. 14

Articles 500, 501, 502, 503, 504, 505, 506, 510, 511, 513, 514, 515, and 516

Robert A. Jones, *Chair*
Independent Electrical Contractors, Inc., TX [IM]
Rep. Independent Electrical Contractors, Inc.

Harold G. Alexander, American Electric Power Company, OH [UT]
Rep. Electric Light & Power Group/EEI

Donald W. Ankele, UL LLC, IL [RT]

Marc J. Bernsen, National Electrical Contractors Association, ID [IM]
Rep. National Electrical Contractors Association

Steven J. Blais, Appleton Group, IL [M]
Rep. National Electrical Manufacturers Association

Corey Cahill, U.S. Coast Guard, DC [E]

Mark Goodman, Mark Goodman Electrical Consulting, CA [U]
Rep. American Petroleum Institute

Haywood Kines, Prince William County Building Development, VA [E]
Rep. International Association of Electrical Inspectors

William G. Lawrence, Jr., FM Global, MA [I]

L. Evans Massey, Baldor Electric Company, SC [M]
Rep. Instrumentation, Systems, & Automation Society

William E. McBride, Northern Electric Company, AK [U]
Rep. Institute of Electrical & Electronics Engineers, Inc.

Jeremy Neagle, U.S. Bureau of Alcohol, Tobacco, Firearms & Explosives, MD [U]

Ryan Parks, Intertek Testing Services, TX [RT]

John L. Simmons, Florida East Coast JATC, FL [L]
Rep. International Brotherhood of Electrical Workers

David B. Wechsler, Consultant, TX [U]
Rep. American Chemistry Council

Mark C. Wirfs, R & W Engineering, Inc., OR [U]
Rep. Grain Elevator and Processing Society

Alternates

Dave Burns, Shell P&T: Innovation/R&D, TX [U]
(Alt. to Mark Goodman)

Larry W. Burns, Burns Electric, Inc., TX [IM]
(Alt. to Robert A. Jones)

Thomas E. Dunne, Long Island Joint Apprenticeship & Training Committee, NY [L]
(Alt. to John L. Simmons)

Mitch Feininger, North Dakota State Electrical Board, ND [E]
(Alt. to Haywood Kines)

Andrew Hernandez, AstraZeneca Pharmaceuticals, DE [U]
(Alt. to William E. McBride)

Richard A. Holub, The DuPont Company, Inc., DE [U]
(Alt. to David B. Wechsler)

Paul T. Kelly, UL LLC, IL [RT]
(Alt. to Donald W. Ankele)

Edmund R. Leubner, Eaton's Crouse-Hinds Business, NY [M]
(Alt. to Steven J. Blais)

Arkady Levi, Exelon Power, MD [UT]
(Alt. to Harold G. Alexander)

Eddie Ramirez, FM Global, MA [I]
(Alt. to William G. Lawrence, Jr.)

Ted H. Schnaare, Rosemount Incorporated, MN [M]
(Alt. to L. Evans Massey)

Steven C. Trapp, Christenson Electric Inc., OR [IM]
(Alt. to Marc J. Bernsen)

Wesley Van Hill, Intertek Testing Services, AB [RT]
(Alt. to Ryan Parks)

Nonvoting

Michael E. Aaron, JENSEN HUGHES, IL [SE]
Rep. TC on Airport Facilities

Timothy J. Pope, Canadian Standards Association, Canada [RT]

Eduardo N. Solano, Estudio Ingeniero Solano S.A., Argentina [SE]

CODE-MAKING PANEL NO. 15

Articles 517, 518, 520, 522, 525, 530, 540

Lawrence E. Todd, *Chair*
Intertek Testing Services, KY [RT]

Chad E. Beebe, ASHE - AHA, WA [U]

David A. Dagenais, Wentworth-Douglass Hospital, NH [U]
Rep. NFPA Health Care Section

Matthew B. Dozier, IDesign Services, TN [U]
Rep. Institute of Electrical & Electronics Engineers, Inc.

Joe L. DuPriest, Orange County Public Schools, FL [E]
Rep. International Association of Electrical Inspectors

Kenneth J. Gilbert, Florida Power & Light Company, FL [UT]
Rep. Electric Light & Power Group/EEI

Mitchell K. Hefter, Philips Lighting, TX [IM]
Rep. Illuminating Engineering Society of North America
(VL to 518, 520, 525, 530, 540)

Kim Jones, Funtastic Shows, OR [U]
Rep. Outdoor Amusement Business Association, Inc.
(VL to 525)

Edwin S. Kramer, Radio City Music Hall, NY [L]
Rep. International Alliance of Theatrical Stage Employees
(VL to 518, 520, 525, 530, 540)

Gary J. Krupa, U.S. Department of Veterans Affairs, NE [U]

Stephen M. Lipster, The Electrical Trades Center, OH [L]
Rep. International Brotherhood of Electrical Workers

Hugh O. Nash, Jr., Nash-Consult, TN [SE]
Rep. TC on Electrical Systems

Kevin T. Porter, Encore Wire Corporation, TX [M]
Rep. The Aluminum Association, Inc.

Brian E. Rock, Hubbell Incorporated, CT [M]
Rep. National Electrical Manufacturers Association

James C. Seabury III, Enterprise Electric, LLC, TN [IM]
Rep. Independent Electrical Contractors, Inc.

Bruce D. Shelly, Shelly Electric Company, Inc., PA [IM]
Rep. National Electrical Contractors Association

Michael D. Skinner, CBS Studio Center, CA [U]
Rep. Alliance of Motion Picture and Television Producers
(VL to 518, 520, 525, 530, 540)

Donald J. Talka, UL LLC, NY [RT]

Kenneth E. Vannice, Portland, OR [M]
Rep. U.S. Institute for Theatre Technology, Inc.
(VL to 518, 520, 525, 530, 540)

Alternates

Gary A. Beckstrand, Utah Electrical JATC, UT [L]
(Alt. to Stephen M. Lipster)

David M. Campbell, AFC Cable Systems, Inc., MA [M]
(Alt. to Kevin T. Porter)

Carmon A. Colvin, Bright Future Electric, LLC, AL [IM]
(Alt. to James C. Seabury III)

Samuel B. Friedman, General Cable Corporation, RI [M]
(Alt. to Brian E. Rock)

Pamela Gwynn, UL LLC, NC [RT]
(Alt. to Donald J. Talka)

Don W. Jhonson, Interior Electric, Inc., FL [IM]
(Alt. to Bruce D. Shelly)

Jay Y. Kogoma, Intertek Testing Services, CA [RT]
(Alt. to Lawrence E. Todd)

Frank Novitzki, U.S. Department of Veterans Affairs, VA [U]
(Alt. to Gary J. Krupa)

Douglas Rheinheimer, Paramount Pictures, CA [U]
(VL to 518, 520, 525, 530, 540)
(Alt. to Michael D. Skinner)

Alan M. Rowe, International Alliance of Theatrical Stage Employees, CA [L]
(VL to 518, 520, 525, 530, 540)
(Alt. to Edwin S. Kramer)

Clinton Bret Stoddard, City of Rexburg, ID [E]
(Alt. to Joe L. DuPriest)

Steven R. Terry, Electronic Theatre Controls Inc., NY [M]
(VL to 518, 520, 525, 530, 540)
(Alt. to Kenneth E. Vannice)

R. Duane Wilson, George C. Izenour Associates, Inc., NM [IM]
(VL to 518, 520, 525, 530, 540)
(Alt. to Mitchell K. Hefter)

CODE-MAKING PANEL NO. 16

Articles 770, 800, 810, 820, 830, 840

Thomas E. Moore, *Chair*
City of Beachwood, OH [E]
Rep. International Association of Electrical Inspectors

George Bish, MasTec, NC [IM]
Rep. Satellite Broadcasting & Communications Association

James E. Brunssen, Telcordia Technologies (Ericsson), NJ [U]
Rep. Alliance for Telecommunications Industry Solutions

Fred C. Dawson, Chemours, Canada [U]
Rep. American Chemistry Council

Gerald Lee Dorna, Belden Wire & Cable Co., IN [M]
Rep. Insulated Cable Engineers Association Inc

Randolph J. Ivans, UL LLC, NY [RT]

Robert W. Jensen, dbi-Telecommunication Infrastructure Design, TX [M]
Rep. Building Industry Consulting Services International

Steven C. Johnson, Johnson Telecom, LLC, CA [UT]
Rep. National Cable & Telecommunications Association

William J. McCoy, Telco Sales, Inc., TX [U]
Rep. Institute of Electrical & Electronics Engineers, Inc.

Jack McNamara, Bosch Security Systems, NY [M]
Rep. National Electrical Manufacturers Association

Michael F. Murphy, Intertek Testing Services, MA [RT]

Harold C. Ohde, IBEW 134/Electrical Joint Apprenticeship Training & Trust, IL [L]
Rep. International Brotherhood of Electrical Workers

Thomas J. Parrish, Telgian Corporation, MI [M]
Rep. Automatic Fire Alarm Association, Inc.

W. Douglas Pirkle, Pirkle Electric Company, Inc., GA [IM]
Rep. National Electrical Contractors Association

Luigi G. Prezioso, M. C. Dean, Inc., VA [IM]
Rep. Independent Electrical Contractors, Inc.

Leo Zieman, Florida Power & Light (Nextera Energy), FL [UT]
Rep. Electric Light & Power Group/EEI

Alternates

Rendell K. Bourg, National Fire Protection Company Inc., HI [M]
(Alt. to Thomas J. Parrish)

Trevor N. Bowmer, Telcordia (Ericsson), NJ [U]
(Alt. to James E. Brunssen)

Larry Chan, City of New Orleans, LA [E]
(Alt. to Thomas E. Moore)

Terry C. Coleman, Electrical Training Alliance, TN [L]
(Alt. to Harold C. Ohde)

Timothy D. Cooke, Times Fiber Communications, Inc., VA [UT]
(Alt. to Steven C. Johnson)

John A. Kacperski, Tele Design Services, CA [M]
(Alt. to Robert W. Jensen)

Stanley Kaufman, CableSafe, Inc./OFS, GA [M]
(Alt. to Gerald Lee Dorna)

Eric Lawrence, Berk-Tek, A Nexans Company, PA [M]
(Voting Alt. to TIA rep)

David M. Lettkeman, Dish Network Service, LLC, CO [IM]
(Alt. to George Bish)

Rodger Reiswig, Tyco/SimplexGrinnell, FL [M]
(Alt. to Jack McNamara)

David B. Schrembeck, DBS Communications, Inc., OH [IM]
(Alt. to Luigi G. Prezioso)

Anthony Tassone, UL LLC, NY [RT]
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CODE-MAKING PANEL NO. 17

Articles 422, 424, 425, 426, 427, 680, 682

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CODE-MAKING PANEL NO. 18

Articles 393, 406, 411, 600, 605

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(VL to 600)

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CODE-MAKING PANEL NO. 19

Articles 545, 547, 550, 551, 552, 553, 555, 604, 675, and Annex D, Examples D11 and D12

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Committee Scope: This Committee shall have primary responsibility for documents on minimizing the risk of electricity as a source of electric shock and as a potential ignition source of fires and explosions. It shall also be responsible for text to minimize the propagation of fire and explosions due to electrical installations.

