**DATE:** August 2003

**TO:** Code Enforcement Officials, Members of Plumbing Code Adoption Boards, and Interested Members of the Plumbing Community

**FROM:** Edward Saltzberg,* PE, CEM, CIPE
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**RE: 2003 International Plumbing Code/Uniform Plumbing Code Review**

The following is a general review of the 2003 versions of both the International Plumbing Code and the Uniform Plumbing Code. The review was prepared by Edward Saltzberg, PE, CEM, CIPE, and J. Richard Wagner, PE, CIPE. The review was undertaken with the health and safety of the consumer as the prime concern. However, other factors considered in our review were the life cycle cost of systems, the ease of enforcement, clarity of the code, plumbing engineering criteria, and any other reservations that the writers may have had concerning the respective provisions of the two codes. This review is not intended as a paragraph by paragraph comparison of the two code documents, but merely a comparison of the significant variations between the two documents and was modified from our 2000 code review. Therefore, we have used a vertical line ( | ) in the margin to indicate a change from the 2000 review and an arrow (→) in the margin to indicate a deletion from the 2000 review.

## A. PREFACE

1. "The Preface to the 2003 IPC declares that it is fully compatible with all International Codes. This is not true. The various "I–Codes" are administered by different committees who do not always agree on the same issues. The *International Residential Code* is an example with regards to plumbing. In very few cases do the referenced "I – Codes" provide any specific technical requirements to supplement the IPC.

   The UPC tries to incorporate sufficient portions of other documents to be a stand alone document.

## B. CHAPTER 1 — ADMINISTRATION

1–1. **Section 101.2 Scope.** The IPC does not apply to plumbing in one–and two–family dwellings, although it includes references thereof. The *International Residential Code (IRC)* covers plumbing in one–and two–family dwellings (where adopted). It refers to the ICC Electrical Code for temporary power in Chapter 1 *Administration*, but has section–by–section references to the NEC (NFPA 70) in its Appendix L. Chapters 33 through 42 of the IRC are based on the NEC instead of the ICC Electrical Code.

   The UPC does not reference the NEC in Chapter 14 but does include residential plumbing as part of the UPC.

1–2. **Section 101.2 Scope**.

The IPC section states, "This code shall also regulate nonflammable medical gas, inhalation anesthetic, vacuum piping, non–medical oxygen systems and sanitary and condensate vacuum collection systems. The installation of fuel gas distribution piping and equipment, fuel gas–fired water heaters and water heater venting systems shall be regulated by the *International Fuel Gas Code*. Provisions in the appendices shall not apply unless specifically adopted."

However, IPC Chapter 12 — Special Piping & Storage Systems has no technical requirements and simply refers to other codes and standards. It refers to NFPA 99C for medical gas and vacuum systems, but does not reference NFPA 99 – Health Care Facilities, which is the parent document of NFPA 99C and is an equivalent standard for medical gas and vacuum systems.

The UPC includes medical gas systems, fuel gas systems and water heaters and heater venting all within the body of the code.

1–3. **IPC Section 101.2.** Fuel gas piping is no longer regulated by the IPC.

Fuel gas piping is within the scope of the UPC. Even though the *National Fuel Gas Code* is referred to gas piping is included in the UPC.

1–4. **IPC Section 102.8, Referenced codes and standards**. The code indicates that those codes listed in Chapter 13 are considered part of the requirement of this code and, therefore, an enforcement agent must have copies of all of those codes and become thoroughly familiar with them.

The UPC attempts to have as much as possible within the body of the code and not refer to or incorporate other codes as part of the UPC. The 2003 UPC contains approximately 413 pages, compared to 142 pages in the 2003 IPC.

1–5. **IPC Section 103.4, Liability.** This section removes any liability from employees. However, from a legalistic standpoint, this section may not be valid. Such matters are usually left to legal staff of the authority having jurisdiction.

The UPC does not include such a provision.

1–6. **IPC Section 104.2, Rule-making authority.** This section gives the code official the authority to adopt and promulgate rules and regulations regarding the Code.

The UPC does not address rule making by the Administrative Authority. Such authority is normally included in the ordinance that created the Administrative Authority and/or in the adopting ordinance for the plumbing code.

1–7. **IPC Section 105.1, Modifications, and 105.2, Alternative materials, methods and equipment.** This section is essentially the same as what is included under UPC Section 301.2, Alternate Materials and Methods.

1–8. **IPC Section 109, MEANS OF APPEAL.** This section provides means of appealing the decision of the code official. It includes the appeal board, board membership, qualification of members, board officers, meetings, and open hearings.

The UPC does not address the filing of appeals and the administration of an appeal board. Such authority is normally included in the ordinance that created the Administrative Authority and/or in the adopting ordinance for the plumbing code.

1–9. On other matters of administration, the IPC and UPC have similar requirements and address those issues that need to be in the Administrative chapter of a plumbing code.

## C. CHAPTER 2 — DEFINITIONS

2–1. **IPC Section 202, GENERAL DEFINITIONS — ACCEPTED ENGINEERING PRACTICE.** The IPC includes a definition for this phrase and the UPC does not.

2–2. **IPC Section 202, GENERAL DEFINITIONS — ALTERNATIVE ENGINEERED DESIGN.** The last sentence of the IPC definition indicates "The system design is not specifically regulated by Chapters 3 through 12". Therefore, as part of any new design, an engineer would have to include all of the appropriate sections of the codes that were to still be enforced as part of his/her submission to give the code official something with which to inspect and approve the alternative engineered design, as the entire body of the IPC has been deleted by this definition.

The UPC includes alternative engineering methods under Section 301.2, Alternate Material and Methods which still requires compliance with the remaining provisions of the UPC.

2–3. **IPC Section 202, GENERAL DEFINITIONS — FLOOD HAZARD AREA.** The IPC defines flood hazard area. While the definition seems clear, there are many areas where locations are not normally subject to 1% flooding but could be during heavy rainstorms where runoffs could have high velocity water. Therefore, from an engineering standpoint it would be somewhat hard to define which zone a specific building is located in.

The UPC does not contain this confusing item.

## D. CHAPTER 3 — GENERAL REGULATIONS

3–1. **IPC Section 303.2, Installation of materials.** The material manufacturer's installation instructions are superseded by the installation provisions of the standard for that particular material. This could prevent a manufacturer from dictating the installation requirements for a specific material or product for which it is responsible.

UPC Section 310.4 requires that material be installed according to the code and the manufacturers recommendations. If there are conflicts, the more stringent is used.

3–2. **IPC Section 303.4, Third-party testing and certification**. The IPC has changed from requiring plumbing products and materials to be labeled by an approved agency to having them either tested or certified by a third party as indicated in Table 303.4. The IPC defines "third-party certification agency", "third-party certified", and "third-party tested", but it does not define the relationship between the third party and the first and second parties.

UPC Section 301.1.1 requires that all pipe, pipe fittings, traps, fixtures, material, and devices used in a plumbing system must be listed or labeled by a listing agency. The UPC defines "labeled", "listed", and "listing agency". The requirements of the IPC and UPC produce essentially the same end results with regard to the compliance of products and materials to accepted standards with considerably less confusion.

3–3. **IPC Section 307.1. STRUCTURAL SAFETY — Cutting, Notching or Bored Holes**. This section refers to the International Building Code for limitations n cutting, notching, and boring framing members. The IBC appears to have the same requirements for wood framing as Appendix F in the IPC (which is not referenced in Section 307.2), but Appendix F has additional requirements for cold–formed steel framing that do not appear to be included in the IBC.

The UPC refers the subject to the Building Code in Section 313.2.

3–4. **IPC Section 307.3. Penetration of Floor/Ceiling Assemblies and Fire–resistance Assemblies**. The IPC refers this matter to the IBC.

The UPC provides an entire chapter—Chapter 15 for the requirements for the use of fire stopping penetration in fire rated wall, floor or ceiling which are installed by plumbing contractors.

3–5. The IPC does not have any method to determine the minimum size of the hanger rods supporting pipe.

Table 3-1 of the UPC indicates the size of the pipe and the minimum rod size for hanging various size piping.

3–6. **IPC Table 308.5, HANGER SPACING.** An exception to Table 308.5 in Section 308.5 is that the interval of support to provide for expansion and contraction of any piping material must be handled as an alternative engineered design in accordance with IPC Section 105.4. This requires the input of a registered design professional for each project requiring provisions for the expansion and contraction of any piping. The reason for this unusual requirement is not obvious. Also, providing for expansion and contraction involves more than support spacing.

In the IPC, the maximum support spacing for ABS and PVC drainage pipe is four feet horizontally and ten feet vertically, with mid-story guides for pipe 2" and smaller.

UPC Table 3-2 requires mid-story guides for all sizes of ABS and PVC drainage pipe. In addition, it requires provisions for expansion at 30-foot intervals per the IAPMO Installation Standards for ABS and PVC drainage pipe. The provisions for expansion and contraction of such piping are addressed by the UPC and do not need to be handled as an alternative engineered design.

3–7. **IPC Table 308.5, HANGER SPACING.** This section lists support spacing for aluminum tubing, but aluminum tubing is not an approved material for any IPC piping systems.

The UPC does not list this material.

3–8. **IPC Table 308.5, HANGER SPACING.** Lists maximum vertical support spacing but does not refer to the base of risers or support at floor levels. (Section 308.9 addresses base of stacks only).

UPC Table 3-2 is generally more detailed. It specifically calls for vertical support at the base of risers and at floor levels.

3–9. **IPC Table 308.5, HANGER SPACING.** Footnote "a" requires that hangers shall be increased to 10-foot spacing where 10-foot lengths of cast iron pipe are used. (Emphasis added.) Furthermore, industry standards call for the supports to be within 18 inches of the joints in cast iron soil pipe. The IPC does not require this.

UPC Table 3-2 says "may be increased". (Emphasis added). There is no reason to prohibit support spacings of less than 10 feet in 10-foot lengths of pipe. Also, the UPC requires that the supports be within 18 inches of the joints.

3–10. **IPC Section 308.6, Sway bracing.** This section requires rigid-support sway bracing for all [emphasis added] pipe 4" and larger at turns greater than 45 degrees.

UPC Table 3-2 requires sway braces only for cast iron soil pipe (all sizes) and only at 40-foot intervals.

3–11. **IPC Section 308.7, Anchorage.** This section calls for restraining anchors on all drain pipe 4" and larger at changes in direction and where the pipe size changes by two (2) pipe sizes. This appears to be based on no-hub cast iron soil pipe, but the IPC does not say so.

UPC Table 3-2 requires bracing on cast iron pipe at 40-foot intervals to prevent horizontal movement.

3–12. **IPC Section 309, FLOOD HAZARD RESISTANCE — General.** Section 309.1 of the IPC refers to the International Building Code (IBC) for requirements for plumbing systems and equipment in flood hazard areas, but the IBC has no specific requirements for plumbing systems and equipment in flood hazard areas. Yet, IPC Sections 309.2 and 309.3, which are maintained by the IBC Committee, have specific requirements for plumbing systems and equipment in flood hazard areas. This is another case where references to other I – Codes are meaningless.

The UPC does not address how to flood proof a plumbing installation.

3–13. **IPC Section 312, TESTS AND INSPECTIONS.** This section includes tests for drain and vent piping, water supply pipe, sewers, and backflow preventers. These requirements are not included in the individual chapters.

The UPC includes individual test requirements of drain and vent, water supply, sewers, and backflow preventer assemblies, etc., in the specific individual chapters.

3–14. **IPC Section 312.9, Inspection and testing of backflow prevention assemblies.** This section still has some confusing requirements. All backflow prevention devices, even air gaps and non-testable devices, must be inspected annually for proper operation. There are no requirements on how to inspect these devices. However, like the UPC, testable devices must be tested at the time of installation, after repairs or relocation, and at least annually.

The UPC, national backflow prevention organizations, and device manufacturers do not require annual inspections of non-testable devices and air gaps.

3–15. The IPC does not specifically address plumbing in food handling establishments except for indirect waste, Section 802.1.1 and 802.1.2. The exception to 802.1.2 permits an air break when backwater valves are provided in drains from food storage areas. However, backwater valves are not 100% leak–proof and can permit sewage backups to contaminate food products.

The UPC addresses special plumbing requirements for food handling establishments and food storage areas in Sections 318.0 and 412.3. The UPC does not place reliance on backwater valves in such critical areas.

3–16. **IPC Section 313.1** references the *International Energy Conservation Code* in Chapter 13 — Referenced Standards.

The UPC does not address equipment efficiencies. The requirements of the energy conservation code that is adopted by the jurisdiction would apply.

3–17. **Section 314.2.2, Drain pipe materials and sizes.** The IPC requires air conditioning condensate drain piping, but does not provide any information as to required sizing.

The UPC in Table 8-2 provides minimum required condensate drain pipe size.

3–18. **Section 314.2.3, Auxiliary and Secondary Drain Systems.** The IPC provides requirements in the plumbing code for the secondary drain pan under cooling coils, which is usually provided by the HVAC contractor. Therefore, the plumbing inspector is required to approve equipment furnished under another scope of work.

The UPC does not include this provision.

