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CODE APPLICATION NOTICE

CAN: 4-1210.2

Health and Safety Code §129851

SUBJECT

Thermal Expansion and Seismic Relative Displacement of Hydronic Piping Connections.

Effective: 04/30/2026

CODE SECTIONS

2025 California Mechanical Code
California Code of Regulations, Title 24, Part 4
Section 1210.2: Expansion and Contraction

2025 California Building Code
California Code of Regulations, Title 24, Part 2, Volume II
Section 1617A.1.26

ASCE 7-22, Minimum Design Loads and Associated Criteria for Buildings and Other Structures
13.6.7 Distribution Systems: Piping and Tubing Systems

Applicable Programs: OSHPD 1,1R, 2, 4, and 5
Reference Code Sections: CMC §1210.2; California Amendments

Appendix A – **ASME B31.1 Example (Thermal Expansion)**

Appendix B – 2025 California Building Standards Code, Title 24, California Code of Regulations, code citation(s) related to this Code Application Notice (CAN).

Acronyms and Definitions assist the user in recognizing and identifying various acronyms and terms generally used in this CAN. Please refer to the "Master Glossary of Acronyms and Definitions – Acronyms and Definitions Used in OSHPD Published Documents" which is posted on the HCAI website at https://hcai.ca.gov/document/master-glossary-of-acronyms-and-definitions/. Other definitions may also be found in the California Building Standards Code, Title 24, California Code of Regulations.

FLEXIBLE CONNECTIONS: Those connections between equipment components that permit rotational and/or translational movement without degradation of performance. Examples include universal joints, bellows expansion joints, and flexible metal hose.

PURPOSE

This Code Application Notice (CAN) clarifies the compliance requirements for the California amendment to CMC §1210.2. This amendment permits piping with a Nominal Pipe Size (NPS) ≤ 2.5 inches, when connecting to coils, humidifiers, or similar equipment, to use either flexible connectors or a three-90-degree offset configuration to mitigate thermal expansion. ASCE 7, 13.6.7 requires the piping connection to equipment to be able to accommodate the seismic relative displacements. The purpose is to ensure localized flexibility effectively mitigates force and moment transmission to equipment under operational and environmental loads.

BACKGROUND

The California Mechanical Code amendment addresses excessive stress at coil and equipment connection points caused by thermal expansion/contraction. It does not relieve the design from the requirements in ASCE 7 for structural movements.

Localized flexibility, achieved through flexible connectors or the specified offset geometry, accommodates:

- Thermal expansion and contraction
- Structural displacement
- Vibratory loads
- Minor settlement or installation misalignments

This flexibility prevents overstressing equipment connections beyond manufacturer-specified allowable limits.

ISSUES

The three-90-degree offset configuration is intended to relieve the stresses of thermal expansion/contraction and only mitigate movement in a single direction. Accommodation for seismic displacement must permit rotational and/or translational movement without degradation of performance.

The term "close proximity" is a performance-based criterion. Its assessment depends on the equipment and piping configuration, anticipated displacement, and Nominal Pipe Size (NPS). Different piping configurations require varying degrees of localized flexibility to effectively accommodate thermal expansion, vibratory loads, and seismic displacement without damaging equipment connections.

Therefore, the piping system's flexibility and deformation capacity must meet the performance objective of CMC §1210.2 and ASCE 7 13.6.7, regardless of the exact dimensional placement from the connection. Acceptable placement of offsets or flexible connectors requires demonstrating sufficient localized flexibility to protect equipment within California Building Code (CBC) and manufacturer-specified limits.

INTERPRETATION

Deformation and Flexibility Requirements

Hydronic piping systems shall be designed for the seismic forces and seismic relative displacements unless flexible connections are provided in accordance with ASCE 7, 13.6.7.A piping configuration using offsets must exhibit sufficient flexibility to accommodate:

- Thermal expansion and contraction.
- Dynamic and operational loads, including vibration, equipment transient forces (start-up/shut-down), and structural displacement.
- Seismic displacements consistent with project design criteria.
- Minor settlement or installation misalignments.

The piping configuration must also ensure:

- Displacement demands are primarily absorbed through flexural deformation in the offset legs, preventing transmission to the equipment.
- Offset geometry exhibits predictable deformation characteristics, typically confined to a single plane unless substantiated by engineering analysis.
- Resultant forces and moments at equipment nozzles remain within manufacturer-specified allowable limits, including axial, torsional, shear, and bending stresses.
- Compliance with ASME B31.1 procedures (refer to Appendix A) is considered to satisfy this requirement.

To comply with CMC §1210.2, the three 90-degree offsets must be located within the terminal piping segment, bounded by the equipment connection and the first pipe anchor.

Flexible Connectors

As per ASCE 13.6.7, flexible connectors shall be provided between the piping system and the equipment where piping is not detailed to accommodate the seismic relative displacement. This method may offer enhanced performance under various conditions. Benefits include:

- Localized flexibility at the connection interface.
- Reduced transfer of thermal, structural, and seismic loads.
- Enhanced vibration isolation.
- Optimized installation in spatially restricted environments.