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NFPA 70

National Electrical Code

2017 Edition

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This 2017 edition includes the following usability features as aids to the user. Changes other than editorial are indicated with gray shading within sections. An entire figure caption with gray shading indicates a change to an existing figure. New sections, tables, and figures are indicated by a bold, italic ***N*** in a gray box to the left of the new material. An ***N*** next to an Article title indicates that the entire Article is new. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

ARTICLE 90
Introduction

90.1 Purpose.

(A) Practical Safeguarding. The purpose of this *Code* is the practical safeguarding of persons and property from hazards arising from the use of electricity. This *Code* is not intended as a design specification or an instruction manual for untrained persons.

(B) Adequacy. This *Code* contains provisions that are considered necessary for safety. Compliance therewith and proper maintenance result in an installation that is essentially free from hazard but not necessarily efficient, convenient, or adequate for good service or future expansion of electrical use.

Informational Note: Hazards often occur because of overloading of wiring systems by methods or usage not in conformity with this *Code*. This occurs because initial wiring did not provide for increases in the use of electricity. An initial adequate installation and reasonable provisions for system changes provide for future increases in the use of electricity.

(C) Relation to Other International Standards. The requirements in this *Code* address the fundamental principles of protection for safety contained in Section 131 of International Electrotechnical Commission Standard 60364-1, *Electrical Installations of Buildings*.

Informational Note: IEC 60364-1, Section 131, contains fundamental principles of protection for safety that encompass protection against electric shock, protection against thermal effects, protection against overcurrent, protection against fault currents, and protection against overvoltage. All of these potential hazards are addressed by the requirements in this *Code*.

90.2 Scope.

(A) Covered. This *Code* covers the installation and removal of electrical conductors, equipment, and raceways; signaling and communications conductors, equipment, and raceways; and optical fiber cables and raceways for the following:

(1) Public and private premises, including buildings, structures, mobile homes, recreational vehicles, and floating buildings
(2) Yards, lots, parking lots, carnivals, and industrial substations
(3) Installations of conductors and equipment that connect to the supply of electricity
(4) Installations used by the electric utility, such as office buildings, warehouses, garages, machine shops, and recreational buildings, that are not an integral part of a generating plant, substation, or control center

(B) Not Covered. This *Code* does not cover the following:

(1) Installations in ships, watercraft other than floating buildings, railway rolling stock, aircraft, or automotive vehicles other than mobile homes and recreational vehicles

Informational Note: Although the scope of this *Code* indicates that the *Code* does not cover installations in ships, portions of this *Code* are incorporated by reference into Title 46, Code of Federal Regulations, Parts 110–113.

(2) Installations underground in mines and self-propelled mobile surface mining machinery and its attendant electrical trailing cable
(3) Installations of railways for generation, transformation, transmission, energy storage, or distribution of power used exclusively for operation of rolling stock or installations used exclusively for signaling and communications purposes
(4) Installations of communications equipment under the exclusive control of communications utilities located outdoors or in building spaces used exclusively for such installations
(5) Installations under the exclusive control of an electric utility where such installations
    a. Consist of service drops or service laterals, and associated metering, or
    b. Are on property owned or leased by the electric utility for the purpose of communications, metering, generation, control, transformation, transmission, energy storage, or distribution of electric energy, or
    c. Are located in legally established easements or rights-of-way, or

d. Are located by other written agreements either designated by or recognized by public service commissions, utility commissions, or other regulatory agencies having jurisdiction for such installations. These written agreements shall be limited to installations for the purpose of communications, metering, generation, control, transformation, transmission, energy storage, or distribution of electric energy where legally established easements or rights-of-way cannot be obtained. These installations shall be limited to federal lands, Native American reservations through the U.S. Department of the Interior Bureau of Indian Affairs, military bases, lands controlled by port authorities and state agencies and departments, and lands owned by railroads.

Informational Note to (4) and (5): Examples of utilities may include those entities that are typically designated or recognized by governmental law or regulation by public service/utility commissions and that install, operate, and maintain electric supply (such as generation, transmission, or distribution systems) or communications systems (such as telephone, CATV, Internet, satellite, or data services). Utilities may be subject to compliance with codes and standards covering their regulated activities as adopted under governmental law or regulation. Additional information can be found through consultation with the appropriate governmental bodies, such as state regulatory commissions, the Federal Energy Regulatory Commission, and the Federal Communications Commission.

(C) Special Permission. The authority having jurisdiction for enforcing this *Code* may grant exception for the installation of conductors and equipment that are not under the exclusive control of the electric utilities and are used to connect the electric utility supply system to the service conductors of the premises served, provided such installations are outside a building or structure, or terminate inside at a readily accessible location nearest the point of entrance of the service conductors.

90.3 Code Arrangement. This *Code* is divided into the introduction and nine chapters, as shown in Figure 90.3. Chapters 1, 2, 3, and 4 apply generally. Chapters 5, 6, and 7 apply to special occupancies, special equipment, or other special conditions and may supplement or modify the requirements in Chapters 1 through 7 .

Chapter 8 covers communications systems and is not subject to the requirements of Chapters 1 through 7 except where the requirements are specifically referenced in Chapter 8.

Chapter 9 consists of tables that are applicable as referenced.

Informative annexes are not part of the requirements of this *Code* but are included for informational purposes only.

90.4 Enforcement. This *Code* is intended to be suitable for mandatory application by governmental bodies that exercise legal jurisdiction over electrical installations, including signaling and communications systems, and for use by insurance inspectors. The authority having jurisdiction for enforcement of the *Code* has the responsibility for making interpretations of the rules, for deciding on the approval of equipment and materials, and for granting the special permission contemplated in a number of the rules.

By special permission, the authority having jurisdiction may waive specific requirements in this *Code* or permit alternative methods where it is assured that equivalent objectives can be achieved by establishing and maintaining effective safety.

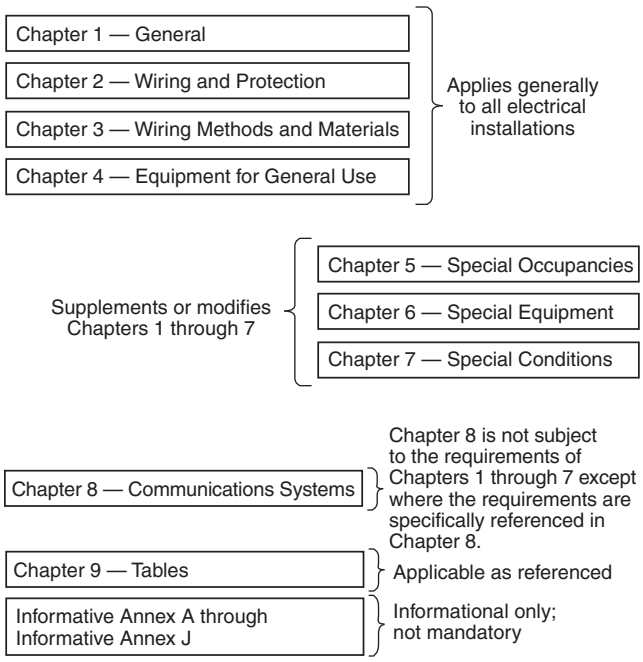

FIGURE 90.3 Code Arrangement.

This *Code* may require new products, constructions, or materials that may not yet be available at the time the *Code* is adopted. In such event, the authority having jurisdiction may permit the use of the products, constructions, or materials that comply with the most recent previous edition of this *Code* adopted by the jurisdiction.

90.5 Mandatory Rules, Permissive Rules, and Explanatory Material.

(A) Mandatory Rules. Mandatory rules of this *Code* are those that identify actions that are specifically required or prohibited and are characterized by the use of the terms *shall* or *shall not*.

(B) Permissive Rules. Permissive rules of this *Code* are those that identify actions that are allowed but not required, are normally used to describe options or alternative methods, and are characterized by the use of the terms *shall be permitted* or *shall not be required*.

(C) Explanatory Material. Explanatory material, such as references to other standards, references to related sections of this *Code,* or information related to a *Code* rule, is included in this *Code* in the form of informational notes. Such notes are informational only and are not enforceable as requirements of this *Code*.

Brackets containing section references to another NFPA document are for informational purposes only and are provided as a guide to indicate the source of the extracted text. These bracketed references immediately follow the extracted text.

Informational Note: The format and language used in this *Code* follows guidelines established by NFPA and published in the *NEC Style Manual*. Copies of this manual can be obtained from NFPA.

(D) Informative Annexes. Nonmandatory information relative to the use of the *NEC* is provided in informative annexes.

Informative annexes are not part of the enforceable requirements of the *NEC*, but are included for information purposes only.

90.6 Formal Interpretations. To promote uniformity of interpretation and application of the provisions of this *Code*, formal interpretation procedures have been established and are found in the NFPA Regulations Governing Committee Projects.

90.7 Examination of Equipment for Safety. For specific items of equipment and materials referred to in this *Code*, examinations for safety made under standard conditions provide a basis for approval where the record is made generally available through promulgation by organizations properly equipped and qualified for experimental testing, inspections of the run of goods at factories, and service-value determination through field inspections. This avoids the necessity for repetition of examinations by different examiners, frequently with inadequate facilities for such work, and the confusion that would result from conflicting reports on the suitability of devices and materials examined for a given purpose.

It is the intent of this *Code* that factory-installed internal wiring or the construction of equipment need not be inspected at the time of installation of the equipment, except to detect alterations or damage, if the equipment has been listed by a qualified electrical testing laboratory that is recognized as having the facilities described in the preceding paragraph and that requires suitability for installation in accordance with this *Code*. Suitability shall be determined by application of requirements that are compatible with this *Code*.

Informational Note No. 1: See requirements in 110.3.

Informational Note No. 2: *Listed* is defined in Article 100.

Informational Note No. 3: Informative Annex A contains a list of product safety standards that are compatible with this *Code*.

90.8 Wiring Planning.

(A) Future Expansion and Convenience. Plans and specifications that provide ample space in raceways, spare raceways, and additional spaces allow for future increases in electric power and communications circuits. Distribution centers located in readily accessible locations provide convenience and safety of operation.

(B) Number of Circuits in Enclosures. It is elsewhere provided in this *Code* that the number of circuits confined in a single enclosure be varyingly restricted. Limiting the number of circuits in a single enclosure minimizes the effects from a short circuit or ground fault.

90.9 Units of Measurement.

(A) Measurement System of Preference. For the purpose of this *Code*, metric units of measurement are in accordance with the modernized metric system known as the International System of Units (SI).

(B) Dual System of Units. SI units shall appear first, and inch-pound units shall immediately follow in parentheses. Conversion from inch-pound units to SI units shall be based on hard conversion except as provided in 90.9(C).

(C) Permitted Uses of Soft Conversion. The cases given in 90.9(C)(1) through (C)(4) shall not be required to use hard conversion and shall be permitted to use soft conversion.

(1) Trade Sizes. Where the actual measured size of a product is not the same as the nominal size, trade size designators shall be used rather than dimensions. Trade practices shall be followed in all cases.

(2) Extracted Material. Where material is extracted from another standard, the context of the original material shall not be compromised or violated. Any editing of the extracted text shall be confined to making the style consistent with that of the *NEC*.

(3) Industry Practice. Where industry practice is to express units in inch-pound units, the inclusion of SI units shall not be required.

(4) Safety. Where a negative impact on safety would result, soft conversion shall be used.

(D) Compliance. Conversion from inch-pound units to SI units shall be permitted to be an approximate conversion. Compliance with the numbers shown in either the SI system or the inch-pound system shall constitute compliance with this *Code*.

Informational Note No. 1: Hard conversion is considered a change in dimensions or properties of an item into new sizes that might or might not be interchangeable with the sizes used in the original measurement. Soft conversion is considered a direct mathematical conversion and involves a change in the description of an existing measurement but not in the actual dimension.