## E. CHAPTER 4 - FIXTURES, FAUCETS, AND FIXTURE FITTINGS

4–1. **IPC Table 403.1, MINIMUM NUMBER OF REQUIRED PLUMBING FACILITIES.** This table generally requires fewer plumbing fixtures than UPC Table 4-1.

The current trend in the plumbing industry is to increase the minimum number of required fixtures due to complaints of inadequate "potty parity".

4–2. **IPC Section 404, ACCESSIBLE PLUMBING FACILITIES.** This section now refers to the IBC but the 2003 IBC has no specific requirements for plumbing fixtures.

UPC Section 408.7 defers to the applicable building regulations for accessibility requirements for plumbing fixtures and facilities.

4–3. **IPC Section 406, AUTOMATIC CLOTHES WASHERS.** The IPC requires the installation of either an integral air gap or an external backflow preventer for a domestic clothes washer. The IPC fails to recognize that the industry standard for domestic clothes washers requires that they have an internal air gap.

The UPC recognizes that domestic clothes washers have internal backflow protection. UPC Section 603.4.7 specifically excludes clothes washer hose connections from required backflow protection.

4–4. **IPC Section 409, DISHWASHING MACHINES.** The IPC requires either an air gap or a backflow preventer for domestic and commercial dishwashers. The IPC fails to recognize that the industry standards for dishwashing machines require that they have an internal air gap.

The UPC recognizes that dishwashing machines have built-in backflow protection and does not mention the possible need for external devices.

4–5. **IPC Section 412.4, Public Laundries and Central Washing Facilities.** The 2003 IPC still does not require floor drains in public toilet rooms. UPC Section 412.2.1 requires floor drains in public toilet rooms having two (2) or more water closets or a combination of one (1) water closet and one (1) urinal to accommodate housekeeping and the possible overflow of fixtures.

4–6. **IPC Section 419.2, Substitution for water closets.** The IPC permits urinals to be substituted for 67% of the minimum required number of water closets instead of 50%.

UPC Table 4-1 lists minimum required numbers of both water closets and urinals for males. If the number of urinals is increased above the minimum, one required water closet can be deducted for each additional urinal, except that the number of water closets cannot be reduced to less than 2/3 of the minimum requirements. The UPC provides more water closets and urinals than the IPC in most occupancies and assures an adequate number of water closets.

4–7. **Section 424, FAUCETS & OTHER FIXTURE FITTINGS**. The IPC in Section 424.3 requires shower valves control the maximum hot water temperature to showers to 120ºF. It does not regulate, however, the maximum hot water temperature to bathtubs.

The UPC in Section 421 limits the maximum discharge temperature to bathtubs to 120ºF.

4–8. **IPC Section 426.1, MANUAL FOOD AND BEVERAGE DISPENSING EQUPMENT — Approval.** This **s**ection requires that such equipment conform to ANSI/NSF 18. This makes the Administrative Authority for plumbing responsible for this equipment, which is not considered plumbing equipment.

The UPC does not include manual food and beverage dispensing equipment in its scope, except for any required potable water connections or provisions for drainage.

## F. CHAPTER 5 - WATER HEATERS

5–1. **Section 502.1, General.** The IPC references the International Fuel Gas Code for gas-fired water heaters.

The UPC includes complete requirements for gas-fired water heaters in its Chapter 5. Gas piping is included in Chapter 12 and appliance venting is in Chapter 5.

5–2. **IPC Section 505.1, Unfired vessel insulation.** This section requires specific insulation on unfired hot water storage tanks.

The UPC does not contain this requirement. It would be regulated by the local energy conservation code.

5–3. **Water Heater Venting**. The IPC states that the installation of gas water heaters shall conform to the requirements of the International Fuel Gas Code.

The UPC contains the requirements for installing water heaters including the gas and venting.

## G. CHAPTER 6 — WATER SUPPLY AND DISTRIBUTION

6–1. **IPC Chapter 6, WATER SUPPLY AND DISTRIBUTION.** This section does not contain a water pipe sizing procedure. IPC Section 604.1 requires that piping be sized per "accepted engineering practice". It also requires that methods used to determine pipe sizes shall be approved, but it does not say how or by whom. Furthermore, it does not refer to Appendix E, which is supposedly an acceptable method.

UPC Section 610.0 covers sizing potable water piping. UPC Table 6-5 is used for sizing smaller systems of up to 50 water supply fixture units (WSFU) and 200 feet maximum length without a great deal of engineering. In addition, UPC Section 610.10 provides a mechanism for adapting flush valve fixtures in these moderate size systems that does not require the utilization of the engineered method to size the piping. This makes it much more convenient for the plumbing contractors, the plumbing inspectors for checking, and the engineers who do not want to do a lot of detailed engineering. Systems having more than 50 WSFU can be sized by Table 6-5 up to 1000 feet maximum, by the procedures in Appendix A, or by Appendix L.

6–2. **IPC Section 604.3, Water distribution system design criteria.** The "conditions of peak demand" under which fixtures are expected to perform according to Table 604.3 are not described. Furthermore, IPC Table 604.3 is not consistent with IPC Table 604.4 as noted below:

a. A lavatory that flows 2.2 gpm at 60 psig will not flow 2 gpm at 8 psig.

b. A shower head that flows 2.5 gpm at 80 psig will not flow 3 gpm at 8 psig nor 3.0 gpm at 20 psig.

c. A sink faucet that flows 2.2 gpm at 60 psig will not flow 2.5 gpm at 8 psig.

d. Table 604.4 lists 2.5 gpm maximum for showers but Table 604.3 lists 3 gpm required design flow.

e. Table 604.4 lists 0.5 gpm for public lavatories but Table 604.3 lists 2 gpm design for all lavatories. The flow rate of 0.5 gpm is associated with self-closing faucets.

6–3. **IPC Table 604.3, WATER DISTRIBUTION SYSTEM DESIGN CRITERIA, REQUIRED CAPACITIES AT FIXTURE SUPPLY PIPE OUTLETS.** This table lists 8 psi flow pressure at the water supply pipe outlet for two-piece water closets. However, many ultra low flow water closets require higher water pressure for proper flushing. The IPC does not address this.

UPC Section 608.1, Inadequate Water Pressure, requires 15 psi minimum (residual) pressure at fixtures, and higher if required by the fixtures and/or fixture fittings.

6–4. The IPC does not dictate where self-closing and self-closing metering faucets are required to be installed.

UPC Section 402.4 requires that self-closing or self-closing metering faucets be installed on lavatories intended to serve the transient public, such as those in, but not limited to, service stations, train stations, airports, restaurants, and convention halls. This is consistent with current water conservation practices.

6–5. **IPC Section 604.5, Size of fixture supply.** This section allows up to a 30" reduced-size flexible tubing supply to each fixture. This can create a significant pressure drop, especially in light of the IPC's already reduced water pipe size allowance for some fixtures. (Also see Items 6-6 and 6-7 below.)

UPC Table 6-4 requires l/2" minimum supply pipes to all fixtures. Therefore, 30" reduced-size flexible connectors will still provide sufficient water pressure and flow at the fixtures.

6–6. **IPC Table 604.5, MINIMUM SIZES OF FIXTURE WATER SUPPLY PIPES.** This section permits 3/8" fixture water supply pipes for the following fixtures:

Bidets
Drinking fountains
Lavatories
Flush tank water closets
Flushometer tank water closets

The pressure loss created by 3.0 gallons per minute for a water closet in 3/8" PEX is 32.4 psig for a 60-foot run. This is excessive pressure loss.

UPC Table 6-4 requires 1/2" minimum supply pipe to all fixtures.

6–7. **IPC Table 604.5, MINIMUM SIZES OF FIXTURE WATER SUPPLY PIPES, Footnote "a".** This footnote states "Where the developed length of the distribution line is 60 feet or less, and the available pressure at the meter is a minimum of 35 psi, the minimum size of an individual distribution line supplied from a manifold and installed as part of a parallel water distribution system shall be one nominal tube size smaller than the sizes indicated". (Emphasis added).

This footnote requires that all parallel water distribution supply lines that were 3/8" be reduced to 1/4" and 1/2" supply lines be reduced to 3/8". This mandatory reduction in size will not allow the required flow of water to the fixtures as required by Table 604.3. For example, for a shower with 2.5 gpm flow in 60 feet of 3/8" PEX equals 23.5 psig loss; residual required pressure of 8 psig; elevational loss of, say, six pounds; meter loss of, say, 2.0 psi, equals a total of 39.5 psig losses without fitting losses.

However, this pipe size reduction can be used with an incoming pressure of only 35 psig. Therefore, the water system cannot provide the required residual pressure and flow to the fixtures. Furthermore, if temperature controlled shower mixing valves or ultra low flow water closets are installed which require higher than 8 pounds residual pressure then the pressure deficiency is even greater. This footnote conflicts with Section 604.3.

UPC Table 6-4 requires 1/2" minimum supply pipe to all fixtures.

6–8. **IPC Section 604.9, Water hammer.** This section states that "The flow velocity of the water distribution system shall be controlled to reduce the possibility of water hammer". Flow velocities are "controlled" by pipe sizing. However, the IPC does not limit the flow velocities for the various water distribution piping materials.

The UPC limits the flow velocities in various piping materials in Sections 6-10.12, 6-10.12.1and 6-10.12.2 in Appendix A.

6–9. **IPC Section 604.10.1, Manifold sizing.** This section requires that the manifold shall be sized on the basis of the summation of the gpm demand of all the outlets (fixtures) supplied by the manifold. This over- sizes the manifold because it does not allow for normally accepted diversity in the use of fixtures, i.e., normally all fixtures do not operate at the same time.

The UPC allows manifolds to be sized on the basis of the same diversity as is used in sizing water piping.

6–10. **IPC Table 604.10.1, MANIFOLD SIZING.** This table has two columns, velocity at 4 feet and velocity at 8 feet per second. However, there is nothing in the IPC to dictate or mandate which column an individual is to utilize in sizing the water system manifold.

The UPC limits the velocity in various materials in its Installation Standards.

6–11. **IPC Table 605.4, WATER DISTRIBUTION PIPE.** This table does not prohibit the use of plastic insert fittings in polybutylene (PB) tubing. It also does not reference ASTM F1390 for metal insert fittings for PB tubing. However, IPC Section 605.19.3, Mechanical joints, mentions metallic lock rings but does not prohibit plastic insert fittings. The manufacturers of polybutylene tubing have blamed the failure of the product on the use of plastic insert fittings. They now recommend only brass insert fittings.

The UPC no longer approves PB piping for water systems due to the number of failures and lawsuits. Also, some jurisdictions prohibit flexible fixture supplies that are PB because of deterioration and failure because of the chlorine in public water systems.

6–12. **IPC Section 605.22.1, Copper or copper-alloy tubing to galvanized steel pipe.** This section does not restrict the joining of copper tubing and galvanized steel pipe except for how the joining is to be made. Also the IPC does not require such dissimilar joint connections to be exposed or accessible.

UPC Section 604.1 indicates that all material used in the water supply system, except valves and similar devices, shall be of a like material, except where otherwise approved by the Administrative Authority. Furthermore, UPC Section 311.6 indicates that except for necessary valves where intermembering or mixing of dissimilar metals occurs, the point of connection shall be confined to exposed or accessible locations.

6–13. **IPC Section 606.2, Location of shutoff valves.** Paragraph 2 requires a shutoff valve ahead of every sillcock.

The UPC does not have this mandatory requirement for all sillcocks. Shutoff valves could be installed if the installer wanted them.

6–14. **IPC Section 606.4, Valve Identification.** This section requires that all service valves, hose bibb valves, and valves not located adjacent to fixtures shall be identified. It is assumed that "hose bibb valves" are the shutoff valves required in 606.2 and not the hose bibb itself.

The UPC does not require valve identification. The function of most shutoff valves is obvious. Typical specifications for commercial construction work generally require labeling of valves.

6–15. **IPC Table 606.5.4, SIZES FOR OVERFLOW PIPES FOR WATER SUPPLY TANKS.** This table provides the required size for overflow pipes from various sizes of storage tanks. However, normally the overflow pipe size is dictated only by the size of the water supply pipe inlet. (The amount of water entering the tank and not by the size of the tank). Therefore, if the tank has a 1" supply pipe it might have a 2" overflow. However, this table does not relate to the size of the inlet pipe, but simply to the capacity of the storage tank. This results in extremely large overflow pipe sizes.

The UPC does not have this requirement.

6–16. **IPC Table 606.5.7, SIZE OF DRAIN PIPES FOR WATER TANKS.** This table dictates the mandatory size of a drain pipe from a water storage tank. This extremely oversized drain piping can create serious damage where this large volume of water drainage is going to be discharged.

The UPC does not contain this requirement.

6–17. **IPC Section 607.2, Hot water supply temperature maintenance.** This section requires that if a fixture is beyond 100 feet developed length from the water heater, a means for maintaining temperature shall be provided to within 100 feet of the fixture. With the allowance of 100 feet of un-maintained hot water supply, in many cases, this could require that only the first few feet of hot water pipe be insulated.

UPC does not address this procedure because it achieves little in energy conservation or water conservation with the allowance of 100 feet of un-maintained hot water supply.