Flexible connectors must be listed, approved, and installed according to applicable code provisions and manufacturer specifications.

APPLICATION AND DOCUMENTATION REQUIREMENTS

Construction documents submitted to HCAI must include:

- The location, configuration, and dimensions of specified offsets or flexible connectors.
- Engineering substantiation verifying the selected flexibility solution's compliance with the intent of CMC §1210.2 and ASCE 7, 13.6.7.

When offsets are used as an alternative to flexible connectors, the following analysis is mandated:

- Calculated displacement capacity demonstrating conformance with anticipated thermal and seismic demands. These displacement calculations must be derived from a pipe stress analysis prepared in accordance with the CBC and ASME B31 to verify:
    - Stresses
    - Displacements
    - Forces and moments
      All values must be within allowable limits and manufacturer specifications.
- Verification that applied loads at equipment connections conform to manufacturer-specified allowable forces and moments.

Documentation must be sufficiently detailed to support plan review and field verification.

ENFORCEMENT

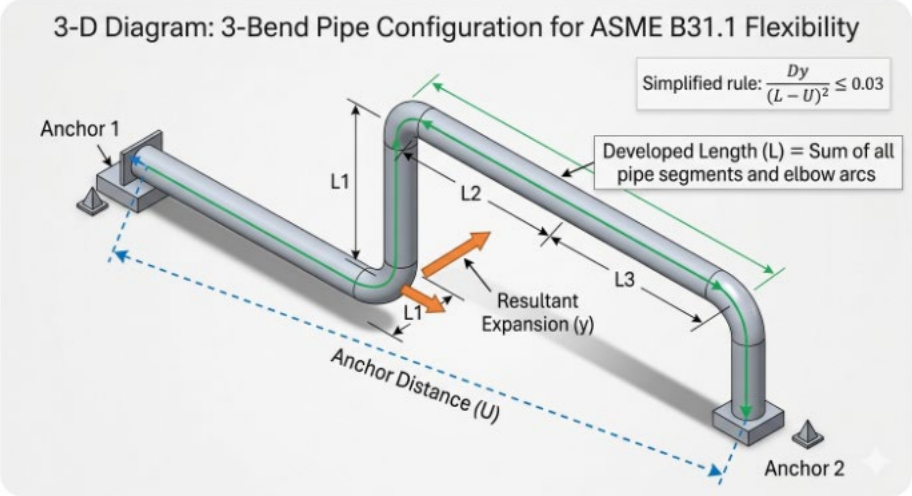
This CAN provides enforceable clarification for the California amendment to **CMC §1210.2**. Project designs must adhere to these requirements to ensure adequate protection of equipment connections and preserve mechanical system integrity.

Original signed	04/30/2026
Chris Tokas, Deputy Director	Date

Appendix A: ASME B31.1 Example

(This example is for thermal expansion, detailed calculations required for seismic displacements)

ASME B31.1 Paragraph 119.7.1 states that a formal piping flexibility analysis is not required for systems that duplicate an existing, successful installation, constitute a low-energy/non-critical system, or satisfy an empirical "3-bend rule" formula based on nominal pipe size (NPS), displacement, and length.



A three-bend system is often considered inherently flexible if its displacement-to-developed-length ratio remains within the empirical limit, calculated as: D y / (L-U)^2 <= K

Where:

- **D:** Nominal Pipe Size (NPS) (in).
- **y:** Resultant total displacement to be accommodated by the piping system (in).
- **L:** Developed piping length between anchors (ft).
- **U:** Straight-line anchor distance (ft).
- **K:** Empirical constant (0.03 for U.S. Customary units).

The table below presents the minimum required **(L-U)** in feet to satisfy the ASME B31.1 simplified flexibility rule. For compliance, the **developed length (L)** minus the **straight-line anchor distance (U)** must be *greater than or equal to* the values specified for an anticipated displacement (y).

Minimum (L-U) Required (in feet)