Informational Note No. 2: SI conversions are based on IEEE/ASTM SI 10-1997, *Standard for the Use of the International System of Units (SI): The Modern Metric System.*

Chapter 1 General

ARTICLE 100 Definitions

Scope. This article contains only those definitions essential to the application of this *Code*. It is not intended to include commonly defined general terms or commonly defined technical terms from related codes and standards. In general, only those terms that are used in two or more articles are defined in Article 100. Other definitions are included in the article in which they are used but may be referenced in Article 100.

Part I of this article contains definitions intended to apply wherever the terms are used throughout this *Code*. Part II contains definitions applicable to installations and equipment operating at over 1000 volts, nominal.

Part I. General

Accessible (as applied to equipment). Admitting close approach; not guarded by locked doors, elevation, or other effective means. (CMP-1)

Accessible (as applied to wiring methods). Capable of being removed or exposed without damaging the building structure or finish or not permanently closed in by the structure or finish of the building. (CMP-1)

Accessible, Readily (Readily Accessible). Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to take actions such as to use tools (other than keys), to climb over or under, to remove obstacles, or to resort to portable ladders, and so forth. (CMP-1)

Informational Note: Use of keys is a common practice under controlled or supervised conditions and a common alternative to the ready access requirements under such supervised conditions as provided elsewhere in the NEC.

Adjustable Speed Drive. Power conversion equipment that provides a means of adjusting the speed of an electric motor. (CMP-11)

Informational Note: A variable frequency drive is one type of electronic adjustable speed drive that controls the rotational speed of an ac electric motor by controlling the frequency and voltage of the electrical power supplied to the motor.

Adjustable Speed Drive System. A combination of an adjustable speed drive, its associated motor(s), and auxiliary equipment. (CMP-11)

Ampacity. The maximum current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating. (CMP-6)

Appliance. Utilization equipment, generally other than industrial, that is normally built in standardized sizes or types and is installed or connected as a unit to perform one or more functions such as clothes washing, air-conditioning, food mixing, deep frying, and so forth. (CMP-17)

Approved. Acceptable to the authority having jurisdiction. (CMP-1)

Arc-Fault Circuit Interrupter (AFCI). A device intended to provide protection from the effects of arc faults by recognizing characteristics unique to arcing and by functioning to de-energize the circuit when an arc fault is detected. (CMP-2)

Askarel. A generic term for a group of nonflammable synthetic chlorinated hydrocarbons used as electrical insulating media. (CMP-9)

Informational Note: Askarels of various compositional types are used. Under arcing conditions, the gases produced, while consisting predominantly of noncombustible hydrogen chloride, can include varying amounts of combustible gases, depending on the askarel type.

Associated Apparatus [as applied to Hazardous (Classified) Locations]. Apparatus in which the circuits are not necessarily intrinsically safe themselves but that affects the energy in the intrinsically safe circuits and is relied on to maintain intrinsic safety. Such apparatus is one of the following:

(1) Electrical apparatus that has an alternative type of protection for use in the appropriate hazardous (classified) location
(2) Electrical apparatus not so protected that shall not be used within a hazardous (classified) location

(CMP-14)

Informational Note No. 1: Associated apparatus has identified intrinsically safe connections for intrinsically safe apparatus and also may have connections for nonintrinsically safe apparatus.

Informational Note No. 2: An example of associated apparatus is an intrinsic safety barrier, which is a network designed to limit the energy (voltage and current) available to the protected circuit in the hazardous (classified) location, under specified fault conditions.

Associated Nonincendive Field Wiring Apparatus [as applied to Hazardous (Classified) Locations]. Apparatus in which the circuits are not necessarily nonincendive themselves but that affect the energy in nonincendive field wiring circuits and are relied upon to maintain nonincendive energy levels. Such apparatus are one of the following:

(1) Electrical apparatus that has an alternative type of protection for use in the appropriate hazardous (classified) location
(2) Electrical apparatus not so protected that shall not be used in a hazardous (classified) location

(CMP-14)

Informational Note: Associated nonincendive field wiring apparatus has designated associated nonincendive field wiring apparatus connections for nonincendive field wiring apparatus and may also have connections for other electrical apparatus.

Attachment Plug (Plug Cap) (Plug). A device that, by insertion in a receptacle, establishes a connection between the conductors of the attached flexible cord and the conductors connected permanently to the receptacle. (CMP-18)

Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a

code or standard, or for approving equipment, materials, an installation, or a procedure. (CMP-1)

Informational Note: The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

Automatic. Performing a function without the necessity of human intervention. (CMP-1)

Bathroom. An area including a basin with one or more of the following: a toilet, a urinal, a tub, a shower, a bidet, or similar plumbing fixtures. (CMP-2)

Battery System. Interconnected battery subsystems consisting of one or more storage batteries and battery chargers, and can include inverters, converters, and associated electrical equipment. (CMP-13)

Bonded (Bonding). Connected to establish electrical continuity and conductivity. (CMP-5)

Bonding Conductor or Jumper. A reliable conductor to ensure the required electrical conductivity between metal parts required to be electrically connected. (CMP-5)

Bonding Jumper, Equipment. The connection between two or more portions of the equipment grounding conductor. (CMP-5)

Bonding Jumper, Main. The connection between the grounded circuit conductor and the equipment grounding conductor at the service. (CMP-5)

Bonding Jumper, System. The connection between the grounded circuit conductor and the supply-side bonding jumper, or the equipment grounding conductor, or both, at a separately derived system. (CMP-5)

Branch Circuit. The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s). (CMP-2)

Branch Circuit, Appliance. A branch circuit that supplies energy to one or more outlets to which appliances are to be connected and that has no permanently connected luminaires that are not a part of an appliance. (CMP-2)

Branch Circuit, General-Purpose. A branch circuit that supplies two or more receptacles or outlets for lighting and appliances. (CMP-2)

Branch Circuit, Individual. A branch circuit that supplies only one utilization equipment. (CMP-2)

Branch Circuit, Multiwire. A branch circuit that consists of two or more ungrounded conductors that have a voltage between them, and a grounded conductor that has equal voltage between it and each ungrounded conductor of the circuit and that is connected to the neutral or grounded conductor of the system. (CMP-2)

Building. A structure that stands alone or that is separated from adjoining structures by fire walls. (CMP-1)

Cabinet. An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung. (CMP-9)

Cable Routing Assembly. A single channel or connected multiple channels, as well as associated fittings, forming a structural system that is used to support and route communications wires and cables, optical fiber cables, data cables associated with information technology and communications equipment, Class 2, Class 3, and Type PLTC cables, and power-limited fire alarm cables in plenum, riser, and general-purpose applications. (CMP-16)

Charge Controller. Equipment that controls dc voltage or dc current, or both, and that is used to charge a battery or other energy storage device. (CMP-13)

Circuit Breaker. A device designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating. (CMP-10)

Informational Note: The automatic opening means can be integral, direct acting with the circuit breaker, or remote from the circuit breaker.

Adjustable (as applied to circuit breakers). A qualifying term indicating that the circuit breaker can be set to trip at various values of current, time, or both, within a predetermined range.

Instantaneous Trip (as applied to circuit breakers). A qualifying term indicating that no delay is purposely introduced in the tripping action of the circuit breaker.

Inverse Time (as applied to circuit breakers). A qualifying term indicating that there is purposely introduced a delay in the tripping action of the circuit breaker, which delay decreases as the magnitude of the current increases.

Nonadjustable (as applied to circuit breakers). A qualifying term indicating that the circuit breaker does not have any adjustment to alter the value of the current at which it will trip or the time required for its operation.

Setting (of circuit breakers). The value of current, time, or both, at which an adjustable circuit breaker is set to trip.

Clothes Closet. A nonhabitable room or space intended primarily for storage of garments and apparel. (CMP-1)

Coaxial Cable. A cylindrical assembly composed of a conductor centered inside a metallic tube or shield, separated by a dielectric material, and usually covered by an insulating jacket. (CMP-16)

Combustible Dust [as applied to Hazardous (Classified) Locations]. Dust particles that are 500 microns or smaller (i.e., material passing a U.S. No. 35 Standard Sieve as defined in ASTM E11-2015, *Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves*), and present a fire or explosion hazard when dispersed and ignited in air. (CMP-14)

Informational Note: See ASTM E1226-2012a, *Standard Test Method for Explosibility of Dust Clouds*, or ISO 6184-1, *Explosion*

protection systems — Part 1: Determination of explosion indices of combustible dusts in air, for procedures for determining the explosibility of dusts.

Combustible Gas Detection System [as applied to Hazardous (Classified) Locations]. A protection technique utilizing stationary gas detectors in industrial establishments. (CMP-14)

Communications Equipment. The electronic equipment that performs the telecommunications operations for the transmission of audio, video, and data, and includes power equipment (e.g., dc converters, inverters, and batteries), technical support equipment (e.g., computers), and conductors dedicated solely to the operation of the equipment. (CMP-16)

Informational Note: As the telecommunications network transitions to a more data-centric network, computers, routers, servers, and their powering equipment, are becoming essential to the transmission of audio, video, and data and are finding increasing application in communications equipment installations.

Communications Raceway. An enclosed channel of nonmetallic materials designed expressly for holding communications wires and cables; optical fiber cables; data cables associated with information technology and communications equipment; Class 2, Class 3, and Type PLTC cables; and power-limited fire alarm cables in plenum, riser, and general-purpose applications. (CMP-16)

Composite Optical Fiber Cable. A cable containing optical fibers and current-carrying electrical conductors. (CMP-16)

Concealed. Rendered inaccessible by the structure or finish of the building. (CMP-1)

Informational Note: Wires in concealed raceways are considered concealed, even though they may become accessible by withdrawing them.

Conductive Optical Fiber Cable. A factory assembly of one or more optical fibers having an overall covering and containing non–current-carrying conductive member(s) such as metallic strength member(s), metallic vapor barrier(s), metallic armor or metallic sheath. (CMP-16)

Conductor, Bare. A conductor having no covering or electrical insulation whatsoever. (CMP-6)

Conductor, Covered. A conductor encased within material of composition or thickness that is not recognized by this *Code* as electrical insulation. (CMP-6)

Conductor, Insulated. A conductor encased within material of composition and thickness that is recognized by this *Code* as electrical insulation. (CMP-6)

Conduit Body. A separate portion of a conduit or tubing system that provides access through a removable cover(s) to the interior of the system at a junction of two or more sections of the system or at a terminal point of the system.