6–18. **IPC Section 607.3.1, Pressure-reducing valve.** This section is very confusing being that the requirement for a means of controlling expansion is only required for service pipes 2" and smaller. Secondly, there is no indication that a device to control thermal expansion is required if the incoming pressure is higher than the relief valve pressure so that subsequently the integral bypass on a pressure-reducing valve would be non-functioning and, therefore, the system would have no provision to compensate for thermal expansion.

The UPC addresses this problem very clearly in the third paragraph of Section 608.3 where it indicates that if the water supply pressure is higher than the relief valve setting, a means of addressing thermal expansion must be provided regardless of the size of the water service.

6–19. **IPC Table 608.15.1, MINIMUM REQUIRED AIR GAPS.** In the IPC table "with effective openings not greater than 3/4" in diameter close to the wall," the minimum required air gap is 2-1/2", which is more restrictive than the UPC, which is only 2-1/4".

6–20. **IPC Section 608.16.3, Heat exchangers.** This section uses the terms "essentially toxic" and "essentially non-toxic" to address restrictions on the use of single-wall heat exchangers for domestic hot water. The IPC defines essentially non-toxic in Section 202, GENERAL DEFINITIONS, as having a Gosselin rating of 1. However, Gosselin ratings indicate the relative toxicity of various substances and household products ranging from a low of "1" to a high of "6". Furthermore, Gosselin's book is intended as an aid to doctors and poison control centers in quickly evaluating potential cases of poisoning that are phoned in. Products are not labeled with a Gosselin rating. The amount of the substance ingested is also a factor in its toxicity. For example, potable water can cause death if too much is ingested.

The Commentary on the 2000 IPC describes a Gosselin rating of "1" as practically non-toxic. (Emphasis added). The lethal dose of a substance having a Gosselin rating of "1" is listed as "more than 1 quart" for a 150 pound person. The IPC does not require that single-wall heat exchangers be permanently marked to indicate the restrictions on additives nor does IPC Section 608.16.3 require single-wall heat exchangers to have warning labels.

UPC Appendix L 3.2 permits single-wall heat exchangers if any additives used are recognized as safe by the FDA. Such products would typically bear the FDA approval. Furthermore, the UPC requires that the equipment must be permanently labeled to indicate that only FDA approved additives shall be used.

6–21. **IPC Section 608.16.4, Connections to automatic fire sprinkler systems and standpipe systems.** This section places no restrictions on the use of double check valve assemblies or double check detector assemblies for backflow protection from fire protection systems.

UPC Section 603.4.18.2 permits only reduced pressure backflow preventers or reduced pressure detector assemblies where there is a non-potable water source (such as a pond or stream) within 1700 feet of a fire department connection. This corresponds to the recommendations of national backflow prevention organizations. (AWWA M14, Class 4)

6–22. **IPC Table 608.17.1, DISTANCE FROM SOURCES OF CONTAMINATION TO PRIVATE WATER SUPPLIES AND PUMP SUCTION LINES.** A comparison of IPC Table 608.17.1 and UPC Table K-1 shows a significant reduction in the IPC in the required separation between water wells and seepage pits, septic tanks, sewers, and subsurface disposal fields. The writers are not aware of any justification for this significant reduction in these dimensions.

For SI: 1 foot = 304.8 mm.

| IPC TABLE 608.17.1 DISTANCE FROM SOURCES OF CONTAMINATION TO PRIVATE WATER SUPPLIES AND PUMP SUCTION LINES | | UPC TABLE K-1 LOCATION OF WATER SUPPLY WELLS |
|---|---|---|
| SOURCE OF CONTAMINATION | DISTANCE (Feet) | DISTANCE (Feet) |
| Barnyard | 100 | Not included |
| Farm Silo | 25 | Not included |
| Pasture | 100 | Not included |
| Pumphouse floor drain of cast iron draining to ground surface | 2 | Not included |
| Seepage pits | 50 | 150 |
| Septic tank | 25 | 50 |
| Sewer | 10 | 50[3] |
| Subsurface disposal fields | 50 | 100 |
| Subsurface pits | 50 | Not included |

UPC Footnote 3, "All drainage piping shall clear domestic water supply wells by at least fifty (50) feet (15240 mm). This distance may be reduced to not less than twenty-five (25) feet (7620 mm) when the drainage piping is constructed of materials approved for use within a building."

6–23. **IPC Section 609, HEALTH CARE PLUMBING.** This section deals with partial requirements of health care plumbing and health care water systems.

The UPC has added some special requirements for health care plumbing in Chapter 13 and in the backflow protection section of Chapter 6. The unique requirements for plumbing in hospitals are usually established by the design professionals and governmental agencies that oversee their design and operation.

6–24. **IPC Section 609.2, Water service.** This section requires that all hospitals have two water services regardless of the size of the facility, the number of beds, or the fact that the public water system may only have one water main in the adjacent area. Therefore, this code requirement seems to be excessive and beyond the normal requirements of a minimum plumbing code.

The UPC does not have this requirement.

6–25. **IPC Section 609.7, Condensate drain trap seal.** This section requires that a water supply be provided for cleaning, flushing, and resealing the [emphasis added] condensate traps in health care facilities. It is not clear whether this requirement is meant for all condensate traps in health care facilities or just certain traps on special equipment, which are not identified. As written, the IPC requires that water supplies be run to all HVAC condensate traps for maintenance purposes. This is a very unusual and excessive requirement. A local water supply is not needed to maintain HVAC traps. The writers are not aware of any piece of equipment that needs a local water supply for condensate trap maintenance.

The UPC does not have this requirement.

## H. CHAPTER 7, SANITARY DRAINAGE

7–1. **IPC Section 702, MATERIALS.** This section has no restrictions on the location of ABS and PVC drain and waste piping.

UPC Section 701.1.2 has been revised and no longer prohibits ABS and PVC DWV piping in structures that are higher than three stories above grade. It does add limits on flame-spread index and smoke-developed index for piping exposed in ducts or plenums, except in individual dwellings. Also, Chapter 15, FIRE STOP PROTECTION defines protection required when penetrating walls, floors or ceilings.

7–2. **IPC Section 704.3, Connections to offsets and bases of stacks.** This section allows fixture connections at bases of stacks or stack offsets as close as ten pipe diameters downstream from the base of the stacks or the stack offsets. However, with sudsing, this dimension could be insufficient to prevent the suds from coming up into a fixture located near the base of the stack or stack offset.

UPC Section 711.0, Suds Relief, dictates a minimum of 8 feet from the base of the stack containing discharge from suds-producing fixtures to any connection to a fixture, with certain exceptions.

7–3. **IPC Section 704.5, Dead ends.** This section prohibits the installation of dead ends which in the definitions are listed as any developed length of greater than two feet. However, cleanout extensions and approved future fixture drainage piping are not considered dead ends. Therefore, with all of these exceptions, why does the IPC prohibit dead ends?

The UPC does not have this restriction on dead ends.

7–4. **IPC Section 705.16.2, Copper or copper-alloy tubing to galvanized steel pipe.** This section requires that the connection between copper tubing and galvanized steel be made with a brass converter fitting or dielectric fitting. The writers have not seen dielectric fittings normally used on waste or vent piping.

The UPC does not have this requirement in the drainage section of the code.

7–5. **IPC Table 706.3, FITTINGS FOR CHANGE IN DIRECTION.** This table is more liberal than the UPC in its use of short radius fittings, particularly on individual fixture drains. However, the table fails to recognize the differences in terminology for the various fitting patterns in different drain pipe materials. For example, a hubless cast iron short sweep is not a short radius fitting and its use need not be restricted. In the plumbing industry, there are some fitting pattern names that are specific to only one material.

UPC Section 706.0 does not permit 1/4 bends or other short radius fittings in individual branch drains.

7–6. **IPC Section 708.3.2, Building Sewers.** The IPC requires that all [emphasis added] sewers 8" and larger have manholes installed at each change of direction and at intervals not to exceed 400 feet. However, as written, building sewers 8" size and larger require cleanouts at 100-foot intervals plus [emphasis added] manholes at 400-foot intervals.

UPC Section 719.6 indicates that manholes may be used on any size sewer in lieu of cleanouts when approved by the Administrative Authority. Distance between manholes shall not exceed 300 feet.

7–7. **IPC Section 708.3.3, Change of Direction.** The IPC requires a cleanout at every change of direction greater then 45 degrees, but does not require a cleanout closer than every 40 feet. Therefore, this section may require more cleanouts in drainage piping than UPC 707.0. Furthermore, regardless of how many changes of direction occur on a drain or waste line within a 40' interval, still only one cleanout is required by the IPC.

UPC Section 707.0 requires cleanouts every 100 feet. Exceptions include lines less than five feet long and all lines above the first floor of the building. Furthermore, an additional cleanout is required for each aggregate horizontal change of direction exceeding 135 degrees. The requirement for fewer cleanouts in the UPC has not proven to be a problem in clearing blockages in drainage piping.

7–8. **IPC Section 708.3.4, Base of stack.** This section requires that cleanouts be installed at the base of each waste or soil stack regardless of their location within the building.

The UPC only requires cleanouts if the base of the stack is part of the building drain or the lowest drain line. The requirement for fewer cleanouts in the UPC has not proven to be a problem in clearing blockages in drainage piping when modern drain cleaning equipment is used.

7–9. **IPC Section 708.4, Concealed piping.** This section requires that cleanouts be provided on all drainage piping in concealed spaces. This would require that drainage piping above the ceiling is required to be provided with cleanouts and, if the ceiling space is less than 24", the cleanout would have to be extended up to a finished wall or out through the face of the building.

The UPC only requires cleanouts on the building drain, not on drainage piping above the lowest floor.

7–10. **IPC Section 708.4, Concealed Piping.** This section requires that the piping cleanout, where the crawl space is less than 24", shall be extended through and terminate flush with finished wall, floor, or ground surface, or shall be extended to outside the building.

UPC Section 707.10 indicates that the piping cleanout shall be extended to outside the building when there is less than 18"' vertical and 30" horizontal clearance from the means of access to such cleanout and that no under-floor cleanout shall be located more than 20 feet from an access door, trap door, or crawl hole. This provides better safety for the building occupant and service personnel.

7–11. **IPC Section 708.8, Clearances.** This section requires that cleanouts on 6" and smaller pipes shall be provided with clearance of not less than 18" and cleanouts on 8" and larger pipes shall have a clearance of not less than 36".

UPC Section 707.10 is less restrictive than the IPC as it only requires that cleanouts on piping 2" or less shall have a clearance of 12" in front of the cleanout, and cleanouts on piping larger than 2" shall have a clearance of not less than 18". The requirement for less clearance for cleanouts in the UPC has not proven to be a problem in clearing blockages in drainage piping.

7–12. **IPC Table 709.1, DRAINAGE FIXTURE UNITS FOR FIXTURES AND GROUPS.** The IPC distinguishes between the demands of private and public plumbing fixtures only for water closets. The dfu values for flushometer tank water closets is the same whether private or public. The IPC fails to recognize use patterns for most other fixtures, which the UPC does. Plus the IPC does not recognize the higher demands caused by continuous use in assembly occupancies. Furthermore, the table omits listing significant types of fixtures which are in common use.

UPC Table 7–3 has private, public, and assembly user groups. The table still better addresses the demands of the various fixtures based on their application. The dfu values in Table 7–3 are based on research by Stevens Institute, which revealed that peak drainage loads in dwellings are caused by bathtubs or combination bath/showers, clothes washers, and dishwashers. The time duration of these discharges is relatively long and combines with other fixtures to create the peak drainage loads.