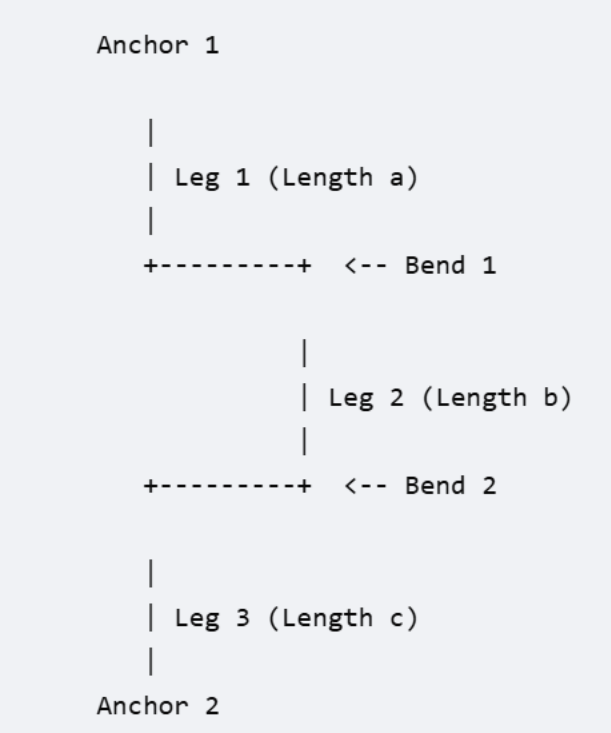
Pipe Size (NPS)	y = 0.5" displacement	y = 1.0" displacement	y = 2.0" displacement
0.25"	2.04 ft	2.89 ft	4.08 ft
0.375"	2.50 ft	3.54 ft	5.00 ft
0.5"	2.89 ft	4.08 ft	5.77 ft
0.75"	3.54 ft	5.00 ft	7.07 ft
1.0"	4.08 ft	5.77 ft	8.16 ft
1.5"	5.00 ft	7.07 ft	10.00 ft
2.0"	5.77 ft	8.16 ft	11.55 ft
2.5"	6.45 ft	9.13 ft	12.91 ft

Table Usage:

1. Identify the Nominal Pipe Size (NPS) in the left column.
2. Ascertain the required anticipated displacement (y).
3. Verify that the (L-U) value of your three-bend configuration equals or exceeds the tabulated minimum.

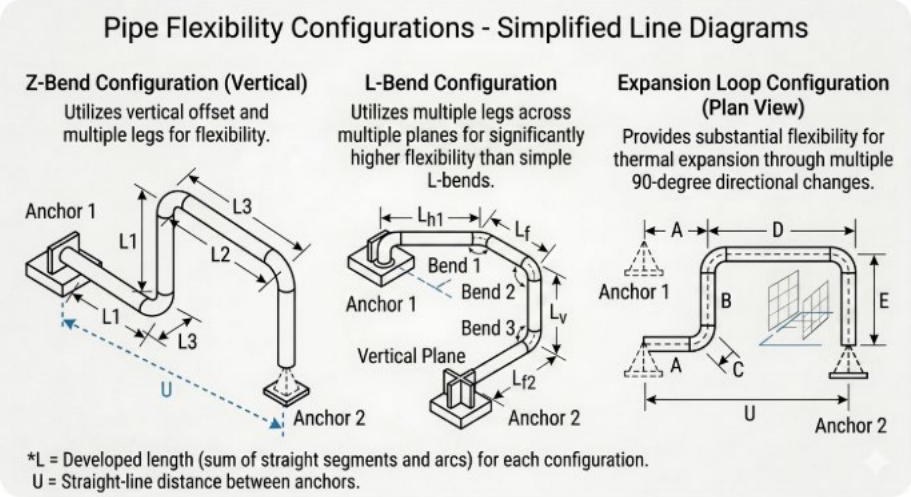
Important Note: This empirical check applies to simple systems with two anchors and no intermediate restraints. Systems with guides or non-uniform NPS require a formal stress analysis.

Understanding L, U, and y in Three-Bend Configurations



- **L (Developed Length)**: The total length of the pipe along its centerline, comprising the sum of all straight legs (Leg 1 + Leg 2 + Leg 3) and the centerline arc lengths of the elbows.
- **U (Anchor Distance)**: The straight-line distance between the two fixed anchor points.
- **y (Displacement)**: The movement the piping must accommodate, typically derived from temperature differential, material coefficient of thermal expansion, or seismic movement.

Common Three-Bend Configurations



1. **Z-Bend (Single Plane)**: A configuration where piping deviates perpendicularly from its primary axis and then returns to the original direction, forming a "Z" shape. This allows for absorption of axial expansion through flexural deformation in the offset leg.
2. **L-Bend (Multi-Plane)**: A configuration that often involves a change in elevation (e.g., horizontal piping turning 90 degrees and then transitioning vertically). This utilizes multi-planar movement to impart flexibility.
3. **Expansion Loop**: While typically requiring four bends for a return-to-line configuration, a three-bend "U-shape" can connect disparate anchor points, yielding a high L/U ratio.

APPENDIX B

2022 California Building Standards Code, Title 24, California Code of Regulations

2025 California Mechanical Code, Part 4
Section 1210.2

1210.2 Expansion and Contraction. Pipe and tubing shall be so installed that it will not be subject to undue strains or
stresses, and provisions shall be made for expansion, contraction, and structural settlement. ***[OSHPD 1, 1R, 2, 4 & 5]*** *Pipe connections less than 2½ inches (64 mm) to heating coils, cooling coils, humidifiers, and similar equipment shall have flexible connectors or three (3) 90-degree offsets in close proximity of the connection.*