Boxes such as FS and FD or larger cast or sheet metal boxes are not classified as conduit bodies. (CMP-9)

Connector, Pressure (Solderless). A device that establishes a connection between two or more conductors or between one or more conductors and a terminal by means of mechanical pressure and without the use of solder. (CMP-1)

Continuous Load. A load where the maximum current is expected to continue for 3 hours or more. (CMP-2)

Control Circuit. The circuit of a control apparatus or system that carries the electric signals directing the performance of the controller but does not carry the main power current. (CMP-11)

Control Drawing [as applied to Hazardous (Classified) Locations]. A drawing or other document provided by the manufacturer of the intrinsically safe or associated apparatus, or of the nonincendive field wiring apparatus or associated nonincendive field wiring apparatus, that details the allowed interconnections between the intrinsically safe and associated apparatus or between the nonincendive field wiring apparatus or associated nonincendive field wiring apparatus. (CMP-14)

Controller. A device or group of devices that serves to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected. (CMP-1)

Cooking Unit, Counter-Mounted. A cooking appliance designed for mounting in or on a counter and consisting of one or more heating elements, internal wiring, and built-in or mountable controls. (CMP-2)

Coordination, Selective (Selective Coordination). Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the selection and installation of overcurrent protective devices and their ratings or settings for the full range of available overcurrents, from overload to the maximum available fault current, and for the full range of overcurrent protective device opening times associated with those overcurrents. (CMP-10)

Copper-Clad Aluminum Conductors. Conductors drawn from a copper-clad aluminum rod, with the copper metallurgically bonded to an aluminum core, where the copper forms a minimum of 10 percent of the cross-sectional area of a solid conductor or each strand of a stranded conductor. (CMP-6)

N **Cord Connector [as applied to Hazardous (Classified) Locations].** A fitting intended to terminate a cord to a box or similar device and reduce the strain at points of termination and may include an explosionproof, a dust-ignitionproof, or a flameproof seal. (CMP-14)

Cutout Box. An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure. (CMP-9)

Dead Front. Without live parts exposed to a person on the operating side of the equipment. (CMP-9)

Demand Factor. The ratio of the maximum demand of a system, or part of a system, to the total connected load of a system or the part of the system under consideration. (CMP-2)

Device. A unit of an electrical system, other than a conductor, that carries or controls electric energy as its principal function. (CMP-1)

Disconnecting Means. A device, or group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply. (CMP-1)

Dust-Ignitionproof [as applied to Hazardous (Classified) Locations]. Equipment enclosed in a manner that excludes dusts and does not permit arcs, sparks, or heat otherwise generated or liberated inside of the enclosure to cause ignition of exterior accumulations or atmospheric suspensions of a specified dust on or in the vicinity of the enclosure. (CMP-14)

Informational Note: For further information on dust-ignitionproof enclosures, see ANSI/UL 1202-2013, *Enclosures for Electrical Equipment,* and ANSI/UL 1203-2013, *Explosionproof and Dust-Ignitionproof Electrical Equipment for Hazardous (Classified) Locations.*

Dusttight. Enclosures constructed so that dust will not enter under specified test conditions. (CMP-14)

Informational Note No. 1: Enclosure Types 3, 3S, 3SX, 4, 4X, 5, 6, 6P, 12, 12K, and 13, per ANSI/NEMA 250-2014, *Enclosures for Electrical Equipment,* are considered dusttight and suitable for use in unclassified locations and in Class II, Division 2; Class III; and Zone 22 hazardous (classified) locations.

Informational Note No. 2: For further information, see ANSI/ISA-12.12.01-2013, *Nonincendive Electrical Equipment for Use in Class I and II, Division 2, and Class III, Divisions 1 and 2 Hazardous (Classified) Locations.*

Duty, Continuous. Operation at a substantially constant load for an indefinitely long time. (CMP-1)

Duty, Intermittent. Operation for alternate intervals of (1) load and no load; or (2) load and rest; or (3) load, no load, and rest. (CMP-1)

Duty, Periodic. Intermittent operation in which the load conditions are regularly recurrent. (CMP-1)

Duty, Short-Time. Operation at a substantially constant load for a short and definite, specified time. (CMP-1)

Duty, Varying. Operation at loads, and for intervals of time, both of which may be subject to wide variation. (CMP-1)

Dwelling, One-Family. A building that consists solely of one dwelling unit. (CMP-1)

Dwelling, Two-Family. A building that consists solely of two dwelling units. (CMP-1)

Dwelling, Multifamily. A building that contains three or more dwelling units. (CMP-1)

Dwelling Unit. A single unit, providing complete and independent living facilities for one or more persons, including permanent provisions for living, sleeping, cooking, and sanitation. (CMP-2)

Effective Ground-Fault Current Path. An intentionally constructed, low-impedance electrically conductive path designed and intended to carry current under ground-fault conditions from the point of a ground fault on a wiring system to the electrical supply source and that facilitates the operation of the overcurrent protective device or ground-fault detectors. (CMP-5)

Electric Power Production and Distribution Network. Power production, distribution, and utilization equipment and facilities, such as electric utility systems that deliver electric power to the connected loads, that are external to and not controlled by an interactive system. (CMP-13)

Electric Sign. A fixed, stationary, or portable self-contained, electrically operated and/or electrically illuminated utilization equipment with words or symbols designed to convey information or attract attention. (CMP-18)

Electric-Discharge Lighting. Systems of illumination utilizing fluorescent lamps, high-intensity discharge (HID) lamps, or neon tubing. (CMP-18)

Electrical Circuit Protective System A system consisting of components and materials intended for installation as protection for specific electrical wiring systems with respect to the disruption of electrical circuit integrity upon exterior fire exposure. (CMP-16)

Electronically Actuated Fuse. An overcurrent protective device that generally consists of a control module that provides current-sensing, electronically derived time–current characteristics, energy to initiate tripping, and an interrupting module that interrupts current when an overcurrent occurs. Such fuses may or may not operate in a current-limiting fashion, depending on the type of control selected. (CMP-10)

Enclosed. Surrounded by a case, housing, fence, or wall(s) that prevents persons from accidentally contacting energized parts. (CMP-1)

Enclosure. The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. (CMP-1)

Informational Note: See Table 110.28 for examples of enclosure types.

Energized. Electrically connected to, or is, a source of voltage. (CMP-1)

Equipment. A general term, including fittings, devices, appliances, luminaires, apparatus, machinery, and the like used as a part of, or in connection with, an electrical installation. (CMP-1)

Explosionproof Equipment. Equipment enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor that may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and that operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby. (CMP-14)

Informational Note: For further information, see ANSI/UL 1203-2009, *Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.*

Exposed (as applied to live parts). Capable of being inadvertently touched or approached nearer than a safe distance by a person. (CMP-1)

Informational Note: This term applies to parts that are not suitably guarded, isolated, or insulated.

Exposed (as applied to wiring methods). On or attached to the surface or behind panels designed to allow access. (CMP-1)

Externally Operable. Capable of being operated without exposing the operator to contact with live parts. (CMP-1)

Feeder. All circuit conductors between the service equipment, the source of a separately derived system, or other power supply source and the final branch-circuit overcurrent device. (CMP-2)

Festoon Lighting. A string of outdoor lights that is suspended between two points. (CMP-18)

N **Field Evaluation Body (FEB).** An organization or part of an organization that performs field evaluations of electrical or other equipment. [**790,** 2012] (CMP-1)

N **Field Labeled (as applied to evaluated products).** Equipment or materials to which has been attached a label, symbol, or other identifying mark of an FEB indicating the equipment or materials were evaluated and found to comply with requirements as described in an accompanying field evaluation report. (CMP-1)

Fitting. An accessory such as a locknut, bushing, or other part of a wiring system that is intended primarily to perform a mechanical rather than an electrical function. (CMP-1)

Garage. A building or portion of a building in which one or more self-propelled vehicles can be kept for use, sale, storage, rental, repair, exhibition, or demonstration purposes. (CMP-1)

Informational Note: For commercial garages, repair and storage, see Article 511.

Ground. The earth. (CMP-5)

Ground Fault. An unintentional, electrically conductive connection between an ungrounded conductor of an electrical circuit and the normally non–current-carrying conductors, metallic enclosures, metallic raceways, metallic equipment, or earth. (CMP-5)

Grounded (Grounding). Connected (connecting) to ground or to a conductive body that extends the ground connection. (CMP-5)

Grounded, Solidly. Connected to ground without inserting any resistor or impedance device. (CMP-5)

Grounded Conductor. A system or circuit conductor that is intentionally grounded. (CMP-5)

Ground-Fault Circuit Interrupter (GFCI). A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class A device. (CMP-2)

Informational Note: Class A ground-fault circuit interrupters trip when the current to ground is 6 mA or higher and do not trip when the current to ground is less than 4 mA. For further information, see UL 943, *Standard for Ground-Fault Circuit Interrupters*.

Ground-Fault Current Path. An electrically conductive path from the point of a ground fault on a wiring system through normally non–current-carrying conductors, equipment, or the earth to the electrical supply source. (CMP-5)

Informational Note: Examples of ground-fault current paths are any combination of equipment grounding conductors, metallic raceways, metallic cable sheaths, electrical equipment, and any other electrically conductive material such as metal, water, and gas piping; steel framing members; stucco mesh; metal ducting; reinforcing steel; shields of communications cables; and the earth itself.

Ground-Fault Protection of Equipment. A system intended to provide protection of equipment from damaging line-to-ground fault currents by operating to cause a disconnecting means to open all ungrounded conductors of the faulted circuit. This protection is provided at current levels less than those required to protect conductors from damage through the operation of a supply circuit overcurrent device. (CMP-5)

Grounding Conductor, Equipment (EGC). The conductive path(s) that provides a ground-fault current path and connects normally non–current-carrying metal parts of equipment together and to the system grounded conductor or to the grounding electrode conductor, or both. (CMP-5)

Informational Note No. 1: It is recognized that the equipment grounding conductor also performs bonding.

Informational Note No. 2: See 250.118 for a list of acceptable equipment grounding conductors.

Grounding Electrode. A conducting object through which a direct connection to earth is established. (CMP-5)

Grounding Electrode Conductor. A conductor used to connect the system grounded conductor or the equipment to a grounding electrode or to a point on the grounding electrode system. (CMP-5)

Guarded. Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach or contact by persons or objects to a point of danger. (CMP-1)

Guest Room. An accommodation combining living, sleeping, sanitary, and storage facilities within a compartment. (CMP-2)

Guest Suite. An accommodation with two or more contiguous rooms comprising a compartment, with or without doors between such rooms, that provides living, sleeping, sanitary, and storage facilities. (CMP-2)

Handhole Enclosure. An enclosure for use in underground systems, provided with an open or closed bottom, and sized to allow personnel to reach into, but not enter, for the purpose of installing, operating, or maintaining equipment or wiring or both. (CMP-9)

Hermetic Refrigerant Motor-Compressor. A combination consisting of a compressor and motor, both of which are enclosed in the same housing, with no external shaft or shaft seals, with the motor operating in the refrigerant. (CMP-11)

Hermetically Sealed [as applied to Hazardous (Classified) Locations]. Equipment sealed against the entrance of an external atmosphere where the seal is made by fusion, for example, soldering, brazing, welding, or the fusion of glass to metal. (CMP-14)

Informational Note: For further information, see ANSI/ISA-12.12.01-2013, *Nonincendive Electrical Equipment for Use in Class I and II, Division 2, and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*.

Hoistway. Any shaftway, hatchway, well hole, or other vertical opening or space in which an elevator or dumbwaiter is designed to operate. (CMP-12)

Hybrid System. A system comprised of multiple power sources. These power sources could include photovoltaic, wind, microhydro generators, engine-driven generators, and others, but do not include electric power production and distribution network systems. Energy storage systems such as batteries, flywheels, or superconducting magnetic storage equipment do not constitute a power source for the purpose of this definition. The energy regenerated by an overhauling (descending) elevator does not constitute a power source for the purpose of this definition. (CMP-4)

Identified (as applied to equipment). Recognizable as suitable for the specific purpose, function, use, environment, applica-

tion, and so forth, where described in a particular *Code* requirement. (CMP-1)

Informational Note: Some examples of ways to determine suitability of equipment for a specific purpose, environment, or application include investigations by a qualified testing laboratory (listing and labeling), an inspection agency, or other organizations concerned with product evaluation.