UPC Table 7–3 also includes a much greater classification of fixture types for simplicity of use, as shown below. The UPC table contains 41 line items as opposed to only 27 contained in the IPC Table 709.1 (a 50% increase in fixture classifications).

| ↓ Arrows indicate IPC Table 709.1 fixture classifications. | UPC Table 7-3 – Plumbing Appliance, Appurtenance or Fixture | Uniform Plumbing Code Table 7-3 Drainage Fixture Unit Values (DFU) | | | | International Plumbing Code Table 709.1 Drainage Fixture Units for Fixtures & Groups | |
|---|---|---|---|---|---|---|---|
| | | Minimum Size Trap & Trap Arm[7] | Private | Public | Assembly[8] | Drainage Fixture Unit Value as Load Factors | Minimum Size of Trap (Inches) |
| → | Automatic Clothes Washers, commercial[a,G] | — | — | — | — | 3 | 2" |
| → | Automatic Clothes Washers, residential | — | — | — | — | 2" | 2" |
| → | Bathroom group as defined in Section 202 (1.6 GPF water closet)[f] | — | — | — | — | 5 | — |
| → | Bathroom group as defined in Section 202 (water closet flushing greater than 1.6 GPF)[f] | — | — | — | — | 6 | — |
| → | Bathtub[b] (with or without overhead shower or whirlpool attachments) | — | — | — | — | 2 | 1-1/2" |
| | Bathtub or Combination Bath/Shower | 1-1/2" | 2.0 | 2.0 | — | — | — |
| → | Bidet | 1-1/4" | 1.0 | — | — | 1 | 1-1/4" |
| | Bidet | 1-1/2" | 2.0 | — | — | — | — |
| | Clothes Washer, domestic, standpipe[5] (Residential) | 2" | 3.0 | 3.0 | 3.0 | — | — |
| → | Combination Sink and Tray | — | — | — | — | 2 | 1-1/2" |
| → | Dental Lavatory | — | — | — | — | 1 | 1-1/4" |
| → | Dental Unit or Cuspidor | 1-1/4" | — | 1.0 | 1.0 | 1 | 1-1/4" |
| → | Dishwasher, domestic, with independent drain | 1-1/2"[2] | 2.0 | 2.0 | 2.0 | 2 | 1-1/2" |
| → | Drinking Fountain or Water Cooler (per head) | 1-1/4" | 0.5 | 0.5 | 1.0 | 0.5 | 1-1/4" |
| | Food-waste-grinder, commercial | 2" | — | 3.0 | 3.0 | — | — |
| → | Floor Drain, emergency | 2" | — | 0.0 | 0.0 | 0 | 2" |
| | Floor Drain (for additional sizes see Section 702) | 2" | 2.0 | 2.0 | 2.0 | — | — |
| → | Floor Drains | — | — | — | — | 2 | 2" |
| | Shower single head trap | 2" | 2.0 | 2.0 | 2.0 | — | — |
| | Multi-head, each additional | 2" | 1.0 | 1.0 | 1.0 | — | — |
| → | Lavatory, single | 1-1/4" | 1.0 | 1.0 | 1.0 | 1 | 1-1/4" |
| | Lavatory in sets of two or three | 1-1/2" | 2.0 | 2.0 | 2.0 | — | — |
| | Washfountain | 1-1/2" | — | 2.0 | 2.0 | — | — |
| | Washfountain | 2" | — | 3.0 | 3.0 | — | — |
| | Mobile Home, trap | 3" | 12.0 | — | — | — | — |
| | Receptor, indirect waste[1,3] | 1-1/2" | — | See Footnote 1,3 | | — | — |
| | Receptor, indirect waste[1,4] | 2" | — | See Footnote 1,4 | | — | — |
| | Receptor, indirect waste[1] | 3" | — | See Footnote 1 | | — | — |
| → | Shower | — | — | — | — | 2 | 1-1/2" |
| | Sinks | | | | | | |
| | Bar | 1-1/2" | 1.0 | — | — | — | — |
| | Bar | 1-1/2"[2] | — | 2.0 | 2.0 | — | — |
| | Clinical | 3" | — | 6.0 | 6.0 | — | — |
| | Commercial with food waste | 1-1/2"[2] | — | 3.0 | 3.0 | — | — |
| → | Sink | — | — | — | — | 2 | 1-1/2" |
| | Special Purpose | 1-1/2" | 2.0 | 3.0 | 3.0 | — | — |
| | Special Purpose | 2" | 3.0 | 4.0 | 4.0 | — | — |
| | Special Purpose | 3" | — | 6.0 | 6.0 | — | — |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| → | Kitchen, domestic (with or without food-waste-grinder and/or dishwasher) | 1-1/2"[2] | 2.0 | 2.0 | — | 2 | 1-1/2" |
| → | Laundry (with or without discharge from a clothes washer) (1 or 2 compartments) | 1-1/2" | 2.0 | 2.0 | 2.0 | 2 | 1-1/2" |
| | Service or Mop Basin | 2" | — | 3.0 | 3.0 | — | — |
| | Service or Mop Basin | 3" | — | 3.0 | 3.0 | — | — |
| | Service, flushing rim | 3" | — | 6.0 | 6.0 | — | — |
| → | Wash, each set of faucets (circular or multiple) | — | — | 2.0 | 2.0 | 2 | 1-1/2" |
| → | Urinal | — | — | — | — | 4 | Footnote d |
| → | Urinal, 1 gallon per flush or less | — | — | — | — | 2[e] | Footnote d |
| | Urinal, integral trap 1.0 GPF[2] | 2" | 2.0 | 2.0 | 5.0 | — | — |
| | Urinal, integral trap greater than 1.0 GPF | 2" | 2.0 | 2.0 | 6.0 | — | — |
| | Urinal, exposed trap | 1-1/2"[2] | 2.0 | 2.0 | 5.0 | — | — |
| → | Water Closet, 1.6 GPF Gravity Tank[6] | 3" | 3.0 | 4.0 | 6.0 | 3[e] Private | Footnote d |
| | Water Closet, 1.6 GPF Flushometer Tank[6] | 3" | 3.0 | 4.0 | 6.0 | — | — |
| → | Water Closet, Flushometer Tank, public or private | — | — | — | — | 4[e] | Footnote d |
| | Water Closet, 1.6 GPF Flushometer Valve[6] | 3" | 3.0 | 4.0 | 6.0 | — | — |
| → | Water Closet, greater than 1.6 GPF Gravity Tank[6] | 3" | 4.0 | 6.0 | 8.0 | 4[e] Private | Footnote d |
| | Water Closet, greater than 1.6 GPF Flushometer Valve[6] | 3" | 4.0 | 6.0 | 8.0 | — | — |
| → | Water Closet, public (1.6 GPF) | — | — | — | — | 4[e] | Footnote d |
| → | Water Closet, public (flushing greater than 1.6 GPF) | — | — | — | — | 6[e] | Footnote d |

**UPC Footnotes**

1. Indirect waste receptors shall be sized based on the total drainage capacity of the fixtures that drain therein to, in accordance with Table 7-4.
2. Provide a 2" (52 mm) minimum drain.
3. For refrigerators, coffee urns, water stations, and similar low demands.
4. For commercial sinks, dishwashers, and similar moderate or heavy demands.
5. Buildings having a clothes washing area with clothes washers in a battery of three (3) or more clothes washers shall be rated at six (6) fixture units each for purposes of sizing common horizontal and vertical drainage piping.
6. Water closets shall be computed as six (6) fixture units when determining septic tank sizes based on Appendix K of this Code.
7. Trap sizes shall not be increased to the point where the fixture discharge may be inadequate to maintain their self-scouring properties.
8. Assembly [public use (See Table 4-1)].

**IPC Footnotes**

a. For traps larger than 3 inches, use Table 709.2.
b. A showerhead over a bathtub or whirlpool bathtub attachments does not increase the drainage fixture unit value.
c. See Sections 709.2 through 709.4 for methods of computing unit value of fixtures not listed in Table 709.1 or for rating of devices with intermittent flows.
d. Trap size shall be consistent with the fixture outlet size.
e. For the purpose of computing loads on building drains and sewers, water closets or urinals shall not be rated at a lower drainage fixture unit unless the lower values are confirmed by testing.
f. For fixtures added to a dwelling unit bathroom group, add the DFU value of those additional fixtures to the bathroom group fixture count.
g. See Section 406.3 for sizing requirements for fixture drain, branch drain, and drainage stack for an automatic clothes washer standpipe.

| Inch | 1-1/4 | 1-1/2 | 2 | 2-1/2 | 3 |
|---|---|---|---|---|---|
| mm | 32 | 40 | 50 | 65 | 80 |

For SI: 1 inch = 25.4 mm, 1 gallon = 3.785 L.

7–13. The IPC and UPC both require 1-1/2" minimum traps on kitchen sinks. The IPC permits a 1-1/2" branch drain. However, the UPC requires a 2" drain beyond the trap on any sink, as there may be food waste now or in the future.

7–14. **IPC Table 709.2, DRAINAGE FIXTURE UNITS FOR FIXTURE DRAINS OR TRAPS.** The DFU values for drain and trap sizes of fixtures not listed in Table 709.1 are less than required in UPC 702.0 as shown below.

| IPC TABLE 709.2<br>DRAINAGE FIXTURE UNITS FOR FIXTURE DRAINS OR TRAPS | |
|---|---|
| FIXTURE DRAIN OR TRAP SIZE (INCHES) | DRAINAGE FIXTURE UNIT VALUE |
| 1-1/4 | 1 |
| 1-1/2 | 2 |
| 2 | 3 |
| 2-1/2 | 4 |
| 3 | 5 |
| 4 | 6 |

For SI: 1 inch = 25.4 mm.

| UPC TABLE 702.0<br>FIXTURE UNIT EQUIVALENTS | |
|---|---|
| DRAINAGE FIXTURE UNIT VALUE | |
| 1-1/4" | 1 Unit |
| 1-1/2" | 3 Units |
| 2" | 4 Units |
| — | — |
| 3" | 6 Units |
| 4" | 8 Units |

Exception: On self-service laundries.

7–15. **IPC Section 710.1, Maximum fixture unit load.** The IPC fixture loading for drainage piping as shown in Table 710.1(1), BUILDING DRAINS AND SEWERS, is more liberal in some cases than the fixture loading shown in UPC Table 7-5. However, UPC Table 7-5 allows greater DFUs on horizontal lines than does IPC Table 710.1(2) for "total for a horizontal branch". Therefore, the UPC has greater allowance for DFU carrying capacity in horizontal drain lines for most installations. See comparisons below.

| **IPC TABLE 710.1(1)**<br>**Building Drains and Sewers** | |
|---|---|
| | MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS CONNECTED TO ANY PORTION OF THE BUILDING DRAIN OR THE BUILDING SEWER, INCLUDING BRANCHES OF THE BUILDING DRAIN[a] |
| DIAMETER OF PIPE (INCHES) | SLOPE PER FOOT<br>1/4 INCH |
| 1-1/4 | 1 |
| 1-1/2 | 3 |
| 2 | 21 |
| 2-1/2 | 24 |
| 3 | 42 |
| 4 | 216 |
| 5 | 480 |
| 6 | 840 |
| 8 | 1,920 |
| 10 | 3,500 |
| 12 | 5,600 |
| 15 | 10,000 |

For SI: 1 inch = 25.4 mm, 1 inch per foot = 0.08.33 mm/m.

a. The minimum size of any building drain serving a water closet shall be 3 inches.

| **IPC Table 710.1(2)**<br>**Horizontal Fixture Branches and Stacks**[a] |
|---|
| MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS (DFU) |
| TOTAL FOR A<br>Horizontal Branch |
| — |
| 3 |
| 6 |
| 12 |
| 20 |
| 160 |
| 360 |
| 620 |
| 1,400 |
| 2,500 |
| 2,900 |
| 7,000 |

For SI: 1 inch = 25.4 mm.

a. Does not include branches of the building drain. Refer to Table 710.1(1).

| **UPC TABLE 7-5**<br>**MAXIMUM UNIT LOADING AND MAXIMUM LENGTH OF DRAINAGE AND VENT PIPING** | |
|---|---|
| SIZE OF PIPE<br>INCHES (mm) | MAXIMUM UNITS<br>DRAINAGE PIPING[1]<br>HORIZONTAL |
| 1-1/4 (32) | 1 |
| 1-1/2 (40) | 1 |
| 2 (50) | 8[3] |
| 2-1/2 (65) | 14[3] |
| 3 (80) | 35[4] |
| 4 (100) | 216[5] |
| 5 (125) | 428[5] |
| 6 (150) | 720[5] |
| 8 (200) | 2,640[5] |
| 10 (250) | 4,680[5] |
| 12 (300) | 8,200[5] |

1. Excluding trap arm
2. Except sinks, urinals and dishwashers.
3. Except six-unit traps or water closets.
4. Only four (4) water closets or six-unit traps allowed on any vertical pipe or stack; and not to exceed three (3) water closets or six-unit traps on any horizontal branch or drain.
5. Based on one-fourth (1/4) inch per foot (20.9 mm/m) slope. For one-eighth (1/8) inch per foot (10.4 mm/m) slope, multiply horizontal fixture units by a factor of 0.8.

7–16. **IPC Section 710, DRAINAGE SYSTEM SIZING, and Tables 709.1 and 709.2.** Nowhere does it require that the minimum size for drainage piping for a water closet shall be 3". Also, Table 710.1(1) indicates that the minimum size for a building drain (emphasis added) serving a water closet shall be 3" but the IPC does not indicate the requirement that a minimum branch size to the water closet shall be 3". Therefore, it could be 2-1/2", which is the trap way for some water closets.

UPC Tables 7-3 and 7-5 require a minimum of 3" drain piping for water closets.

7–17. **IPC Section 710.1.1, Horizontal stack offsets.** The IPC requires that horizontal stack offsets be sized as shown in Table 710.1(1), except as modified by Section 711.4. The reference to modification by Section 711.4 is confusing because Section 711.4 requires the same thing as Section 710.1.1.

The UPC requires only Table 7-5 for determination of vertical and horizontal pipe sizing and does not require other considerations for pipe sizing.

7–18. **IPC Table 710.1(2), HORIZONTAL FIXTURE BRANCHES AND STACKS.** There appears to be a typographical error for the maximum number of DFUs on a 12" horizontal branch drain. The "2900" should probably read "3900".

7–19. **IPC Section 710.1.2, Vertical stack offsets.** The IPC requires that vertical offsets be sized in accordance with Table 710.1(2) except as modified by Section 711.1.1. The IPC language is confusing. Section 711.1.1 does not require that a vertical offset be sized as a building drain. It merely permits vents (if necessary) to be omitted if the offset is sized as a building drain.

The UPC only requires the sizing of the offsets to be as shown in Table 7–5 with no other considerations required for pipe sizing.

7–20. **IPC Section 710, DRAINAGE SYSTEM SIZING, and Section 711, OFFSETS IN DRAINAGE PIPING IN BUILDINGS OF FIVE STORIES OR MORE.** These sections use branch intervals in sizing drainage stacks. Table 710.1(2) has limits on the total number of drainage fixture units that:

(1) can discharge into one (1) branch interval. This makes sure that the stack is large enough that the flow introduced in one (1) branch interval does not block the stack and restrict its flow.

