Plumbing Code Essentials
Based on the 2018 International Plumbing Code®

International Code Council
Dave Cantrell
## Contents

Preface ................................................................. vii
About the International Plumbing Code® ............... viii
Acknowledgments ..................................................... ix
About the Author ................................................... ix
About the International Code Council® ................ x
About PHCC ............................................................ x

**PART I : ADMINISTRATION** 1

Chapter 1: Introduction to the International Codes .......... 2
  Code Development .................................................. 3
  Scope and Limitations of the International Codes ......... 4

Chapter 2: Legal Aspects, Permits and Inspections .......... 7
  Code Adoption ....................................................... 8
    Adoption of the IPC ............................................. 8
    Amending the IPC ............................................... 9
    Appendices ....................................................... 9
  Authority .......................................................... 10
    Authority and Duties of the Code Official ................. 10
    Interpretations ................................................ 11
    Alternative Methods and Materials and Evaluation Service
      Reports ......................................................... 11
  Permits .......................................................... 13
    Permit Application .............................................. 13
    Plans and Specifications .................................... 14
    Fees ............................................................ 15
    Permit Issuance ................................................ 16
    Inspections .................................................... 16
    Required Inspections and Other Inspections .............. 17
  Board of Appeals ................................................ 18

**PART II : LAYOUT AND PLANNING** 19

Chapter 3: Installation ............................................ 20
  Water and Sewer Required ..................................... 21
  Materials and Standards ...................................... 22
  Protection of the Plumbing System and Structure ........ 23
  Interceptors and Separators .................................... 27
    General Requirements ......................................... 27
    Grease Interceptors .......................................... 28
    Oil Separators ............................................... 30
Chemical Wastes .................................................. 32

Chapter 4: Design ................................................... 33
  Minimum Plumbing Fixtures ................................. 34
  Hot Water Requirements and Temperature Limiting .... 36
  Water Heaters .................................................... 38
    Installation ................................................... 38
    Safety Devices .............................................. 39
    Relief Valve Discharge .................................... 40
    Drain Pan .................................................... 41

Fixture Clearances and Space Requirements ............ 41

General Fixture Provisions .................................... 44
  Approved Fixtures .......................................... 44
  Installation .................................................. 44
  Water Closets, Urinals, Lavatories and Bidets ........ 45
  Bathtubs and Showers ....................................... 47
  Kitchen Sinks ............................................... 50
  Food Waste Disposers ....................................... 50
  Dishwashers .................................................. 51
  Clothes Washers and Laundry Trays ....................... 51
  Shampoo Sinks and Footbaths .............................. 52
  Floor Drains, Standpipes and Other Waste Receptors . 53

Food Preparation and Storage .............................. 54
  Protection from Contamination ............................ 54
  Indirect Waste Piping ....................................... 56

PART III : DRAIN, WASTE AND VENT ........................... 57

Chapter 5: Sanitary Drainage ................................... 58
  Connection to Sewer ........................................ 59
  Materials ..................................................... 59
  Testing ......................................................... 60
  Installation .................................................. 61
  Offsets in Drainage Stacks ................................. 62
    Drainage below the Sewer Level ......................... 63
    Cleanouts .................................................. 65
    Sizing of Drains .......................................... 66
    Joints and Connections .................................... 68

Chapter 6: Venting ................................................. 71
  General Requirements ....................................... 72
    Vent Connections and Grades ............................ 73
    Vent Termination .......................................... 74
    Sizing of Vents ............................................ 75
    Relief Vents in Multiple-Story Buildings .......... 80
    Vents for Horizontal Stack Offsets ................. 81
    Venting of Island Fixtures .............................. 81
    Air Admittance Valves .................................... 82
### Venting Methods
- Common Vent ................................................. 86
- Vertical and Horizontal Wet Venting .................... 87
- Circuit Venting ................................................. 89
- Combination Waste and Vent ............................... 91
- Waste Stack Venting ......................................... 94
- Single Stack Venting ......................................... 95

### Chapter 7: Storm Drainage ................................. 97
#### Design Requirements ..................................... 98
- Roof Drains ...................................................... 99
  - Materials ...................................................... 99
  - Installation ................................................... 99
  - Design and Sizing .......................................... 100
  - Testing ....................................................... 104
  - Siphonic Roof Drain Systems .......................... 104
- Subsoil (Foundation/Footing) Drains ...................... 105