In Sight From (Within Sight From, Within Sight). Where this *Code* specifies that one equipment shall be "in sight from," "within sight from," or "within sight of," and so forth, another equipment, the specified equipment is to be visible and not more than 15 m (50 ft) distant from the other. (CMP-1)

Industrial Control Panel. An assembly of two or more components consisting of one of the following: (1) power circuit components only, such as motor controllers, overload relays, fused disconnect switches, and circuit breakers; (2) control circuit components only, such as push buttons, pilot lights, selector switches, timers, switches, and control relays; (3) a combination of power and control circuit components. These components, with associated wiring and terminals, are mounted on, or contained within, an enclosure or mounted on a subpanel.

The industrial control panel does not include the controlled equipment. (CMP-11)

Information Technology Equipment (ITE). Equipment and systems rated 1000 volts or less, normally found in offices or other business establishments and similar environments classified as ordinary locations, that are used for creation and manipulation of data, voice, video, and similar signals that are not communications equipment as defined in Part I of Article 100 and do not process communications circuits as defined in 800.2. (CMP-12)

Informational Note: For information on listing requirements for both information technology equipment and communications equipment, see UL 60950-1-2014, *Information Technology Equipment — Safety — Part 1: General Requirements* or UL 62368-1-2014, *Audio/Video Information and Communication Technology Equipment Part 1: Safety Requirements.*

Innerduct. A nonmetallic raceway placed within a larger raceway. (CMP-16)

Interactive Inverter. An inverter intended for use in parallel with an electric utility to supply common loads that may deliver power to the utility. (CMP-13)

Interactive System. An electric power production system that is operating in parallel with and capable of delivering energy to an electric primary source supply system. (CMP-4)

Interrupting Rating. The highest current at rated voltage that a device is identified to interrupt under standard test conditions. (CMP-10)

Informational Note: Equipment intended to interrupt current at other than fault levels may have its interrupting rating implied in other ratings, such as horsepower or locked rotor current.

Intersystem Bonding Termination. A device that provides a means for connecting intersystem bonding conductors for communications systems to the grounding electrode system. (CMP-16)

Intrinsically Safe Apparatus. Apparatus in which all the circuits are intrinsically safe. (CMP-14)

Intrinsically Safe System [as applied to Hazardous (Classified) Locations]. An assembly of interconnected intrinsically safe apparatus, associated apparatus, and interconnecting cables, in that those parts of the system that may be used in hazardous (classified) locations are intrinsically safe circuits. (CMP-14)

Informational Note: An intrinsically safe system may include more than one intrinsically safe circuit.

Isolated (as applied to location). Not readily accessible to persons unless special means for access are used. (CMP-1)

Kitchen. An area with a sink and permanent provisions for food preparation and cooking. (CMP-2)

Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner. (CMP-1)

Lighting Outlet. An outlet intended for the direct connection of a lampholder or luminaire. (CMP-18)

Lighting Track (Track Lighting). A manufactured assembly designed to support and energize luminaires that are capable of being readily repositioned on the track. Its length can be altered by the addition or subtraction of sections of track. (CMP-18)

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. (CMP-1)

Informational Note: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. Use of the system employed by the listing organization allows the authority having jurisdiction to identify a listed product.

Live Parts. Energized conductive components. (CMP-1)

Location, Damp. Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture. (CMP-1)

Informational Note: Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold-storage warehouses.

Location, Dry. A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction. (CMP-1)

Location, Wet. Installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather. (CMP-1)

Luminaire. A complete lighting unit consisting of a light source such as a lamp or lamps, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light. A lampholder itself is not a luminaire. (CMP-18)

Mobile Equipment. Equipment with electrical components suitable to be moved only with mechanical aids or is provided with wheels for movement by person(s) or powered devices. (CMP-14)

Motor Control Center. An assembly of one or more enclosed sections having a common power bus and principally containing motor control units. (CMP-11)

Multioutlet Assembly. A type of surface, flush, or freestanding raceway designed to hold conductors and receptacles, assembled in the field or at the factory. (CMP-18)

Neutral Conductor. The conductor connected to the neutral point of a system that is intended to carry current under normal conditions. (CMP-5)

Neutral Point. The common point on a wye-connection in a polyphase system or midpoint on a single-phase, 3-wire system, or midpoint of a single-phase portion of a 3-phase delta system, or a midpoint of a 3-wire, direct-current system. (CMP-5)

Informational Note: At the neutral point of the system, the vectorial sum of the nominal voltages from all other phases within the system that utilize the neutral, with respect to the neutral point, is zero potential.

Nonautomatic. Requiring human intervention to perform a function. (CMP-1)

Nonconductive Optical Fiber Cable. A factory assembly of one or more optical fibers having an overall covering and containing no electrically conductive materials. (CMP-16)

Nonincendive Circuit [as applied to Hazardous (Classified) Locations]. A circuit, other than field wiring, in which any arc or thermal effect produced under intended operating conditions of the equipment, is not capable, under specified test conditions, of igniting the flammable gas–air, vapor–air, or dust–air mixture. (CMP-14)

Informational Note: Conditions are described in ANSI/ISA-12.12.01-2013, *Nonincendive Electrical Equipment for Use in Class I and II, Division 2, and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*.

Nonincendive Component [as applied to Hazardous (Classified) Locations]. A component having contacts for making or breaking an incendive circuit and the contacting mechanism is constructed so that the component is incapable of igniting the specified flammable gas–air or vapor–air mixture. The housing of a nonincendive component is not intended to exclude the flammable atmosphere or contain an explosion. (CMP-14)

Informational Note: For further information, see ANSI/ISA-12.12.01-2013, *Nonincendive Electrical Equipment for Use in Class I and II, Division 2, and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*.

Nonincendive Equipment [as applied to Hazardous (Classified) Locations]. Equipment having electrical/electronic circuitry that is incapable, under normal operating conditions, of causing ignition of a specified flammable gas–air, vapor–air, or dust–air mixture due to arcing or thermal means. (CMP-14)

Informational Note: For further information, see ANSI/ISA-12.12.01-2013, *Nonincendive Electrical Equipment for Use in Class I and II, Division 2, and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*.

Nonincendive Field Wiring [as applied to Hazardous (Classified) Locations]. Wiring that enters or leaves an equipment enclosure and, under normal operating conditions of the equipment, is not capable, due to arcing or thermal effects, of igniting the flammable gas–air, vapor–air, or dust–air mixture. Normal operation includes opening, shorting, or grounding the field wiring. (CMP-14)

Nonincendive Field Wiring Apparatus [as applied to Hazardous (Classified) Locations]. Apparatus intended to be connected to nonincendive field wiring. (CMP-14)

Informational Note: For further information, see ANSI/ISA-12.12.01-2013, *Nonincendive Electrical Equipment for Use in Class I and II, Division 2, and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*.

Nonlinear Load. A load where the wave shape of the steady-state current does not follow the wave shape of the applied voltage. (CMP-1)

Informational Note: Electronic equipment, electronic/electric-discharge lighting, adjustable-speed drive systems, and similar equipment may be nonlinear loads.

Oil Immersion [as applied to Hazardous (Classified) Locations]. Electrical equipment immersed in a protective liquid in such a way that an explosive atmosphere that may be above the liquid or outside the enclosure cannot be ignited. (CMP-14)

Optical Fiber Cable. A factory assembly or field assembly of one or more optical fibers having an overall covering. (CMP-16)

Informational Note: A field-assembled optical fiber cable is an assembly of one or more optical fibers within a jacket. The jacket, without optical fibers, is installed in a manner similar to conduit or raceway. Once the jacket is installed, the optical fibers are inserted into the jacket, completing the cable assembly.

Outlet. A point on the wiring system at which current is taken to supply utilization equipment. (CMP-1)

Outline Lighting. An arrangement of incandescent lamps, electric-discharge lighting, or other electrically powered light sources to outline or call attention to certain features such as the shape of a building or the decoration of a window. (CMP-18)

Overcurrent. Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault. (CMP-10)

Informational Note: A current in excess of rating may be accommodated by certain equipment and conductors for a given set of conditions. Therefore, the rules for overcurrent protection are specific for particular situations.

Overcurrent Protective Device, Branch-Circuit. A device capable of providing protection for service, feeder, and branch circuits and equipment over the full range of overcurrents between its rated current and its interrupting rating. Such devices are provided with interrupting ratings appropriate for the intended use but no less than 5000 amperes. (CMP-10)

Overcurrent Protective Device, Supplementary. A device intended to provide limited overcurrent protection for specific applications and utilization equipment such as luminaires and appliances. This limited protection is in addition to the protection provided in the required branch circuit by the branch-circuit overcurrent protective device. (CMP-10)

Overload. Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload. (CMP-10)

Panelboard. A single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front. (CMP-9)

Photovoltaic (PV) System. The total components and subsystem that, in combination, convert solar energy into electric energy for connection to a utilization load. (CMP-4)

Plenum. A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system. (CMP-3)

Portable Equipment. Equipment with electrical components suitable to be moved by a single person without mechanical aids. (CMP-14)

Power Outlet. An enclosed assembly that may include receptacles, circuit breakers, fuseholders, fused switches, buses, and watt-hour meter mounting means; intended to supply and control power to mobile homes, recreational vehicles, park trailers, or boats or to serve as a means for distributing power required to operate mobile or temporarily installed equipment. (CMP-19)

Premises Wiring (System). Interior and exterior wiring, including power, lighting, control, and signal circuit wiring together with all their associated hardware, fittings, and wiring devices, both permanently and temporarily installed. This includes (a) wiring from the service point or power source to the outlets or (b) wiring from and including the power source to the outlets where there is no service point.

Such wiring does not include wiring internal to appliances, luminaires, motors, controllers, motor control centers, and similar equipment. (CMP-1)

Informational Note: Power sources include, but are not limited to, interconnected or stand-alone batteries, solar photovoltaic systems, other distributed generation systems, or generators.

Pressurized [as applied to Hazardous (Classified) Locations]. The process of supplying an enclosure with a protective gas with or without continuous flow, at sufficient pressure to prevent the entrance of combustible dust or ignitible fibers/flyings. (CMP-14)

N **Process Seal [as applied to Hazardous (Classified) Locations].** A seal between electrical systems and flammable or combustible process fluids where a failure could allow the migration of process fluids into the premises' wiring system. (CMP-14)

Purged and Pressurized [as applied to Hazardous (Classified) Locations]. The process of (1) purging, supplying an enclosure with a protective gas at a sufficient flow and positive pressure to reduce the concentration of any flammable gas or vapor initially present to an acceptable level; and (2) pressurization, supplying an enclosure with a protective gas with or without continuous flow at sufficient pressure to prevent the entrance of a flammable gas or vapor, a combustible dust, or an ignitible fiber. (CMP-14)

Informational Note: For further information, see ANSI/NFPA 496-2013, *Purged and Pressurized Enclosures for Electrical Equipment.*

Qualified Person. One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. (CMP-1)

Informational Note: Refer to NFPA 70E-2012, *Standard for Electrical Safety in the Workplace*, for electrical safety training requirements.

Raceway. An enclosed channel designed expressly for holding wires, cables, or busbars, with additional functions as permitted in this *Code*. (CMP-8)

Informational Note: A raceway is identified within specific article definitions.