(2) can discharge into stacks of up to three (3) branch intervals. This adds some diversity in the total number of DFUs allowed.

(3) can discharge into stacks of greater than three (3) branch intervals. This includes more diversity in the total allowable load on the stack.

By definition, branch intervals correspond to a story height but are not less than eight (8) feet high. This is so that where there are branch connections from fixtures on one floor that have connections both above and below the floor, it does not count as more than one (1) branch interval.

However, a problem can occur if the floors of the building are staggered and drain connections from fixtures on two (2) floors occur within an eight (8) foot height.

UPC Table 7-5 does not use the branch interval principle and also allows 1-1/4" stacks for one DFU fixtures. Furthermore, the UPC permits greater carrying capacity in vertical drainage piping than does the IPC in most of their "one branch interval stacks" and "three branch intervals or less" which results in smaller drainage sizing with the UPC method for most installations. For comparison of the carrying capacity of stacks, see the following tables;

**IPC TABLE 710.1(2)**
**HORIZONTAL FIXTURE BRANCHES AND STACKS [a]**

| DIAMETER OF PIPE (INCHES) | MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS (DFU) STACKS [b] | | |
|---|---|---|---|
| | TOTAL DISCHARGE INTO ONE BRANCH INTERVAL | TOTAL FOR STACK OF THREE BRANCH INTERVALS OR LESS | TOTAL FOR STACK GREATER THAN THREE BRANCH INTERVALS |
| — | — | — | — |
| 1-1/2 | 2 | 4 | 8 |
| 2 | 6 | 10 | 24 |
| 2-1/2 | 9 | 20 | 42 |
| 3 | 20 | 48 | 72 |
| 4 | 90 | 240 | 500 |
| 5 | 200 | 540 | 1,100 |
| 6 | 350 | 960 | 1,900 |
| 8 | 600 | 2,200 | 3,600 |
| 10 | 1,000 | 3,800 | 5,600 |
| 12 | 1,500 | 6,000 | 8,400 |
| 15 | Footnote c | Footnote c | Footnote c |

For SI: 1 inch = 25.4 mm.

a. Does not include branches of the building drain. Refer to Table 710.1(1).
b. Stacks shall be sized based on the local accumulated connected load at each story or branch interval. As the total accumulated connected load decreases, stacks are permitted to be reduced in size. Stack diameters shall not be reduced to less than one-half of the diameter of the largest stack size required.
c. Sizing load based on design criteria.

**UPC TABLE 7-5**
**MAXIMUM UNIT LOADING AND MAXIMUM LENGTH OF DRAINAGE AND VENT PIPING**

| SIZE OF PIPE INCHES (mm) | MAXIMUM UNITS DRAINAGE PIPING [1] VERTICAL |
|---|---|
| 1-1/4 (32) | 1 |
| 1-1/2 (40) | 2[2] |
| 2 (50) | 16[3] |
| 2-1/2 (65) | 32[3] |
| 3 (80) | 48[4] |
| 4 (100) | 256 |
| 5 (125) | 600 |
| 6 (150) | 1,380 |
| 8 (200) | 3,600 |
| 10 (250) | 5,600 |
| 12 (300) | 8,400 |

1. Excluding trap arm
2. Except sinks, urinals and dishwashers.
3. Except six-unit traps or water closets.
4. Only four (4) water closets or six-unit traps allowed on any vertical pipe or stack; and not to exceed three (3) water closets or six-unit traps on any horizontal branch or drain.
5. Based on one-fourth (1/4) inch per foot (20.9 mm/m) slope. For one-eighth (1/8) inch per foot (10.4 mm/m) slope, multiply horizontal fixture units by a factor of 0.8.

7–21. **IPC Table 710.1(2), HORIZONTAL FIXTURE BRANCHES AND STACKS.** IPC 709.1 addresses whether or not water closets are rated for 1.6 GPF or greater than 1.6 GPF, but the IPC still has no restrictions on the number of water closets on a 3" drainage stack. As an example, if the stack served only water closets in hotel guest rooms, the IPC would permit as many as twenty-four (24) 1.6 GPF water closets on the stack.

The UPC restricts 3" stacks to four (4) water closets to avoid possible overloading of the stack in the event that more than the predicted number of fixtures are flushed simultaneously.

7–22. **IPC Section 711, OFFSETS IN DRAINAGE PIPING IN BUILDINGS OF FIVE STORIES OR MORE.** This section contains six sections with different requirements as to where the vents are required, how and where they have to be installed, and their sizing, etc. Furthermore, while the title of IPC Section 711 refers to "buildings of five stories or more", the text refers to branch intervals.

UPC Table 7–5 can be used directly to size stacks and offsets in stacks, but the UPC does not require sizing changes for venting offsets.

7–23. **IPC Section 712, SUMPS AND EJECTORS.** This section does not require that sewage ejector pumps in commercial and other "public use" occupancies be duplexed. Also Section 712.3 refers to a "sump pump" for a sewage sump. Sump pumps do not have the solids-handling capacity of a sewage pump.

UPC Section 710.9 requires dual sewage pumps or ejectors in "public-use" occupancies that function independently to assure continuous operation of the drainage system during maintenance or in the event of equipment failure.

7–24. **IPC Section 713, HEALTH CARE PLUMBING.** This section still includes many provisions that are outdated regarding local vents for sterilizers and bed pan washers. Boiling-type sterilizers are no longer used in modern health care facilities. The requirements for vacuum systems in Sections 713.4, 713.5, 713.6 and 713.7 are far from complete and do not include sufficient requirements to assure that medical vacuum disposal systems in health care facilities are safe and sanitary. These four (4) sections are not coordinated with IPC Section 1202.1, which references NFPA 99C for the design and installation of medical vacuum systems.

The UPC has been revised to include the special requirements for plumbing in health care facilities in its Chapter 13, where its extensive requirements for medical gas and vacuum systems are located. The UPC references both NFPA 99C – *Gas and Vacuum Systems* and its parent document, NFPA 99 – *Health Care Facilities*, either of which can be used for medical gas and vacuum systems in health care facilities.

7–25. The IPC has no specific requirements for suds relief at the base of stacks or offsets of stacks serving suds-producing fixtures, such as bathtubs, clothes washers, kitchen sinks, and dishwashers.

UPC Section 711.0, in order to prevent the sudsing backup problem, prohibits fixture connections within eight (8) feet of the base of the stack or offsets of stacks having suds-producing fixtures except in dwellings or stacks less than three (3) stories high.

7–26. **IPC Section 714, COMPUTERIZED DRAINAGE DESIGN.** This sounds impressive but it is largely meaningless. The section does not indicate what computer program design methods are approved. Furthermore, COMPUTERIZED DRAINAGE DESIGN does not mandate that the design comply with the minimum requirements of IPC Section 105.4, Alternative engineered design.

a. **IPC Section 714.2** requires that the load on the drainage system be determined by:

1) the simultaneous discharge conditions from fixtures, appurtenances, and appliances, or

2) the sequential discharge conditions from fixtures, appurtenances, and appliances, or

3) the peak usage design condition.

These three criteria represent three (3) completely different conditions and the IPC does not specify which condition is to be used.

b. **IPC Section 714.2.1, Fixture discharge profiles.** This section requires that the flow rate versus time be in accordance with manufacturer's specifications. This data is normally not published by manufacturers and would normally be difficult to obtain.

c. **IPC Section 714.3, Selections of drainage pipe sizes.** This section permits sizing the drainage pipe up to (but not at) its full-bore flow. Historically, drainage pipe sizing tables have been typically based on the drainage pipes flowing only half full. This provides for air movement above the flow and allows for temporary overloads and surges. The writers are not aware of any engineering exception to this fundamental requirement.

d. **IPC Section 714.3.1, Selecting pipe wall roughness.** This section sounds impressive but does not say anything. Allowance for aging, deposit, and corrosion are historically included in the drainage pipe sizing tables in most plumbing codes, being that over time most drainage piping ends up with a similar roughness factor.

The UPC does not prohibit the use of computers to size drainage piping, provided that the sizing complies with all requirements of Chapter 7, Sanitary Drainage. If the resulting pipe sizing is different from that required by Chapter 7, the design would be considered as an "engineered plumbing system" and would have to comply with the requirements of Appendix L.

Appendix L includes provisions to assure that the alternate design will comply with the public health and safety requirements of the code.

## I. CHAPTER 8, INDIRECT/SPECIAL WASTE

8–1. **IPC Section 802.1.2, Floor drains in food storage area**. The exception to this section permits an air break in lieu of an air gap on an indirect waste line from a food storage area that has a backwater valve. A backwater valve would be of benefit only if the flood level rim of the receptor was at or above the flood level of the food storage area. This exception places total reliance on the backwater valve to protect the stored food from contamination by backflow of sewage. Backwater valves typically do not provide the leak-tightness that this exception should require.

UPC Section 801.2.2 permits air breaks in indirect wastes from food storage areas, but requires that the floor level rim of the receptor be at least six (6) inches lower than the lowest floor drain (in the food storage area). It further requires that where the food storage area (and indirect waste pipe) may be under a vacuum, only air gaps are permitted. The UPC thus requires more protection from sewage backflow in food storage areas than the IPC.

8–2. **IPC Section 803.1, Waste water temperature.** This section requires that waste water above 140° Fahrenheit simply be discharged to an indirect waste receptor that is connected to the drainage system. This method, in itself, does not prevent the excessively hot water from entering the sanitary discharge system. Plumbing codes limit the temperature of waste discharge to protect the drain piping and also to prevent the high temperature from adversely affecting bacterial action in the sewage.

UPC Section 810.0 contains detailed requirements for the sumps and condensers that are necessary to cool the waste before it enters the drainage system. Furthermore, Table 8-1 contains minimum sizing for blowoff condensers and sump pipe sizing.

8–3. **IPC Section 803, SPECIAL WASTES.** This section provides minimum criteria for corrosive/chemical wastes.

UPC Section 811.0 provides a far more comprehensive code section controlling chemical waste discharge.

8–4. The IPC does not contain any specific criteria for sizing air conditioning condensate piping.

UPC Section 815.1 and 815.2 and Table 8-2 provide complete criteria for sizing air conditioning condensate piping.

## J. CHAPTER 9, VENTS

9-1. **IPC Section 902.1, Vents.** This section has no restrictions on the location of ABS and PVC vent piping.

UPC Section 903.1.2 has limits on flame-spread index and smoke-developed index for piping exposed in ducts or plenums, except in individual dwellings.

9–2. **IPC Section 903.1, Stack required.** This Section requires that there be at least one stack that is not less than one–half the required size of the building drain. This stack must extend from the building drain to the open air. This dictates that it be a vent stack, although stack vents are mentioned in Section 903.1.1 If none of the vent stacks in a system are one–half the size of the building drain, then the size of one would have to be increased or a separate vent stack of adequate size installed. The IPC does not permit the sizes of vents to be added to meet the requirement of this Section.

UPC Section 904.1 requires that each drainage system have one or more vents with an aggregate cross-sectional area that is not less than that of the largest required building sewer. This assures adequate venting of the system and typically adds little or no cost to the plumbing system, depending on its layout.

9–3. **IPC Section 903.2, Vent stack required.** This section requires vent stacks for drainage stacks having only five (5) branch intervals or more.

UPC Section 907.1 only requires vent stacks for drainage stacks extending ten (10) stories or more. There are no indications that this causes inadequate venting of the stack and branches of the building drain.

9–4. **IPC Section 904.2, Frost closure.** This section requires 3" minimum size vents to prevent frost closure. Furthermore, the IPC requires enlargement where the 97.5 percent value (ASHRAE) for outside design temperature is less than zero degrees Fahrenheit (-18 degrees C). This temperature, however, is not the minimum winter design temperature but is the normal winter heating design temperature for buildings. Normally in the middle of the night the heating system may or may not be at maximum capacity, but the plumbing system would still be exposed to the colder minimum temperature. Also from the *ASHRAE Design Manual*, the 97.5% value is exceeded in a normal year by at least 54 hours. Therefore, this 97.5% temperature is not the appropriate temperature to use to protect a plumbing vent terminal from freezing. The edition of the *ASHRAE Fundamentals Handbook* from which Appendix D was extracted also listed 99% temperature values. In addition, the more recent *ASHRAE Fundamentals Handbook* edition lists the mean of the annual daily minimum extremes which is the more appropriate temperature to be used for freeze protection.

UPC Section 906.7 requires 2" minimum vents to prevent frost and snow closure. The 2" size has proven to be adequate. Also, the UPC requires that any installation that has a minimum design temperature below zero degrees F. be so protected, as opposed to the 97.5% design temperature used by the IPC.

9–5. **IPC Section 904.5, Location of vent terminal.** This section allows that vent terminals may be two (2) feet above any opening and within ten (10) feet horizontally of an opening.

UPC Section 906.2 requires that vent terminals be at least three (3) feet above any opening within ten (10) feet horizontally. The three-foot dimension is derived from the Building Materials & Structures (BMS) 66, the basis of most modern plumbing codes.

