



DENVER AMENDMENT PROPOSAL FORM FOR PROPOSALS TO THE 2019 DENVER BUILDING CODE AMENDMENTS AND THE 2021 INTERNATIONAL CODES

DENVER
THE MILE HIGH CITY

2021 CODE DEVELOPMENT CYCLE

1) **Name:** John Woycheese **Date:** August 31, 2021
Email: John.woycheese@denvergov.org **Representing (organization or self):** Organization

2) One proposal per this document is to be provided with clear and concise information.

Is a separate graphic file provided ("X" to answer): ___ Yes or X No

3) Highlight the code and acronym that applies to the proposal

<u>Acronym</u>	<u>Code Name</u>	<u>Acronym</u>	<u>Code Name</u>
DBC-AP	Denver Building Code–Administrative Provisions	IPC	International Plumbing Code
IBC	International Building Code	IRC	International Residential Code
IECC	International Energy Conservation Code	IFGC	International Fuel Gas Code
IEBC	International Existing Building Code	IMC	International Mechanical Code
IFC	International Fire Code	DGC	Denver Green Code

AMENDMENT PROPOSAL

Please provide all the following items in your amendment proposal.

Code Sections/Tables/Figures Proposed for Revision:

Instructions: If the proposal is for a new section, indicate (new), otherwise enter applicable code section.

Proposal:

Instructions: Show the proposal using ~~strikeout~~, underline format.

Place "X" next to choice that best defines your proposal: ___ Revision X New Text ___ Delete/Substitute ___ Deletion

Section 903.3.13 is added as follows:

903.3.13 Modifications to older systems. Where modifications are proposed to *automatic sprinkler systems* that were installed more than 30 years ago, the Hazen-Williams C-Factor provided in NFPA 13 shall be reduced to the following values: provided below, unless an engineering analysis based on internal inspection of the pipes demonstrates that higher values (to a maximum of those provided in NFPA 13) are appropriate.

- 1. Steel pipe, black or galvanized (wet): 100
- 2. Steel pipe, black or galvanized (dry): 80
- 3. Concrete- or asbestos cement-lined: 130
- 4. Cast or ductile iron, unlined: 90
- 5. Plastic or plastic-lined: 130
- 6. Copper tube: per NFPA 13

Exception: Where an engineering analysis based on internal inspection of pipes demonstrates that greater values, not exceeding those provided in NFPA 13, are appropriate.

Supporting Information (Required):

All proposals must include a written explanation and justification as to how they address physical, environmental, and/or customary characteristics that are specific to the City and County of Denver. The following questions must be answered for a proposal to be considered.

- Purpose: What does your proposal achieve?

This proposal addresses a gap in determining the capability of water supplies to meet sprinkler demands in older systems. It requires further review or assessment of piping during the design phase to verify that the aging system piping is able to meet code requirements for sprinkler protection.

- Reason: Why is your proposal necessary?

Denver has numerous buildings with aging sprinkler systems. In some cases, the use or occupancy of those buildings can change significantly, leading to modification of the sprinkler system as originally designed. In these cases, hydraulic calculations are provided to demonstrate that the water supply can satisfy required demands, as identified by the adopted Denver Fire Code and NFPA 13, the standard for installation of automatic sprinkler systems. NFPA 13 provides guidance for expected pressure losses due to friction; the values provided, however, are geared towards newer buildings, with some degradation to account for moderate changes to piping over the years.

The Hazen-Williams C-Factor is an expression of the interior roughness of sprinkler piping. Multiple studies (see below for examples) have demonstrated that the friction losses increase in aged piping, with the degree of degradation a factor of the corrosivity of the water, the pipe material, and the pipe size. Some studies have also pointed to biological growth as a potential means of decreasing the pipe's carrying capacity.

Corrosion also requires oxygen, such that systems installed with remote inspector's test valves, which are opened every year, are more susceptible to corrosion.

Denver has recently requested that certain facilities provide justification for using the NFPA 13-based c-factors for sprinkler systems that are more than 50 years old, based on concerns that the piping may have degraded more than expected. Note that NFPA 25, as adopted by the DFC, requires internal inspection of sprinkler piping on a 5-year basis. It is unlikely that building owners have been performing this inspection; as such, the condition of older piping is uncertain. This proposal codifies a process to address aging piping.

- Substantiation: Why is your proposal valid? (i.e. technical justification)

Selected references:

Rahman, N.A., Muhammad, N.S., Abdullah, J., and Mohrar, W.H.M.W, "Model performance Indicator of Aging Pipes in a Domestic Water Supply Distribution Network," *Water*, **11**:11, pp. 2378, 2019. Available here: [Water | Free Full-Text | Model Performance Indicator of Aging Pipes in a Domestic Water Supply Distribution Network \(mdpi.com\)](#) – suggests 20-year old PVC pipe have HW C-factor of 130-140

Kuok, K.K., Chiu, P.C., and Ting, D.C.M, "Evaluation of 'C' Values to Head Loss and Water Pressure Due to Pipe Aging: Case Study of Uni-Central Sarawak," *J. Water Res Prot*, **12**:12, 12 p, 2020. Available here: [Evaluation of "C" Values to Head Loss and Water Pressure Due to Pipe Aging: Case Study of Uni-Central Sarawak \(scirp.org\)](#) – provides c-factors for unlined ductile iron and cast iron pipe.

Shahzad, A., and James, W., "Loss in carrying capacity of water mains due to encrustation and biofouling, and application to Walkerton, Ontario," *J. Water Manage Model*, R208-19, 22 p., 2002. Available here: [R208-19.pdf \(chijournal.org\)](#) – provides relationship between pipe aging and c-factor based on pipe size; appears to focus on unlined ductile or cast iron.

Kwon, HJ, "Design criteria of Hazen-Williams C value of water pipe systems [in Korean]," *J. Kor Soc Water Waste*, **29**:6, pp 659-666, 2015. Available here: [Design criteria of Hazen-Williams C value of water pipe system -Journal of Korean Society of Water and Wastewater | Korea Science](#) – provides graphs indicating c-values for steel and ductile iron pipe of varying ages, showing decay of steel pipe down to c=100 (some samples showed this C-factor after as little as 10 years)

This proposal will increase the cost of design and, in cases where piping must be replaced, construction. Restrictiveness is unaffected.

Bibliography and Access to Materials (as needed when substantiating material is associated with the amendment proposal):

Other Regulations Proposed to be Affected

***For proposals to delete content from the 2019 Denver Green Code in conjunction with adding it to other mandatory Denver codes and/or regulations, only.**

Please identify which other mandatory codes or regulations are suggested to be updated (if any) to accept relocated content.

Referenced Standards:

List any new referenced standards that are proposed to be referenced in the code.

Although NFPA 13 is referenced in this section, it is not new; it is referenced, in fact, multiple times throughout IBC Section 903.

Impact:

How will this proposal impact cost and restrictiveness of code? ("X" answer for each item below)

Cost of construction: Increase Decrease No Impact

Cost of design: Increase Decrease No Impact

Restrictiveness: Increase Decrease No Impact

Departmental Impact (City use only):

This amendment proposal increases/decreases/is neutral to the cost of plans review.

This amendment increases/decreases/is neutral to the cost of inspections.