Rainproof. Constructed, protected, or treated so as to prevent rain from interfering with the successful operation of the apparatus under specified test conditions. (CMP-1)

Raintight. Constructed or protected so that exposure to a beating rain will not result in the entrance of water under specified test conditions. (CMP-1)

Receptacle. A contact device installed at the outlet for the connection of an attachment plug, or for the direct connection of electrical utilization equipment designed to mate with the corresponding contact device. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke. (CMP-18)

Receptacle Outlet. An outlet where one or more receptacles are installed. (CMP-18)

Remote-Control Circuit. Any electrical circuit that controls any other circuit through a relay or an equivalent device. (CMP-3)

Retrofit Kit. A general term for a complete subassembly of parts and devices for field conversion of utilization equipment. (CMP-18)

Sealable Equipment. Equipment enclosed in a case or cabinet that is provided with a means of sealing or locking so that live parts cannot be made accessible without opening the enclosure. (CMP-1)

Informational Note: The equipment may or may not be operable without opening the enclosure.

Separately Derived System. An electrical source, other than a service, having no direct connection(s) to circuit conductors of any other electrical source other than those established by grounding and bonding connections. (CMP-5)

Service. The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served. (CMP-4)

Service Cable. Service conductors made up in the form of a cable. (CMP-4)

Service Conductors. The conductors from the service point to the service disconnecting means. (CMP-4)

Service Conductors, Overhead. The overhead conductors between the service point and the first point of connection to the service-entrance conductors at the building or other structure. (CMP-4)

Service Conductors, Underground. The underground conductors between the service point and the first point of connection to the service-entrance conductors in a terminal box, meter, or other enclosure, inside or outside the building wall. (CMP-4)

Informational Note: Where there is no terminal box, meter, or other enclosure, the point of connection is considered to be the point of entrance of the service conductors into the building.

Service Drop. The overhead conductors between the utility electric supply system and the service point. (CMP-4)

Service-Entrance Conductors, Overhead System. The service conductors between the terminals of the service equipment and a point usually outside the building, clear of building walls, where joined by tap or splice to the service drop or overhead service conductors. (CMP-4)

Service-Entrance Conductors, Underground System. The service conductors between the terminals of the service equipment and the point of connection to the service lateral or underground service conductors. (CMP-4)

Informational Note: Where service equipment is located outside the building walls, there may be no service-entrance conductors or they may be entirely outside the building.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service conductors to a building or other structure, or an otherwise designated area, and intended to constitute the main control and cutoff of the supply. (CMP-4)

Service Lateral. The underground conductors between the utility electric supply system and the service point. (CMP-4)

Service Point. The point of connection between the facilities of the serving utility and the premises wiring. (CMP-4)

Informational Note: The service point can be described as the point of demarcation between where the serving utility ends and the premises wiring begins. The serving utility generally specifies the location of the service point based on the conditions of service.

Short-Circuit Current Rating. The prospective symmetrical fault current at a nominal voltage to which an apparatus or system is able to be connected without sustaining damage exceeding defined acceptance criteria. (CMP-10)

Show Window. Any window, including windows above doors, used or designed to be used for the display of goods or advertising material, whether it is fully or partly enclosed or entirely open at the rear and whether or not it has a platform raised higher than the street floor level. (CMP-2)

Signaling Circuit. Any electrical circuit that energizes signaling equipment. (CMP-3)

Simple Apparatus [as applied to Hazardous (Classified) Locations]. An electrical component or combination of components of simple construction with well-defined electrical parameters that does not generate more than 1.5 volts, 100 mA, and 25 mW, or a passive component that does not dissipate more than 1.3 watts and is compatible with the intrinsic safety of the circuit in which it is used. (CMP-14)

Informational Note: The following apparatus are examples of simple apparatus:

(1) Passive components; for example, switches, junction boxes, resistance temperature devices, and simple semiconductor devices such as LEDs
(2) Sources of stored energy consisting of single components in simple circuits with well-defined parameters; for example, capacitors or inductors, whose values are considered when determining the overall safety of the system
(3) Sources of generated energy; for example, thermocouples and photocells, that do not generate more than 1.5 volts, 100 mA, and 25 mW

Special Permission. The written consent of the authority having jurisdiction. (CMP-1)

Stand-Alone System. A system that supplies power independently of an electrical production and distribution network. (CMP-4)

Structure. That which is built or constructed, other than equipment. (CMP-1)

Surge Arrester. A protective device for limiting surge voltages by discharging or bypassing surge current; it also prevents continued flow of follow current while remaining capable of repeating these functions. (CMP-5)

Surge-Protective Device (SPD). A protective device for limiting transient voltages by diverting or limiting surge current; it also prevents continued flow of follow current while remaining capable of repeating these functions and is designated as follows:

Type 1: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.

Type 2: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

Type 3: Point of utilization SPDs.

Type 4: Component SPDs, including discrete components, as well as assemblies. (CMP-5)

Informational Note: For further information on Type 1, Type 2, Type 3, and Type 4 SPDs, see UL 1449, *Standard for Surge Protective Devices*.

Switch, Bypass Isolation. A manually operated device used in conjunction with a transfer switch to provide a means of directly connecting load conductors to a power source and of disconnecting the transfer switch. (CMP-13)

Switch, General-Use. A switch intended for use in general distribution and branch circuits. It is rated in amperes, and it is capable of interrupting its rated current at its rated voltage. (CMP-9)

Switch, General-Use Snap. A form of general-use switch constructed so that it can be installed in device boxes or on box covers, or otherwise used in conjunction with wiring systems recognized by this *Code*. (CMP-9)

Switch, Isolating. A switch intended for isolating an electrical circuit from the source of power. It has no interrupting rating,

and it is intended to be operated only after the circuit has been opened by some other means. (CMP-9)

Switch, Motor-Circuit. A switch rated in horsepower that is capable of interrupting the maximum operating overload current of a motor of the same horsepower rating as the switch at the rated voltage. (CMP-11)

Switch, Transfer. An automatic or nonautomatic device for transferring one or more load conductor connections from one power source to another. (CMP-13)

Switchboard. A large single panel, frame, or assembly of panels on which are mounted on the face, back, or both, switches, overcurrent and other protective devices, buses, and usually instruments. These assemblies are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets. (CMP-9)

Switchgear. An assembly completely enclosed on all sides and top with sheet metal (except for ventilating openings and inspection windows) and containing primary power circuit switching, interrupting devices, or both, with buses and connections. The assembly may include control and auxiliary devices. Access to the interior of the enclosure is provided by doors, removable covers, or both. (CMP-9)

Informational Note: All switchgear subject to *NEC* requirements is metal enclosed. Switchgear rated below 1000 V or less may be identified as "low-voltage power circuit breaker switchgear." Switchgear rated over 1000 V may be identified as "metal-enclosed switchgear" or "metal-clad switchgear." Switchgear is available in non–arc-resistant or arc-resistant constructions.

Thermal Protector (as applied to motors). A protective device for assembly as an integral part of a motor or motor-compressor that, when properly applied, protects the motor against dangerous overheating due to overload and failure to start. (CMP-11)

Informational Note: The thermal protector may consist of one or more sensing elements integral with the motor or motor-compressor and an external control device.

Thermally Protected (as applied to motors). The words *Thermally Protected* appearing on the nameplate of a motor or motor-compressor indicate that the motor is provided with a thermal protector. (CMP-11)

Unclassified Locations [as applied to Hazardous (Classified) Locations]. Locations determined to be neither Class I, Division 1; Class I, Division 2; Class I, Zone 0; Class I, Zone 1; Class I, Zone 2; Class II, Division 1; Class II, Division 2; Class III, Division 1; Class III, Division 2; Zone 20; Zone 21; Zone 22; nor any combination thereof. (CMP-14)

Ungrounded. Not connected to ground or to a conductive body that extends the ground connection. (CMP-5)

Uninterruptible Power Supply. A power supply used to provide alternating current power to a load for some period of time in the event of a power failure. (CMP-13)

Informational Note: In addition, it may provide a more constant voltage and frequency supply to the load, reducing the effects of voltage and frequency variations.

Utilization Equipment. Equipment that utilizes electric energy for electronic, electromechanical, chemical, heating, lighting, or similar purposes. (CMP-1)

Ventilated. Provided with a means to permit circulation of air sufficient to remove an excess of heat, fumes, or vapors. (CMP-14)

Volatile Flammable Liquid. A flammable liquid having a flash point below 38°C (100°F), or a flammable liquid whose temperature is above its flash point, or a Class II combustible liquid that has a vapor pressure not exceeding 276 kPa (40 psia) at 38°C (100°F) and whose temperature is above its flash point. (CMP-14)

Voltage (of a circuit). The greatest root-mean-square (rms) (effective) difference of potential between any two conductors of the circuit concerned. (CMP-1)

Informational Note: Some systems, such as 3-phase 4-wire, single-phase 3-wire, and 3-wire direct current, may have various circuits of various voltages.

Voltage, Nominal. A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g., 120/240 volts, 480Y/277 volts, 600 volts). (CMP-1)

Informational Note No. 1: The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment.

Informational Note No. 2: See ANSI C84.1-2011, *Voltage Ratings for Electric Power Systems and Equipment (60 Hz)*.

Informational Note No. 3: Certain battery units may be considered to be rated at nominal 48 volts dc, but may have a charging float voltage up to 58 volts. In dc applications, 60 volts is used to cover the entire range of float voltages.

Voltage to Ground. For grounded circuits, the voltage between the given conductor and that point or conductor of the circuit that is grounded; for ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit. (CMP-1)

Watertight. Constructed so that moisture will not enter the enclosure under specified test conditions. (CMP-1)

Weatherproof. Constructed or protected so that exposure to the weather will not interfere with successful operation. (CMP-1)

Informational Note: Rainproof, raintight, or watertight equipment can fulfill the requirements for weatherproof where varying weather conditions other than wetness, such as snow, ice, dust, or temperature extremes, are not a factor.

Part II. Over 1000 Volts, Nominal

Electronically Actuated Fuse. An overcurrent protective device that generally consists of a control module that provides current sensing, electronically derived time–current characteristics, energy to initiate tripping, and an interrupting module that interrupts current when an overcurrent occurs. Electronically actuated fuses may or may not operate in a current-limiting fashion, depending on the type of control selected. (CMP-10)

Fuse. An overcurrent protective device with a circuit-opening fusible part that is heated and severed by the passage of overcurrent through it. (CMP-10)

Informational Note: A fuse comprises all the parts that form a unit capable of performing the prescribed functions. It may or

may not be the complete device necessary to connect it into an electrical circuit.

Controlled Vented Power Fuse. A fuse with provision for controlling discharge circuit interruption such that no solid material may be exhausted into the surrounding atmosphere.

Informational Note: The fuse is designed so that discharged gases will not ignite or damage insulation in the path of the discharge or propagate a flashover to or between grounded members or conduction members in the path of the discharge where the distance between the vent and such insulation or conduction members conforms to manufacturer's recommendations.

Expulsion Fuse Unit (Expulsion Fuse). A vented fuse unit in which the expulsion effect of gases produced by the arc and lining of the fuseholder, either alone or aided by a spring, extinguishes the arc.

Nonvented Power Fuse. A fuse without intentional provision for the escape of arc gases, liquids, or solid particles to the atmosphere during circuit interruption.

Power Fuse Unit. A vented, nonvented, or controlled vented fuse unit in which the arc is extinguished by being drawn through solid material, granular material, or liquid, either alone or aided by a spring.

Vented Power Fuse. A fuse with provision for the escape of arc gases, liquids, or solid particles to the surrounding atmosphere during circuit interruption.