9–6. **IPC Section 904.5, Location of vent terminal.** This section does not indicate how close a vent termination can be to a lot line or property line. It refers only to openings in buildings. Section 904.6 requires that a vent extension through a wall must be 10 feet from a lot line and 10 feet above grade, but this only applies to sidewall vents.

UPC Section 906.2, Vent Terminations, requires that vents terminate not less than three (3) feet in any direction from any lot line; alleys and streets excepted.

9–7. **IPC Section 904.6, Extension through the wall.** This section permits sidewall vent terminals. It does not require that the vent terminal be turned up or down. Furthermore, sidewall vents that terminate horizontally are subject to direct wind loads. A 45 mile per hour wind produces a pressure of 1" wg, which when added to the 1" wg design basis for the vent piping, could blow a 2" trap seal and create an unsanitary condition. In addition, sidewall vent terminals must be protected against the entrance of birds or rodents. Does this mean that screens must be provided? If so, this creates a maintenance problem and the potential for the vent becoming blocked and ineffective.

The UPC does not allow side wall vents but requires all vents to terminate above the roof.

9–8. **IPC Section 904.6, Extension through the wall.** This section does not indicate how far the vent line has to terminate from the wall. Therefore, wind blowing against the wall could create additional pressure even if the pipe is turned down or up, as the wall acts as a wind break. Furthermore, this section indicates that vents shall not be installed below a roof extension if they have soffit vents. However, one could have a roof extension without soffit vents and then sewer gas could be trapped underneath the roof extension and could migrate over to openable windows that are located ten feet away. This would allow sewer gas into the building and there is no prohibition against this condition in the IPC.

The UPC does not allow sidewall vents and also requires in Section 906.1 that the vent terminate not less than one foot from any vertical surface.

9–9. **IPC Section 904.7, Extension outside a structure.** This section again uses the 97.5 percent design temperature value for requirements for protection of vents outside the structure from freezing by insulation, heat or both. This is the wrong outside temperature to use. (See Item 9–4 above).

UPC Section 906.7 requires the use of the minimum design temperature instead of the 97.5% design temperature figure. Also, insulation alone will not keep a pipe outdoors from freezing.

9–10. **IPC Section 905.2, Grade.** This section indicates that all vent pipes be so graded (emphasis added) and connected as to drain back to the drainage pipe by gravity.

UPC Section 905.1 indicates that "all vents shall be free from drops or sags and such vents shall be level or shall be graded and connected as to drip back by gravity to the drainage pipes". Therefore, it is not required to grade vents. This simplifies the installation of vent piping by not having to grade them.

9–11. **IPC Section 906.1, Distance of trap from vent, and Table 906.1, MAXIMUM DISTANCE OF FIXTURE TRAP FROM VENT.** This section and table establish the allowable distances between traps and their protecting vents to prevent self-siphonage. The purpose is to keep the vent pipe opening at the end of the trap arm above the overflow weir of the trap.

UPC Table 10-1 has allowable trap arm lengths that are less than those shown in IPC Table 906.1.

9–12. **IPC Section 909, WET VENTING.** This section has criteria for horizontal and vertical wet venting two bathroom groups on the same floor. However, the code does not fully describe how to determine the DFU load in the various portions of the wet vent piping. In the Commentary of the 2000 IPC, it takes one (1) full page of text and twenty three (23) diagrams to explain all of the possible conditions that affect the arrangement of the wet vent piping and its sizing. This section specifically addresses two bathroom groups. It is not clear whether wet venting is permitted in a single bathroom group.

**IPC Section 909.1, Wet vent permitted.** This section allows the fixtures to be connected in any combination and permits water closets to discharge into the wet vent piping. IPC Table 704.1 permits 3" drain piping to be sloped at only 1/8" per foot. Thus, the discharge of one or two water closets into a 3" wet vent sloped at 1/8" per foot could interfere with its venting function.

The UPC includes wet venting of single and back-to-back bathroom groups in Appendix L 6.2 and 6.3 for those jurisdictions who permit this method of venting.

9–13. **IPC Section 910, WASTE STACK VENT.** This section permits waste stacks to vertically wet vent limited numbers of drainage fixture units (DFU) in a single stack concept. The DFUs are limited to 1/3 to 1/20 the maximum allowed DFUs for waste stacks with vented fixtures.

The UPC does not recognize waste stack venting other than vertical wet venting as allowed in Section 908.0.

9–14. **IPC Section 911, CIRCUIT VENTING.** This section permits circuit venting of up to eight (8) fixtures on a horizontal branch drain without venting the individual fixtures. This practice is common in large toilet rooms having rows of fixtures.

The UPC now includes battery venting (circuit venting) in Appendix L 6.1 for those jurisdictions who permit this method of venting. The UPC does not allow the battery vents and relief vents to be used at wet vents. The IPC permits up to four (4) DFU to discharge into a relief vent.

9–15. **IPC Section 912, COMBINATION DRAIN AND VENT SYSTEM.** This section permits a combination waste and vent system where conventional venting is not practical. Examples are floor drains in large warehouses, markets, and service outlet drains in exhibition halls. The drain pipes are sized per Table 912.3 to presumably oversize them to lower the depth of flow and thereby providing free movement of air to avoid disturbing the trap seals in the fixtures being drained. Water closets and urinals cannot be connected to a combination waste and vent system.

UPC Section 910.0 permits combination waste and vent systems. The pipes must be increased two sizes and branch lengths are limited to fifteen (15) feet of unvented length. Plans must be approved by the Administrative Authority before installation.

9–16. **IPC Table 912.3, SIZE OF COMBINATION DRAIN AND VENT PIPE.** This table has two columns which are both under the title Maximum Number of Drainage Fixture Units. The first column is "Connecting to a Horizontal Branch or Stack" and the second is "Connecting to a Building Drain or Building Subdrain". The first column increases the pipes one size compared to Table 710.1(2) for horizontal fixture branches. The second column increases the pipes one size, except for 1-1/2", compared to Table 710.1(1) for building drains and sewers at 1/2" slope, which is the maximum allowable slope for combination waste and vent piping. The writers are unaware of what the second column is actually based on since the IPC permits combination waste and vent piping to be sloped less than 1/2" and also why there is a difference in the allowable DFUs based on what the combination waste and vent piping connects to. The IPC sizing method does not consider the slope of the piping.

The UPC simply increases the combination piping two sizes larger than conventionally vented drain piping.

9–17. **IPC Section 913, ISLAND FIXTURE VENTING.** This section permits island fixture venting with the vent pipe at the sink permitted to be below the flood level rim of the sink, then turned down and connected to the horizontal drain beneath the floor. This is similar to UPC Section 909.0.

9–18. **IPC Section 915, VENTS FOR STACK OFFSETS.** This section has requirements for venting horizontal offsets in stacks having five (5) branch intervals or more above the offset.

The UPC has no specific requirements for venting horizontal offsets in drainage stacks, but the upper and lower portions of the stack should be considered as separate stacks and vented accordingly.

9–19. **IPC Table 916.1, SIZE AND DEVELOPED LENGTH OF STACK VENTS AND VENT STACKS.** IPC Table 916.1 determines maximum developed length of vents from three factors: Fixture units being vented, size of waste stacks, and size of the vent. This table is a far more complex chart to use than UPC Table 7-5 which gives maximum length of feet and maximum vent size based solely on fixture unit loading. Furthermore, the IPC does not have any restrictions on the horizontal length limitation on the vent piping. Therefore, the entire developed length could be horizontal according to this table. The table has a larger range of pipe sizes (15" drain stack and 12" vent) and allowable DFU loadings per vent pipe size than UPC Table 7-5.

UPC Table 7-5 is much easier to use and provides a note that only one-third of the total developed length of the vent may be installed horizontally without increasing size. The UPC uses Table 7-5, which is limited to 12" drains and 8" vents, to size all vent piping.

9–20. **IPC Section 916.2, Vents other than stack vents or vent stacks.** This section requires that vents, other than stack vents or vent stacks, be one-half the pipe size of the equivalent drain(s) that it is venting. This method requires sizing drains that do not exist in order to size the various sections of vent piping. Vent piping exceeding 40 feet in developed length must be increased one pipe size.

The UPC uses Table 7-5 to size drain and vent piping. It permits up to one-third of the maximum listed developed length of the various vent pipe sizes to be horizontal. The required vent pipe sizes in Table 7-5 are generally larger than those required by IPC Section 916.2.

9–21. **IPC Section 916.4.1, Multiple branch vents exceeding 40 feet in developed length.** Section 916.4 has sizing requirements for common branch vents that have multiple branch vents connected to them. It appears that Section 916.4.1 should be referring to the common branch vent rather than the multiple branch vents. The use of the term "multiple branch vents" is confusing.

This is far more confusing than UPC Table 7-5 in which the venting is simply sized on the fixture units and the length of the pipe and not whether it is a multiple branch. Furthermore, the UPC permits up to one-third of the maximum allowable length of a vent pipe to be horizontal. There are no limits on length if the vent is increased one pipe size.

9–22. **IPC Table 916.5.1, SIZE AND LENGTH OF SUMP VENTS.** This table sizes vents for sewage sumps, based on the discharge capacity (GPM) of the pump and the maximum allowable developed length of the vent. Footnote "a" requires that an allowance of 50% be made for fittings and other losses. Table 916.1 SIZE AND DEVELOPED LENGTH OF STACK VENTS AND VENT STACKS does not have a similar requirement.

UPC Section 710.10 sizes sewage sump vents based on the fixture unit load served by the sump, using Table 7-5. An allowance for fittings and other losses is included in the maximum allowable lengths in the table.

9–23. **IPC Section 917, AIR ADMITTANCE VALVES.** The IPC permits the use of fixture or branch type air admittance valves in lieu of vents to the outdoor air. Section 917.7 requires that only one stack vent or vent stack be extended to the open air outdoors, but it has no sizing requirements for that vent, compared to the overall size of the drainage and vent system. Section 917.8 prohibits the installation of air admittance valves in HVAC supply or return air plenums because the valves require neutral surrounding air pressure to operate as designed.

Section 917.3 permits air admittance valves to be installed for horizontal branch drains up to four branch intervals from the top of a stack without relief vents. This provides no means to relieve positive pressures or permit air to circulate and equalize within the drain and vent piping.

The UPC does not allow the use of air admittance valves as they are mechanical and subject to malfunction in the field, they are affected by pressures within the building, they do not prevent or relieve over-pressurization in the drain and vent system, they can become fouled with backflow of waste and sewage, and they are an ongoing maintenance consideration for the building owner. Although the IPC prohibits air admittance valves in supply and return air plenums, it is not uncommon for entire buildings to be pressurized (positive and negative) by the HVAC system or by vertical "stack effect". The UPC relies on the physics of nature which never fail.

9–24. **IPC Section 918, ENGINEERED VENT SYSTEMS.** The IPC allows engineered small size vent piping. This is an example of decimal point engineering that does not provide sufficient margin of safety for varying field conditions, both at the time of installation and throughout the life of the system. Furthermore, a 1/2" or 3/4" size vent can be easily closed by any obstruction getting into the end of the vent or by a kink in the vent tubing, thereby destroying the beneficial effect of the venting system. In addition, the sizing concept is dependent upon the precise "design discharge load" of the fixture which is questionable if ever known initially. Furthermore, if a homeowner or occupant changes out a fixture and the flow rate becomes somewhat greater, the venting system may not function properly.

IPC Table 918.2 is based on "smooth pipe". In Appendix E, copper tube is referred to as smooth pipe. However, Section 918 does not indicate what piping materials are permissible for "engineered vent systems", therefore, any material could be used and the required correction factors for the calculations are not provided in the IPC. Lastly, using copper tubing for the venting system creates as great an expense as a conventional venting system. Therefore, there is no significant savings in using the reduced size venting system.

IPC Section 918 does not appear to include sufficient data to design reduced-size vents. The IPC concept is completely different from the relatively simple procedure in Chapter 17 of the *ASPE Data Book* which includes all necessary data and limitations. ASPE also restricts reduced-size vents to residential fixtures in low rise (1 - 2 story) residential buildings and requires that some listed 1/2" and 3/4" vent sizes be increased in two-story buildings. Furthermore, ASPE does not permit reduced-size vents where the fixture is more than 15 feet above the building drain or its branches. ASPE additionally requires that vents not be reduced until 6" above the flood level rim of the fixture served. The 2000 IPC Commentary "suggests" the same thing, but vents can be reduced below the fixture overflow in the IPC. There are not the required restrictions on reduced-size venting in the IPC.

The UPC does not include reduced-size venting because it has not proven itself in the field and it does not provide sufficient margin of safety for dependable operation. However, reduced-size venting with appropriate restrictions could be submitted as an alternate method under Section 301.2 or as an engineered plumbing system under Section L 2.0.

9–25. **IPC Section 919, Computerized Vent Design.** It is not clear why this section is necessary in the code. It simply says that vent systems can be sized and designed using a computer program and that the design be based on the peak load on the drainage system. Section 919.1 requires that the computer program be approved, but it does not say what the basis of approval is. It does not require that the design and sizing comply with the other requirements of IPC Chapter 9.

The IPC has similar provisions for designing drainage systems using a computer program, but not water distribution piping or storm drainage piping.

The UPC does not prohibit using computer programs or any other means to design plumbing systems, so long as the results meet the requirements of the code.