### PART IV: WATER DISTRIBUTION ......................... 107

#### Chapter 8: Water Piping ................................. 108
- General Requirements ....................................... 109
  - Materials ...................................................... 109
  - Joints and Connections ................................... 111
  - Testing and Disinfection ................................ 111
  - Design and Installation ................................ 112
  - Valves ......................................................... 113
  - Sizing ........................................................ 114

#### Chapter 9: Backflow Protection ......................... 121
- Identification of Nonpotable Water ....................... 122
- General Requirements ....................................... 122
- Backflow Assemblies, Devices and Methods .............. 124
  - Protection of Potable Water Outlets ................ 127
    - Hose Connections ....................................... 127
    - Carbonated Beverage Dispensers ................ 128
    - Coffee Machines ...................................... 128
    - Boilers ..................................................... 128
    - Heat Exchangers ...................................... 129
    - Fire Sprinklers ......................................... 129
    - Lawn Irrigation Systems ................................ 130
    - Chemical Dispensers ................................ 130
- Required Test and Inspection of Backflow Preventers .. 131

#### Chapter 10: Water Reuse ................................. 133
- General Provisions ........................................... 134
  - Water Quality and Treatment .......................... 135
  - Protection of Potable Water ............................ 136
  - Protection of the Water Reuse System ................. 137
  - System Abandonment .................................... 137
Plumbing design and installation routinely consists of conventional practices, those tried-and-true methods that have performed well over the years and have long been recognized by the plumbing code. With the introduction of new technology, materials and methods, improved understanding of safe and sanitary plumbing systems, and innovation in designs, plumbing technology and the code that regulates it have become increasingly complex. Such complexity is necessary to afford flexibility in design and construction. Reference publications intending to explain the provisions regulating plumbing design and installation may overwhelm the reader with a broad range of topics and alternatives, may provide superficial coverage of all requirements or may focus on the details of a limited number of provisions.

*Plumbing Code Essentials: Based on the 2018 International Plumbing Code®* (Includes 2018 IRC Plumbing Provisions and a Chapter on Fuel Gas Piping) was developed to address the need for an illustrated text explaining the essentials of the plumbing code—those provisions essential to understanding the application of the code to the most commonly encountered plumbing practices. The text is presented and organized in a user-friendly manner with an emphasis on technical accuracy and clear non-code language.

*Plumbing Code Essentials* features full-color illustrations to assist the reader in visualizing the application of the code requirements. Practical examples, simplified tables and highlights of particularly useful information also aid in understanding the provisions and determining code compliance. References to the applicable sections of the 2018 codes are helpful in locating the corresponding code language and related topics in the code. A glossary of code and plumbing terms clarifies the meaning of the technical provisions.

Anyone involved in the design, installation or inspection of plumbing systems will benefit from this book. Beginner and experienced inspectors, plan checkers, installers, contractors, home builders, architects, designers, home inspectors and students of plumbing technology or related fields will gain understanding and practical application of the frequently used provisions of the 2018 edition of the IPC, plus provisions from IRC plumbing and IFGC piping.

The content of *Plumbing Code Essentials* is organized to correspond to the order of construction, beginning with layout and planning, things one needs to identify during the design. For instance, the planning phase must consider the minimum number of required fixtures, the potable water source, interceptors or separators needed before connecting to the sewer, safety provisions that may apply to the hot water temperature at its source and fixture outlets. This is followed by the design of the drain, waste and vent (DWV) system as well as roof drains and subsoil drainage. Also discussed is the design and installation of the water supply and distribution system, including requirements necessary for protecting the potable water by means of appropriate backflow preventers. In addition,
with the increased need for water conservation, the book will review important details with regard to water reuse, such as rainwater harvesting and graywater reuse. References to the applicable IPC code sections are followed by reference to the corresponding section from the 2018 *International Residential Code* (IRC). Finally, fuel gas piping and appliance installation are covered with references to the applicable sections of the 2018 *International Fuel Gas Code* and the 2018 IRC.

Correct and reasonable application of the code provisions is enhanced by a basic understanding of the code development process, the scope, intent and correlation of the family of International Codes, and the proper administration of those codes. Such fundamental information is provided in the opening chapters of this publication. The book also explains the interaction of a plumbing code with other local, state or federal regulations.

This book does not intend to cover all provisions of the IPC, IRC and IFGC or all of the accepted materials and methods of plumbing design and installation. Focusing in some detail on the most common plumbing provisions affords an opportunity to fully understand the essentials without exploring every variable and alternative. This is not to say that information not covered is any less important or valid. This book is best used as a companion to the IPC, IRC and IFGC, which should be referenced for more complete information.