Multiple Fuse. An assembly of two or more single-pole fuses. (CMP-10)

Substation. An assemblage of equipment (e.g., switches, interrupting devices, circuit breakers, buses, and transformers) through which electric energy is passed for the purpose of distribution, switching, or modifying its characteristics. (CMP-9)

Switching Device. A device designed to close, open, or both, one or more electrical circuits. (CMP-1)

Circuit Breaker. A switching device capable of making, carrying, and interrupting currents under normal circuit conditions, and also of making, carrying for a specified time, and interrupting currents under specified abnormal circuit conditions, such as those of short circuit.

Cutout. An assembly of a fuse support with either a fuseholder, fuse carrier, or disconnecting blade. The fuseholder or fuse carrier may include a conducting element (fuse link) or may act as the disconnecting blade by the inclusion of a nonfusible member.

Disconnecting Means. A device, group of devices, or other means whereby the conductors of a circuit can be disconnected from their source of supply.

Disconnecting (or Isolating) Switch (Disconnector, Isolator). A mechanical switching device used for isolating a circuit or equipment from a source of power.

Interrupter Switch. A switch capable of making, carrying, and interrupting specified currents.

Oil Cutout (Oil-Filled Cutout). A cutout in which all or part of the fuse support and its fuse link or disconnecting blade is mounted in oil with complete immersion of the contacts and the fusible portion of the conducting element (fuse link) so that arc interruption by severing of the fuse link or by opening of the contacts will occur under oil.

Oil Switch. A switch having contacts that operate under oil (or askarel or other suitable liquid).

Regulator Bypass Switch. A specific device or combination of devices designed to bypass a regulator.

ARTICLE 110
Requirements for Electrical Installations

Part I. General

110.1 Scope. This article covers general requirements for the examination and approval, installation and use, access to and spaces about electrical conductors and equipment; enclosures intended for personnel entry; and tunnel installations.

Informational Note: See Informative Annex J for information regarding ADA accessibility design.

110.2 Approval. The conductors and equipment required or permitted by this *Code* shall be acceptable only if approved.

Informational Note: See 90.7, Examination of Equipment for Safety, and 110.3, Examination, Identification, Installation, and Use of Equipment. See definitions of *Approved, Identified, Labeled,* and *Listed.*

110.3 Examination, Identification, Installation, Use, and Listing (Product Certification) of Equipment.

(A) Examination. In judging equipment, considerations such as the following shall be evaluated:

(1) Suitability for installation and use in conformity with the provisions of this *Code*

Informational Note No. 1: Equipment may be new, reconditioned, refurbished, or remanufactured.

Informational Note No. 2: Suitability of equipment use may be identified by a description marked on or provided with a product to identify the suitability of the product for a specific purpose, environment, or application. Special conditions of use or other limitations and other pertinent information may be marked on the equipment, included in the product instructions, or included in the appropriate listing and labeling information. Suitability of equipment may be evidenced by listing or labeling.

(2) Mechanical strength and durability, including, for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided
(3) Wire-bending and connection space
(4) Electrical insulation
(5) Heating effects under normal conditions of use and also under abnormal conditions likely to arise in service
(6) Arcing effects
(7) Classification by type, size, voltage, current capacity, and specific use
(8) Other factors that contribute to the practical safeguarding of persons using or likely to come in contact with the equipment

(B) Installation and Use. Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling.

N **(C) Listing.** Product testing, evaluation, and listing (product certification) shall be performed by recognized qualified electrical testing laboratories and shall be in accordance with applicable product standards recognized as achieving equivalent and effective safety for equipment installed to comply with this *Code*.

Informational Note: The Occupational Safety and Health Administration (OSHA) recognizes qualified electrical testing laboratories that perform evaluations, testing, and certification of certain products to ensure that they meet the requirements of both the construction and general industry OSHA electrical standards. If the listing (product certification) is done under a qualified electrical testing laboratory program, this listing mark signifies that the tested and certified product complies with the requirements of one or more appropriate product safety test standards.

110.4 Voltages. Throughout this *Code*, the voltage considered shall be that at which the circuit operates. The voltage rating of electrical equipment shall not be less than the nominal voltage of a circuit to which it is connected.

110.5 Conductors. Conductors normally used to carry current shall be of copper or aluminum unless otherwise provided in this *Code*. Where the conductor material is not specified, the sizes given in this *Code* shall apply to copper conductors. Where other materials are used, the size shall be changed accordingly.

Informational Note: For copper-clad aluminum conductors, see 310.15.

110.6 Conductor Sizes. Conductor sizes are expressed in American Wire Gage (AWG) or in circular mils.

110.7 Wiring Integrity. Completed wiring installations shall be free from short circuits, ground faults, or any connections to ground other than as required or permitted elsewhere in this *Code*.

110.8 Wiring Methods. Only wiring methods recognized as suitable are included in this *Code*. The recognized methods of wiring shall be permitted to be installed in any type of building or occupancy, except as otherwise provided in this *Code*.

110.9 Interrupting Rating. Equipment intended to interrupt current at fault levels shall have an interrupting rating at nominal circuit voltage at least equal to the current that is available at the line terminals of the equipment.

Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage at least equal to the current that must be interrupted.

110.10 Circuit Impedance, Short-Circuit Current Ratings, and Other Characteristics. The overcurrent protective devices, the total impedance, the equipment short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit protective devices used to clear a fault to do so without extensive damage to the electrical equipment of the circuit. This fault shall be assumed to be either between two or more of the circuit conductors or between any circuit conductor and the equipment grounding conductor(s) permitted in 250.118. Listed equipment applied in accordance with their listing shall be considered to meet the requirements of this section.

110.11 Deteriorating Agents. Unless identified for use in the operating environment, no conductors or equipment shall be located in damp or wet locations; where exposed to gases, fumes, vapors, liquids, or other agents that have a deteriorating effect on the conductors or equipment; or where exposed to excessive temperatures.

Informational Note No. 1: See 300.6 for protection against corrosion.

Informational Note No. 2: Some cleaning and lubricating compounds can cause severe deterioration of many plastic materials used for insulating and structural applications in equipment.

Equipment not identified for outdoor use and equipment identified only for indoor use, such as "dry locations," "indoor use only," "damp locations," or enclosure Types 1, 2, 5, 12, 12K, and/or 13, shall be protected against damage from the weather during construction.

Informational Note No. 3: See Table 110.28 for appropriate enclosure-type designations.

Informational Note No. 4: Minimum flood provisions are provided in NFPA 5000-2015 *Building Construction and Safety Code*, the *International Building Code (IBC)*, and the *International Residential Code for One- and Two-Family Dwellings (IRC)*.

110.12 Mechanical Execution of Work. Electrical equipment shall be installed in a neat and workmanlike manner.

Informational Note: Accepted industry practices are described in ANSI/NECA 1-2015, *Standard for Good Workmanship in Electrical Construction*, and other ANSI-approved installation standards.

(A) Unused Openings. Unused openings, other than those intended for the operation of equipment, those intended for mounting purposes, or those permitted as part of the design for listed equipment, shall be closed to afford protection substantially equivalent to the wall of the equipment. Where metallic plugs or plates are used with nonmetallic enclosures, they shall be recessed at least 6 mm (¼ in.) from the outer surface of the enclosure.

(B) Integrity of Electrical Equipment and Connections. Internal parts of electrical equipment, including busbars, wiring terminals, insulators, and other surfaces, shall not be damaged or contaminated by foreign materials such as paint, plaster, cleaners, abrasives, or corrosive residues. There shall be no damaged parts that may adversely affect safe operation or mechanical strength of the equipment such as parts that are broken; bent; cut; or deteriorated by corrosion, chemical action, or overheating.

110.13 Mounting and Cooling of Equipment.

(A) Mounting. Electrical equipment shall be firmly secured to the surface on which it is mounted. Wooden plugs driven into holes in masonry, concrete, plaster, or similar materials shall not be used.

(B) Cooling. Electrical equipment that depends on the natural circulation of air and convection principles for cooling of exposed surfaces shall be installed so that room airflow over such surfaces is not prevented by walls or by adjacent installed equipment. For equipment designed for floor mounting, clearance between top surfaces and adjacent surfaces shall be provided to dissipate rising warm air.

Electrical equipment provided with ventilating openings shall be installed so that walls or other obstructions do not prevent the free circulation of air through the equipment.

110.14 Electrical Connections. Because of different characteristics of dissimilar metals, devices such as pressure terminal or pressure splicing connectors and soldering lugs shall be identified for the material of the conductor and shall be properly installed and used. Conductors of dissimilar metals shall not be intermixed in a terminal or splicing connector where physical contact occurs between dissimilar conductors (such as copper and aluminum, copper and copper-clad aluminum, or aluminum and copper-clad aluminum), unless the device is identified for the purpose and conditions of use. Materials such as solder, fluxes, inhibitors, and compounds, where employed, shall be suitable for the use and shall be of a type that will not adversely affect the conductors, installation, or equipment.

Connectors and terminals for conductors more finely stranded than Class B and Class C stranding as shown in Chapter 9, Table 10, shall be identified for the specific conductor class or classes.

(A) Terminals. Connection of conductors to terminal parts shall ensure a thoroughly good connection without damaging the conductors and shall be made by means of pressure connectors (including set-screw type), solder lugs, or splices to flexible leads. Connection by means of wire-binding screws or studs and nuts that have upturned lugs or the equivalent shall be permitted for 10 AWG or smaller conductors.

Terminals for more than one conductor and terminals used to connect aluminum shall be so identified.

(B) Splices. Conductors shall be spliced or joined with splicing devices identified for the use or by brazing, welding, or soldering with a fusible metal or alloy. Soldered splices shall first be spliced or joined so as to be mechanically and electrically secure without solder and then be soldered. All splices and joints and the free ends of conductors shall be covered with an insulation equivalent to that of the conductors or with an identified insulating device.

Wire connectors or splicing means installed on conductors for direct burial shall be listed for such use.

(C) Temperature Limitations. The temperature rating associated with the ampacity of a conductor shall be selected and coordinated so as not to exceed the lowest temperature rating of any connected termination, conductor, or device. Conductors with temperature ratings higher than specified for terminations shall be permitted to be used for ampacity adjustment, correction, or both.

(1) Equipment Provisions. The determination of termination provisions of equipment shall be based on 110.14(C)(1)(a) or (C)(1)(b). Unless the equipment is listed and marked otherwise, conductor ampacities used in determining equipment termination provisions shall be based on Table 310.15(B)(16) as appropriately modified by 310.15(B)(7).

(a) Termination provisions of equipment for circuits rated 100 amperes or less, or marked for 14 AWG through 1 AWG conductors, shall be used only for one of the following:

(1) Conductors rated 60°C (140°F).
(2) Conductors with higher temperature ratings, provided the ampacity of such conductors is determined based on the 60°C (140°F) ampacity of the conductor size used.
(3) Conductors with higher temperature ratings if the equipment is listed and identified for use with such conductors.
(4) For motors marked with design letters B, C, or D, conductors having an insulation rating of 75°C (167°F) or higher shall be permitted to be used, provided the ampacity of such conductors does not exceed the 75°C (167°F) ampacity.

(b) Termination provisions of equipment for circuits rated over 100 amperes, or marked for conductors larger than 1 AWG, shall be used only for one of the following:

(1) Conductors rated 75°C (167°F)
(2) Conductors with higher temperature ratings, provided the ampacity of such conductors does not exceed the 75°C (167°F) ampacity of the conductor size used, or up to their ampacity if the equipment is listed and identified for use with such conductors

(2) Separate Connector Provisions. Separately installed pressure connectors shall be used with conductors at the ampacities not exceeding the ampacity at the listed and identified temperature rating of the connector.