## K. CHAPTER 10, TRAPS

10–1. **IPC Section 1003, INTERCEPTORS AND SEPARATORS.** This section has specific requirements for where interceptors, separators, and grease traps are required.

UPC Sections 1009.1 and 1014.1 give the Administrative Authority more discretion in determining the need for interceptors and grease traps, based on the particular application.

10–2. **IPC Section 1003.3.2, Food waste grinders.** Where food waste grinders discharge through grease traps, this section requires a solids separator to separate solids before entering the grease trap, as recommended by PDI.

UPC Section 1015.0 prohibits food waste grinders to discharge through grease traps unless specifically required or permitted by the Administrative Authority. Manufacturers of most grease traps recommend that food particles not be allowed to enter grease traps. The food particles become trapped with the grease and decompose, causing foul odors. Furthermore, the "contaminated" grease cannot be sold to renderers due to the food particles from the waste grinder in the grease.

10–3. **IPC Section 1003.4, Oil separators required.** This section includes very limited criteria for the design of oil and flammable liquid separators.

UPC Section 1017.0 has detailed requirements for the design and construction of oil and flammable liquid interceptors, including venting, line sizes, cleanouts, waste oil tanks, and pump-out connections.

## L. CHAPTER 11, STORM DRAINAGE

11–1. **IPC Section 1101.7, Roof design.** This section requires that the roof be designed to withstand the level of the water based on the height of the overflows or scuppers assuming that all of the primary roof drains are blocked [emphasis added].

The UPC has requirements for primary and secondary roof drainage that are based on the roof design, but the UPC does not have requirements for the roof design itself, since it is not regulated by the plumbing code.

11–2. The IPC does not specifically address thermal expansion in storm drain piping.

UPC Section 1101.4, Expansion Joints Required, specifically requires expansion joints where there are temperature variations or physical conditions that would warrant the use of expansion joints.

11–3. **IPC Tables 1106.2, SIZE OF VERTICAL CONNECTORS AND LEADERS, and 1106.3, SIZE OF HORIZONTAL STORM DRAINAGE PIPING.** These tables need to be interpolated for the rainfall rates in Appendix B that fall between the listed whole numbers.

UPC Tables 11-1 and 11-2 list gallons per minute (gpm) of flow associated with the vertical piping and the sloped horizontal piping. Table D-1 lists rainfalls for cities in inches per hour and gpm per square foot of roof (gpm/sf). The roof area being drained (sf) can be multiplied by the gpm/sf to determine the required gpm of drainage. The pipe size can then be selected directly from Table 11-1 or 11-2 without interpolation.

11–4. **IPC Section 1106.4, Vertical walls.** This section adds 50% of the area of walls that drain rainwater onto roofs to the area of the roof to allow for wind-driven rain in sizing roof drainage systems.

UPC Section 1106.4 lists six (6) different orientations of walls and the various allowances for more accurately determining the adjusted roof area for rainfall. The highest added allowance is 50%. Some allowances are zero.

11–5. **IPC Section 1106.5, Parapet wall scupper location**. This section refers to the *International Building Code* for the location of scuppers. However, the *International Building Code* refers to *the International Plumbing Code* (IPC) for the design and installation of roof drainage systems.

The UPC does not address wall scuppers unless the roof drainage system is controlled – flow system.

11–6. **IPC Section 1107.3, Sizing of secondary drains.** The rainfall rate for sizing secondary roof drains appears to have been changed in the 2003 IPC, although there is no solid vertical line in the margin. This section now says to size the secondary system the same as the primary system, rather than double the capacity.

UPC Section 1101.2.1 also sizes the secondary system the same as the primary system. Both the IPC and the UPC require that the secondary roof drainage system be piped independently from the primary system and discharge at grade.

11–7. **IPC Section 1108, COMBINED SANITARY AND STORM SYSTEM.** This section has criteria for sizing combined sanitary and storm water drains and sewers. It converts the sanitary fixture unit (DFU) load into equivalent square feet of roof, based on a rainfall rate of one inch per hour. However, the section does not indicate how to adjust the DFU equivalent roof area for the actual local rainfall rate used in the system design. It is necessary to refer to the 2000 IPC Commentary for an explanation of how to convert the DFU load for rainfall rates other than one inch per hour.

The UPC does not include sizing of combined sewers. It addresses requirements where combined sewers exist, but does not encourage their use by providing sizing data, as combined sanitary and storm systems are no longer looked on with favor due to federal clean water laws and the impact on the sizing of sewer systems and the capacity of sewage treatment plants.

11–8. **IPC Section 1109, VALUES FOR CONTINUOUS FLOW.** This section equates gpm of flow from sources other than rainfall to square feet of roof based on a rainfall rate of one inch per hour. It is necessary to refer to the 2000 Commentary for an explanation of how to convert the gpm flows for rainfall rates other than one inch per hour.

UPC Chapter 11 and Appendix D provide means of sizing storm drainage piping on the basis of gpm, which simply allows gpm flows from sources other than rainwater to be added directly to the gpm of rainwater flow without conversion to equivalent square feet of roof for a particular rainfall rate.

11–9. **IPC Section 1110, CONTROLLED FLOW ROOF DRAIN SYSTEMS.** This section covers controlled flow roof drainage systems. The rainfall rate used is the same as a primary roof drain system (100-year, 60-minute storm). However, there is no reference to the requirement of a secondary drainage system as mandated under IPC Section 1107.

UPC Section 1108.0 covers controlled flow roof drainage in detail (14 paragraphs). It requires scuppers for emergency drainage. Furthermore, Tables 11-4 and 11-5 also dictate height of water and scuppers above the roof for controlled flow roof drains and the slope of the roof.

11–10. **IPC Section 1110, CONTROLLED FLOW ROOF DRAIN SYSTEMS.** This section requires that a controlled flow roof drainage system be considered as an "engineered plumbing system" with associated submittals, approvals, inspections, and testing. Furthermore, IPC Section 1110.1 requires that the rainfall rate used for design be in accordance with Section 1106.1, which is a 100-year, 60-minute storm.

However, the 2000 IPC Commentary states that many engineers design for the total rainfall for the duration of a 25-year storm, which is not listed in the IPC. The intent of the IPC is not clear. The 2000 IPC Commentary also states that the purpose of controlled flow roof drainage is to cool the roof, whereas the primary intent is to reduce the peak flows in storm sewers.

The UPC does not require that controlled flow roof drainage systems be "engineered" and includes sufficient data for their design, construction, and inspection without the need for extra engineering. The UPC requires that the calculations merely need to be submitted with the plans.

11–11. **IPC Section 1110.4, Minimum number of roof drains.** The IPC requires, "for controlled flow systems, not less than two roof drains to be installed in a roof area of 10,000 square feet or less and not less than four roof drains to be installed in roofs over 10,000 square feet". This means for a roof area of 10,001 square feet the number of required controlled flow roof drains jumps from two to four. Furthermore, the IPC does not provide information on the required number of controlled flow roof drains for roof areas over, say, 20,000 square feet. Therefore, a building of 100,000 square feet could, per code, only have four controlled flow roof drains installed. This does not seem prudent to the writers.

UPC Section 1108.1(3) requires that two roof drains shall be provided for each 10,000 square feet and no less than one additional roof drain for each additional 10,000 square feet over 10,000 square feet, which is a more accurate way of providing the number of roof drains required.

11–12. **IPC Section 1111, Subsoil drains.** This section covers subsoil drainage. It requires 4" minimum drain size.

**IPC Section 1113.1.1, Pump capacity and head.** This section requires that the sump pump have "capacity and head appropriate for the anticipated use requirements". It has no minimum requirements.

**IPC Section 1113.1.2, Construction.** This section requires that sump pits be not less than 18' in diameter.

**IPC Section 1113.1.4, Piping.** This section requires that pipe and fittings be equal to or larger than the pump discharge tapping.

UPC Section 1101.5 covers subsoil drainage in greater detail than the IPC. It requires 3" minimum drains and sump pits that are 15" in diameter by 18" deep. Minimum pump flow rates are 15 gpm and the minimum discharge pipe size is 1-1/2". Furthermore, UPC Sections 1101.7 and 1101.8 cover areaway drains and window well drains, which are not addressed in the IPC.

## M. CHAPTER 12, SPECIAL PIPING AND STORAGE SYSTEMS.

12-1. **IPC Chapter 12, SPECIAL PIPING AND STORAGE SYSTEMS.** This chapter was formerly for fuel gas piping. The IPC presently does not include requirements for fuel gas piping.

UPC Chapter 12, Fuel Piping, covers the sizing and installation of fuel gas piping in complete detail. In addition, Table 14-1 lists NFPA 54 as a referenced standard.

12-2. **IPC Chapter 12, SPECIAL PIPING AND STORAGE SYSTEMS.** This chapter is very limited, the scope is not clear, and there are several contradictions. For example, Section 1202 references NFPA 99C for medical gas and vacuum piping systems. However, it also references the mechanical code for vacuum system exhaust, even though vacuum piping and exhaust is included in the scope of NFPA 99C. In addition, it references NFPA 50 - *Standard for Bulk Oxygen Systems at Consumer Sites* and NFPA 51 - *Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes* for non-medical oxygen systems. However, non-medical oxygen systems and other compressed gas systems do not appear to be within the scope of the IPC. Also, NFPA 50 is referenced in NFPA 99C for medical bulk oxygen systems.

IPC Section 1202 also excludes cylinder storage, even though NFPA 99C includes cylinder storage for nitrogen and nitrous oxide systems.

The IPC does not reference NFPA 99 - *Health Care Facilities*, which is the parent document of NFPA 99C - *Gas and Vacuum Systems*. Although NFPA 99 covers more than medical gas and vacuum piping, it is a legally acceptable alternative to NFPA 99C for gas and vacuum piping systems.

UPC Chapter 13 includes detailed requirements for the design, installation, inspection, testing, and certification of medical gas and vacuum piping systems. In addition, the UPC references both NFPA 99 and NFPA 99C. It does not include references to non-medical oxygen systems or other special compressed gas piping or storage systems that are not within the scope of the UPC.

## N. CHAPTER 13, REFERENCE STANDARDS.

In the text of the IPC, references to the National Electrical Code (NFPA 70) have been replaced with references to the *ICC Electrical Code*. However, Chapter 13 *Referenced Standards* still lists NFPA 70 with specific references to sections in the IPC.

The UPC does not reference the National Electrical Code in Chapter 14.

## O. IPC APPENDIX C, GRAY WATER RECYCLING SYSTEMS

C-1. The gray water systems covered by this appendix are not the same as the gray water systems covered by UPC Appendix G. The IPC gray water system permits recycled waste water from bathtubs, showers, and lavatories to be used for flushing water closets and urinals within the same building. Also, Appendix C includes very general requirements for filtering and disinfection.

The UPC does not permit this type of gray water recycling system which is essentially "reclaimed water" and most health departments do not allow this type of untreated water to be utilized for flushing toilets in residential installations in the event that a child or pet might drink the "gray water" from the water closet.

Therefore, this subject is covered in the UPC in Section 601.2.3, Reclaimed Water, and thoroughly in Appendix J, Reclaimed Water Systems for Non-Residential Buildings, which is specifically mandated as highly treated reclaimed water and not simply a partially treated gray water system. The UPC covers gray water systems for single family dwellings in great detail in Appendix G.

## P. IPC APPENDIX D, DEGREE DAY AND DESIGN TEMPERATURES FOR CITIES IN THE UNITED STATES

D-1. This table lists winter heating degree days, 97-1/2% winter design temperature, summer design temperatures, and latitudes for various cities in the United States. The only apparent use for this appendix is in Section 904.2 (Frost Closure of Vents) and 904.7 (Extension of Vents Outside of Buildings) where they refer to the 97-1/2% outdoor design temperature. There are no references to heating degree days, summer design temperatures, or latitudes.

The UPC does not use this 97-1/2% winter design temperature in that this figure is exceeded a minimum of 54 hours a year and the minimum design temperature is the figure to be used for protection of the plumbing system. (Also see writers' comments concerning IPC Sections 904.2 and 904.7.)

## Q. IPC APPENDIX E, SIZING OF WATER PIPING SYSTEM

E-1. **IPC Appendix E.** This appendix, because it does not differentiate between 1.6 GPF water closets and greater than 1.6 GPF water closets, and does not differentiate between different use classifications, results in higher design water flow rates in most typical IPC installations and larger water pipe sizes in many IPC installations when compared to UPC Appendix A.

Example: Public general use toilet room with four (4) 1.6 gpf flush valve water closets and four (4) 1.0 gpf urinals. Lavatories are ignored in this comparison.

From the IPC: 4 Water closets @ 10 WSFU = 40 WSFU
4 Urinals @ 5 WSFU = 20 WSFU
40 + 20 = 60 WSFU = 54 gpm demand
Cold water supply pipe size = 2" "L" copper
2" pipe size required to keep velocity below 8 fps

From the UPC: 4 Water Closets @ 5 WSFU = 20 WSFU
4 Urinals @ 4 WSFU = 16 WSFU
20 + 16 = 36 WSFU = 45 gpm demand
Cold water pipe size = 1-1/2" or 2" "L" copper
Pipe size could be 1-1/2" or 2" depending on desired maximum velocity

The differences in demand gpms between the IPC and UPC increase respectively as the number of fixtures increase, as does the increased pipe sizes. Therefore, the UPC creates less expensive water systems for most installations.