**ABOUT THE INTERNATIONAL PLUMBING CODE®**

The IPC is a comprehensive plumbing code that establishes minimum regulations for the design and installation of plumbing systems in all types of construction and occupancies. The IPC incorporates prescriptive provisions for conventional design as well as performance criteria that allow the use of new materials and new design methods. The IPC is one of the codes in the family of International Codes published by the International Code Council (ICC). All are maintained and updated through an open code development process and are available internationally for adoption by the governing authority to provide consistent enforceable regulations for the built environment.

The impact of the IPC extends well beyond the regulatory arena, as it is used in a variety of nonregulatory settings, including:

- Voluntary compliance programs such as those promoting sustainability, energy efficiency and disaster resistance.
- The insurance industry, to estimate and manage risk, and as a tool in underwriting and rate decisions.
- Certification and credentialing of individuals involved in the fields of building design, construction and safety.
- Certification of building and construction-related products.
- US federal agencies, to guide construction in an array of government-owned properties.
- Facilities management.
• “Best practices” benchmarks for designers and builders, including those who are engaged in projects in jurisdictions that do not have a formal regulatory system or a governmental enforcement mechanism.
• College, university and professional school textbooks and curricula.
• Reference works related to building design and construction.

ACKNOWLEDGMENTS

The International Code Council and the author greatly appreciate the review, coordination and production efforts by individuals without whom this publication would not have been possible. Gary Gauthier, ICC Director of PMG Technical Resources, did the technical peer review; Cindy Rodriguez, ICC Manager of Product Development, coordinated all of the development efforts with the author; Mary Lou Luif, ICC Manager of Publications, and Jen Fitzsimmons, ICC Manager of Publications Production, and their staff implemented the editorial and production process.

The author would like to thank the Washington Association of Building Officials (WABO) who supported his involvement in technical code development over the past two decades, and both WABO and ICC staff and members who have always been a great resource of knowledge and expertise.

ABOUT THE AUTHOR

Dave Cantrell has been actively involved in the plumbing industry for over 45 years, having received his journeyman plumber certification in the state of Washington in 1978 after completing his apprenticeship. Over 30 years of his career in the state have been in the public sector, first with Snohomish County Planning & Development Services, and then with Public Health—Seattle and King County. He began as a plumbing inspector in Snohomish County, then became a senior inspector; and later, as a building inspection specialist, he worked in code development at the local, state and national level. As the chief plumbing inspector for Seattle and King County from May 2004 until his retirement on December 31, 2016, he continued his involvement in code development. He was the recipient of the 2013 Code Official of the Year from the Washington Association of Building Officials (WABO). Dave has been a member of the Plumbing Code Technical Advisory Group for the Washington State Building Code Council since 1994 and is a member of WABO’s Technical Code Development Committee. He has conducted many plumbing and fuel gas code seminars over the years on behalf of WABO. He has served on a number of ICC committees since the mid-1990s and was chair of the International Plumbing/Private Sewage Disposal Code Committee for the development of the 2015 and 2018 International Plumbing Code. Most recently he served on the Rainwater Collection System Design and
Installation Consensus Committee that developed the joint ICC/CSA standard for rainwater harvesting systems.

ABOUT THE INTERNATIONAL CODE COUNCIL®

The International Code Council is a member-focused association. It is dedicated to developing model codes and standards used in the design, build and compliance process to construct safe, sustainable, affordable and resilient structures. Most US communities and many global markets choose the International Codes. ICC Evaluation Service (ICC-ES) is the industry leader in performing technical evaluations for code compliance fostering safe and sustainable design and construction.

Governmental Affairs Office: 500 New Jersey Avenue, NW, 6th Floor, Washington, DC 20001

Regional Offices: Eastern Regional Office (BIR), Central Regional Office (CH), Western Regional Office (LA)

888-ICC-SAFE (888-422-7233)
www.iccsafe.org

ABOUT PHCC
BEST PEOPLE. BEST PRACTICES.®

The premiere organization for the p-h-c professional, PHCC provides legislative advocacy, education and training to approximately 3,300 plumbing and HVACR open shop and union businesses and 65,000 technicians. Our members work in the residential, commercial, new construction, industrial and service and repair segments of the construction industry.

Members of PHCC have access to a wide variety of resources and services, strengthening their reputation as the best choice for professionalism, reliable products and knowledgeable service—and as a proud protector of public health and safety and the environment.

Approximately 125 state and local association affiliates are part of PHCC's chapter network.

https://www.phccweb.org/