Informational Note: With respect to 110.14(C)(1) and (C)(2), equipment markings or listing information may additionally restrict the sizing and temperature ratings of connected conductors.

N **(D) Installation.** Where a tightening torque is indicated as a numeric value on equipment or in installation instructions provided by the manufacturer, a calibrated torque tool shall be used to achieve the indicated torque value, unless the equipment manufacturer has provided installation instructions for an alternative method of achieving the required torque.

110.15 High-Leg Marking. On a 4-wire, delta-connected system where the midpoint of one phase winding is grounded, only the conductor or busbar having the higher phase voltage to ground shall be durably and permanently marked by an outer finish that is orange in color or by other effective means. Such identification shall be placed at each point on the system where a connection is made if the grounded conductor is also present.

110.16 Arc-Flash Hazard Warning.

(A) General. Electrical equipment, such as switchboards, switchgear, panelboards, industrial control panels, meter socket enclosures, and motor control centers, that is in other than dwelling units, and is likely to require examination, adjustment, servicing, or maintenance while energized, shall be field or factory marked to warn qualified persons of potential electric arc flash hazards. The marking shall meet the requirements in 110.21(B) and shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

(B) Service Equipment. In other than dwelling units, in addition to the requirements in (A), a permanent label shall be field or factory applied to service equipment rated 1200 amps or more. The label shall meet the requirements of 110.21(B) and contain the following information:

(1) Nominal system voltage
(2) Available fault current at the service overcurrent protective devices
(3) The clearing time of service overcurrent protective devices based on the available fault current at the service equipment

(4) The date the label was applied

Exception: Service equipment labeling shall not be required if an arc flash label is applied in accordance with acceptable industry practice.

Informational Note No. 1: *NFPA 70E*-2015, *Standard for Electrical Safety in the Workplace*, provides guidance, such as determining severity of potential exposure, planning safe work practices, arc flash labeling, and selecting personal protective equipment.

Informational Note No. 2: ANSI Z535.4-2011, *Product Safety Signs and Labels*, provides guidelines for the design of safety signs and labels for application to products.

Informational Note No. 3: Acceptable industry practices for equipment labeling are described in *NFPA 70E*-2015 *Standard for Electrical Safety in the Workplace*. This standard provides specific criteria for developing arc-flash labels for equipment that provides nominal system voltage, incident energy levels, arc-flash boundaries, minimum required levels of personal protective equipment, and so forth.

110.18 Arcing Parts. Parts of electrical equipment that in ordinary operation produce arcs, sparks, flames, or molten metal shall be enclosed or separated and isolated from all combustible material.

Informational Note: For hazardous (classified) locations, see Articles 500 through 517. For motors, see 430.14.

110.19 Light and Power from Railway Conductors. Circuits for lighting and power shall not be connected to any system that contains trolley wires with a ground return.

Exception: Such circuit connections shall be permitted in car houses, power houses, or passenger and freight stations operated in connection with electric railways.

110.21 Marking.

(A) Equipment Markings.

(1) General. The manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product can be identified shall be placed on all electrical equipment. Other markings that indicate voltage, current, wattage, or other ratings shall be provided as specified elsewhere in this *Code*. The marking or label shall be of sufficient durability to withstand the environment involved.

N **(2) Reconditioned Equipment.** Reconditioned equipment shall be marked with the name, trademark, or other descriptive marking by which the organization responsible for reconditioning the electrical equipment can be identified, along with the date of the reconditioning.

Reconditioned equipment shall be identified as "reconditioned" and approval of the reconditioned equipment shall not be based solely on the equipment's original listing.

Exception: In industrial occupancies, where conditions of maintenance and supervision ensure that only qualified persons service the equipment, the markings indicated in 110.21(A)(2) shall not be required.

Informational Note: Industry standards are available for application of reconditioned and refurbished equipment. Normal servicing of equipment that remains within a facility should not be considered reconditioning or refurbishing.

(B) Field-Applied Hazard Markings. Where caution, warning, or danger signs or labels are required by this *Code*, the labels shall meet the following requirements:

(1) The marking shall warn of the hazards using effective words, colors, symbols, or any combination thereof.

Informational Note: ANSI Z535.4-2011, *Product Safety Signs and Labels*, provides guidelines for suitable font sizes, words, colors, symbols, and location requirements for labels.

(2) The label shall be permanently affixed to the equipment or wiring method and shall not be handwritten.

Exception to (2): Portions of labels or markings that are variable, or that could be subject to changes, shall be permitted to be handwritten and shall be legible.

(3) The label shall be of sufficient durability to withstand the environment involved.

Informational Note: ANSI Z535.4-2011, *Product Safety Signs and Labels*, provides guidelines for the design and durability of safety signs and labels for application to electrical equipment.

110.22 Identification of Disconnecting Means.

(A) General. Each disconnecting means shall be legibly marked to indicate its purpose unless located and arranged so the purpose is evident. The marking shall be of sufficient durability to withstand the environment involved.

(B) Engineered Series Combination Systems. Equipment enclosures for circuit breakers or fuses applied in compliance with series combination ratings selected under engineering supervision in accordance with 240.86(A) shall be legibly marked in the field as directed by the engineer to indicate the equipment has been applied with a series combination rating. The marking shall meet the requirements in 110.21(B) and shall be readily visible and state the following:

CAUTION — ENGINEERED SERIES COMBINATION SYSTEM RATED _____ AMPERES. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED.

(C) Tested Series Combination Systems. Equipment enclosures for circuit breakers or fuses applied in compliance with the series combination ratings marked on the equipment by the manufacturer in accordance with 240.86(B) shall be legibly marked in the field to indicate the equipment has been applied with a series combination rating. The marking shall meet the requirements in 110.21(B) and shall be readily visible and state the following:

CAUTION — SERIES COMBINATION SYSTEM RATED ____ AMPERES. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED.

Informational Note: See IEEE 3004.5-2014 *Recommended Practice for the Application of Low-Voltage Circuit Breakers in Industrial and Commercial Power Systems*, for further information on series tested systems.

110.23 Current Transformers. Unused current transformers associated with potentially energized circuits shall be short-circuited.

110.24 Available Fault Current.

(A) Field Marking. Service equipment at other than dwelling units shall be legibly marked in the field with the maximum available fault current. The field marking(s) shall include the date the fault-current calculation was performed and be of sufficient durability to withstand the environment involved. The calculation shall be documented and made available to

those authorized to design, install, inspect, maintain, or operate the system.

Informational Note: The available fault-current marking(s) addressed in 110.24 is related to required short-circuit current ratings of equipment. *NFPA 70E* -2015, *Standard for Electrical Safety in the Workplace,* provides assistance in determining the severity of potential exposure, planning safe work practices, and selecting personal protective equipment.

(B) Modifications. When modifications to the electrical installation occur that affect the maximum available fault current at the service, the maximum available fault current shall be verified or recalculated as necessary to ensure the service equipment ratings are sufficient for the maximum available fault current at the line terminals of the equipment. The required field marking(s) in 110.24(A) shall be adjusted to reflect the new level of maximum available fault current.

Exception: The field marking requirements in 110.24(A) and 110.24(B) shall not be required in industrial installations where conditions of maintenance and supervision ensure that only qualified persons service the equipment.

110.25 Lockable Disconnecting Means. If a disconnecting means is required to be lockable open elsewhere in this *Code*, it shall be capable of being locked in the open position. The provisions for locking shall remain in place with or without the lock installed.

Exception: Locking provisions for a cord-and-plug connection shall not be required to remain in place without the lock installed.

Part II. 1000 Volts, Nominal, or Less

110.26 Spaces About Electrical Equipment. Access and working space shall be provided and maintained about all electrical equipment to permit ready and safe operation and maintenance of such equipment.

(A) Working Space. Working space for equipment operating at 1000 volts, nominal, or less to ground and likely to require examination, adjustment, servicing, or maintenance while energized shall comply with the dimensions of 110.26(A)(1), (A)(2), (A)(3), and (A)(4) or as required or permitted elsewhere in this *Code*.

Informational Note: NFPA 70E-2015, *Standard for Electrical Safety in the Workplace*, provides guidance, such as determining severity of potential exposure, planning safe work practices, arc flash labeling, and selecting personal protective equipment.

(1) Depth of Working Space. The depth of the working space in the direction of live parts shall not be less than that specified in Table 110.26(A)(1) unless the requirements of 110.26(A)(1)(a), (A)(1)(b), or (A)(1)(c) are met. Distances shall be measured from the exposed live parts or from the enclosure or opening if the live parts are enclosed.

(a) *Dead-Front Assemblies.* Working space shall not be required in the back or sides of assemblies, such as dead-front switchboards, switchgear, or motor control centers, where all connections and all renewable or adjustable parts, such as fuses or switches, are accessible from locations other than the back or sides. Where rear access is required to work on nonelectrical parts on the back of enclosed equipment, a minimum horizontal working space of 762 mm (30 in.) shall be provided.

(b) *Low Voltage.* By special permission, smaller working spaces shall be permitted where all exposed live parts operate at not greater than 30 volts rms, 42 volts peak, or 60 volts dc.

(c) *Existing Buildings.* In existing buildings where electrical equipment is being replaced, Condition 2 working clearance shall be permitted between dead-front switchboards, switchgear, panelboards, or motor control centers located across the aisle from each other where conditions of maintenance and supervision ensure that written procedures have been adopted to prohibit equipment on both sides of the aisle from being open at the same time and qualified persons who are authorized will service the installation.

(2) Width of Working Space. The width of the working space in front of the electrical equipment shall be the width of the equipment or 762 mm (30 in.), whichever is greater. In all cases, the work space shall permit at least a 90 degree opening of equipment doors or hinged panels.

(3) Height of Working Space. The work space shall be clear and extend from the grade, floor, or platform to a height of 2.0 m (6½ ft) or the height of the equipment, whichever is greater. Within the height requirements of this section, other equipment that is associated with the electrical installation and is located above or below the electrical equipment shall be permitted to extend not more than 150 mm (6 in.) beyond the front of the electrical equipment.

Exception No. 1: In existing dwelling units, service equipment or panelboards that do not exceed 200 amperes shall be permitted in spaces where the height of the working space is less than 2.0 m (6½ ft).

Exception No. 2: Meters that are installed in meter sockets shall be permitted to extend beyond the other equipment. The meter socket shall be required to follow the rules of this section.

Exception No. 3: On battery systems mounted on open racks, the top clearance shall comply with 480.10(D).

N **(4) Limited Access.** Where equipment operating at 1000 volts, nominal, or less to ground and likely to require examination, adjustment, servicing, or maintenance while energized is required by installation instructions or function to be located in a space with limited access, all of the following shall apply:

Table 110.26(A)(1) Working Spaces

Nominal Voltage to Ground	Minimum Clear Distance		
	Condition 1	Condition 2	Condition 3
0–150	900 mm (3 ft)	900 mm (3 ft)	900 mm (3 ft)
151–600	900 mm (3 ft)	1.0 m (3 ft 6 in.)	1.2 m (4 ft)
601–1000	900 mm (3 ft)	1.2 m (4 ft)	1.5 m (5 ft)

Note: Where the conditions are as follows:
Condition 1 — Exposed live parts on one side of the working space and no live or grounded parts on the other side of the working space, or exposed live parts on both sides of the working space that are effectively guarded by insulating materials.
Condition 2 — Exposed live parts on one side of the working space and grounded parts on the other side of the working space. Concrete, brick, or tile walls shall be considered as grounded.
Condition 3 — Exposed live parts on both sides of the working space.