E–2. **IPC Table E103.3(2**): In the 2003 IPC, the 2.2 WSFU private water closet and 5.0 WSFU private water closet are listed as the flush valve type where in the 2000 IPC, they were the flush tank type.

E–3. **IPC Table E103.3(3), TABLE FOR ESTIMATING DEMAND.** This table equates water supply fixture units (WSFU) to demand flow. Demand is listed in gallons per minute (gpm) and cubic feet per minute (cfm). The cfm figures extend to six (6) decimal places in some cases. The reason for this high degree of accuracy is not clear since the cfm figures do not appear to be used anywhere in the IPC.

The UPC does not include the cfm equivalent of WSFUs as it is not useful.

## R. IPC APPENDIX F, STRUCTURAL SAFETY

F-1. This appendix lists restrictions on notches and holes in wood joists and rafters, cutting and notching wood studs, and holes in wood studs. There is no apparent reference to this appendix in the IPC. Furthermore, IPC Section 307.2, Cutting, notching, or bored holes refers to the International Building Code for limitations.

The UPC does not have this appendix, but the essence of this appendix is included in the body of the code as UPC Section 313.11.

## S. SECTIONS OF THE UPC THAT ARE NOT INCLUDED IN THE IPC.

1. UPC Chapter 5 contains the sizing requirements for venting domestic water heaters.

The IPC refers the subject to the International Fuel Gas Code.

2. **UPC APPENDIX B, EXPLANATORY NOTES ON COMBINATION WASTE AND VENT SYSTEMS.**

Combination waste and vent systems are covered by UPC Section 910.0 and Appendix B. This appendix further explains the requirements in non-code language.

3. **UPC APPENDIX E, MANUFACTURED/MOBILE HOME PARKS AND RECREATIONAL VEHICLE PARKS.**

UPC Appendix E includes complete information on the design and installation of plumbing systems for mobile vehicle parks.

4. **UPC APPENDIX G, GRAY WATER SYSTEMS FOR SINGLE FAMILY DWELLINGS.**

UPC Appendix G covers gray water systems for underground landscape irrigation at single family dwellings. Untreated waste from bathtubs, showers, bathroom wash basins, clothes washers, and laundry sinks is collected in a holding tank and distributed to an underground irrigation/disposal field as allowed by many health department officials. This is significantly different than the requirements in IPC Appendix C.

5. **UPC APPENDIX H, RECOMMENDED PROCEDURES FOR DESIGN, CONSTRUCTION, AND INSTALLATION OF COMMERCIAL KITCHEN GREASE INTERCEPTORS.**

UPC Appendix H includes complete information on the subject of grease interceptors for commercial kitchens.

6. **UPC APPENDIX I, INSTALLATION STANDARDS.**

UPC Appendix I includes twenty (20) IAPMO Installation Standards for various plumbing materials, systems, and procedures for the benefit of the inspection and installing personnel.

7. **UPC APPENDIX J, RECLAIMED WATER SYSTEMS FOR <u>NON-RESIDENTIAL BUILDINGS</u>** (emphasis added).

UPC Appendix J covers treated waste water systems used to supply water closets, urinals, and trap primers in other than residential buildings. The waste water must be treated by a public agency to criteria listed in the appendix and approved by the public health authority. The appendix includes requirements for piping, warning signs, valve seals, inspection, and cross-connection tests. This system is restricted to non-residential buildings because of the health concerns and the potential home handyman interconnecting potable and reclaimed water systems. This criteria is significantly different than the requirements in IPC Appendix C and provides a far greater level of public safety.

8. **UPC APPENDIX K, PRIVATE SEWAGE DISPOSAL SYSTEMS.**

UPC Appendix K includes complete information on the design, construction, inspection, and testing of private sewage disposal systems. Comparable data is now included in a separate IPC private sewage disposal code.

9. **UPC APPENDIX L, ALTERNATE PLUMBING SYSTEMS.**

UPC Appendix L includes sections on engineered plumbing systems, single-wall heat exchangers, fixture unit values for bathroom groups, vacuum drainage systems, battery venting, and wet venting in single and double bathroom groups.

10. **Useful Tables.**

The tables and charts include inch-pound and metric conversions, properties of circles, and gravity flow in rates and velocities in half-full and full pipes of varying slopes.

## –– CONCLUSIONS ––

We, the authors, having reviewed both the 2003 International Plumbing Code and the 2003 Uniform Plumbing Code, find the following significant differences between the two code documents. The specific items noted in this section, however, only represent a few of all those noted in the main body of our comparison.

1. The UPC is essentially self-contained and incorporates portions of most of the documents that are needed to use or enforce this code and, therefore, is more user friendly. The IPC is not self-contained, it refers to numerous other code documents and, therefore, these other documents must be adopted at the time of adoption of the IPC. This makes the IPC far more difficult to use for the engineer, the plumbing contractor, and the plumbing officials.

2. Being that the UPC is more self-contained, it can be used as a teaching document for the members of the plumbing community, i.e., the inspectors, the designers, and the plumbing contractors. Whereas the IPC does not contain all of this information, but relies on other engineering manuals or other documents and, therefore, it is awkward to utilize as a teaching tool.

3. The IPC requires that products and materials be tested or certified by a third-party agency as opposed to a listing agency. The significance of the "third party" requirement is not clear. The UPC uses listing agencies.

4. The IPC requires that determining the support spacing for all piping designed to provide for thermal expansion and contraction must be considered as an alternative engineering design involving design professionals. It fails to recognize the factors (which are not support spacing) that permit piping to expand and contract safely.

5. The requirements for sway bracing and pipe anchors in the IPC far exceed what is standard practice in the plumbing and piping industries, which is what the UPC is based on.

6. The IPC refers the venting of water heaters to the International Fuel Gas Code while the UPC contains the requirements to vent water heaters.

7. The IPC requires unnecessary and undefined annual inspections of non-testable backflow prevention devices and air gaps to determine if they are operable. The UPC is based on industry standards, which require no such inspections.

8. The IPC has no special requirements for plumbing in food handling establishments to prevent leakage or condensation that could contaminate food or drink that is stored, prepared, or displayed under soil or drain piping.

9. The IPC requires far less fixtures for various types of occupancies than the UPC. This is contrary to the "potty parity" movement which demands more fixtures for women's toilet rooms to avoid the long waiting lines. The UPC also provides more water closets and urinals in most men's toilet rooms than the IPC and assures adequate water closets by limiting the number that can be deleted by installing additional urinals.

10. Gas piping is not within the scope of the IPC. It has no provisions for venting gas-fired water heaters. The UPC has a chapter on fuel gas piping and an appendix on venting.

11. The IPC is extremely lax and incomplete in its requirements for water pipe sizing. Its extensive use of 3/8" branch piping is not consistent with accepted practices in the plumbing trade and will produce water distribution systems having significantly reduced and variable water flow rates at the fixtures. The problem is of particular concern in dwellings having well pumps as their source of water pressure or low initial water pressure.

12. The IPC is inconsistent in its requirements as to the degree of regulation that it provides. For example, in the water section it requires two water services for all hospitals, but in the sanitary drainage section only one sewage ejector is required in public buildings. This type of inconsistency exists throughout the IPC.

13. The IPC places no limits on flow velocities in water distribution piping to prevent erosion corrosion and excessive pressure drop. The UPC limits velocities to industry standards.

14. The IPC does not recognize the different use patterns for plumbing fixtures in different occupancies except for the traditional "private" and "public" water closets. The UPC recognizes three (3) different use patterns and has appropriate fixture unit values for both water supply and drainage which allows the water and waste systems to be sized more correctly based on the usage.

15. The IPC has unusual and excessive requirements for local water supplies to maintain condensate trap seals in health care facilities.

16. The IPC horizontal branch drain pipe sizing is more restrictive than the UPC horizontal drain sizing. The UPC horizontal drain sizing permits more DFUs on horizontal drains which results in smaller pipe sizing with most UPC installations.

17. The IPC drainage stack sizing is far more liberal than the UPC in one respect. The IPC allows as many as 12 bathroom groups including water closets on a 3" drainage stack. However, the UPC allows more DFUs on vertical stacks having three or less branch intervals than does the IPC which results in smaller UPC sized stacks for most installations.

18. IPC Section 714 allows computerized drainage design which conflicts with IPC Section 105.4, Alternative engineered design, and IPC Section 105.2, Alternative materials, methods and equipment. The UPC requires that all engineered designs be in compliance with UPC Section 301.2, Alternate Materials and Methods.

19. The IPC requires more cleanouts in its drainage piping than does the UPC. These additional cleanouts are of limited value and if used, could contribute to unsanitary conditions within the building.

20. The IPC drainage and vent pipe sizing tables are more complicated and difficult to use than those in the UPC.

21. The IPC permits indirect wastes from floor drains in food storage areas to terminate with only an air break if they have a backwater valve. This seriously compromises the protection of stored food from the backflow of sewage and waste.

22 The IPC permits wet venting in two bathroom groups, but it does not appear to permit it in a single bathroom group. The UPC permits wet venting in single and double bathroom groups.

23. The UPC is more conservative than the IPC in its requirement of when to prevent frost closure of vent terminals. However, the IPC is more conservative than the UPC by requiring 3" IPC minimum vent size rather than 2" UPC minimum to avoid frost closure.

24. The IPC permits sidewall venting, which is less positive than the rooftop venting required by the UPC.

25. The IPC allows the extensive use of mechanical vent devices (air admittance valves). These devices are not universally accepted in the plumbing industry and they are not approved in the UPC.

26. The IPC allows 1/2" and 3/4" vent pipe sizes in engineered vent systems. The UPC requires the traditional 1-1/4" minimum vent pipe size without the need for special engineering and approvals due to concerns about clogging.

27. The UPC does not recognize the single-pipe waste stack vent that the IPC allows.

28. The IPC does not recognize the problem of suds pressure in drainage stacks serving suds-producing fixtures. The UPC prohibits drain connections to portions of a stack that may be subject to blockage by suds.

29. The UPC requires more separation between well locations and potential sources of contamination than does the IPC, thereby providing a higher degree of public safety.

30. IPC Appendix C allows the use of semi-treated waste water for flushing water closets and urinals in all types of applications. The UPC restricts "reclaimed water" (Appendix J) only to commercial buildings and "gray water systems" (Appendix G) to residential units for underground irrigation only. Thus, the UPC provides a higher degree of public safety in the use of recycled water systems.

31. Where controlled flow roof drainage is used, the UPC requires fewer roof drains on roofs between 10,001 square foot area and 20,000 square foot area, but more roof drains on roofs over 30,000 square foot area. Subsequently, the IPC is more conservative than the UPC on small roofs. However, the UPC is more conservative on large roofs because the IPC provides no code criteria for the required number of controlled flow roof drains for large buildings.

32. The IPC makes specific references in various sections to the requirements of the *International Building Code*, the *International Mechanical Code*, the *International Fuel Gas Code*, the *International Electrical Code*, and the *International Energy Conservation Code*. This makes jurisdictions that have adopted other building, mechanical, fuel gas, electrical, and energy conservation codes amend those sections if they adopt the IPC. The UPC does not incorporate by direct reference other codes that may conflict with those that may have already been adopted by the jurisdiction.

33. The IPC uses "hard conversations" for metric equivalents of its inch-pound (I-P) pipe sizes. These do not agree with the "soft" metric pipe size designations that have been recommended by the Construction Metrication Council of the National Institute of Building Sciences and are used on all metric construction documents. The UPC uses the "soft" metric pipe size designations that are recommended by the Construction Metrication Council of the National Institute of Building Sciences and are being used on metric projects by the building design and construction industries.

34. The IPC references CSA standards for various materials, fixtures, faucets, and fixture fittings. The UPC does not reference CSA standards. Some of the requirements in CSA standards are not the same as those in ANSI, ASTM, and ASME standards. An item that meets a CSA standard may not comply with all of the requirements of a comparable ANSI, ASTM, or ASME standard for the same item.

35. The IPC includes some requirements that are not normally the responsibility of the Administrative Authority for plumbing.

36. The IPC requires more engineering input to design, install, and inspect plumbing systems that meet its requirements. The UPC permits engineered systems but employs a more prescriptive format that allows most plumbing systems to be designed, installed, and inspected without the need for special engineering and approvals. Subsequently, any supposed savings created through the use of the IPC will be more than offset by additional engineering cost required. Therefore, what the IPC has done is increased engineering costs for lack of practical code language.

37. The numerous vagaries and inconsistencies in the IPC leave it open to interpretation by the various members of the plumbing and legal professions.

In conclusion, based on all of the items noted in this engineering comparison, it is the writers' professional opinions that the 2003 Uniform Plumbing Code is a far superior and preferable plumbing code than the 2003 International Plumbing Code on technical, practical, economic, public health, and safety matters. Furthermore, the coordinated input from plumbing officials, plumbing engineers, plumbing contractors, and the manufacturers of plumbing materials and products is far more evident in the UPC than in the IPC. Therefore, plumbing code adopting agencies should be aware of the distinct differences between the IPC and the UPC when considering plumbing code adoption.

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Date Aug 1, 2003

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