IBC 2000/2003 Piping Restraint Rules

The following information is based on the 2000 IBC Code. (The same data is present in the 2003 IBC and/or Chapter 9 of ASCE 7-02, but the citation references would vary). These do not take into account more stringent specifications or local requirements. Systems relating to power piping; process piping; liquid transportation systems for hydrocarbons, LPG, anhydrous ammonia and alcohol; refrigeration; slurries; or gas transmission are subject to ASME standards that should also be consulted where applicable. Should such requirements exist, they would need to be evaluated independently.

For the remainder of this document "piping" refers only to piping not related to those items above.

Prior to using this document, the appropriate (S_{DS}) design spectral response for the project in question must be determined. This is a function of the mapped short period spectral response and the soil classification factor. If the soil type is unknown, type "D" should be assumed.

In addition, the project must be classified according to "seismic use group." Refer to the code or separate documentation for a detailed breakdown as to the definitions of various "seismic use groups."

Lastly, the piping system's importance factor must be determined. This factor is now tied more closely to the use of, or hazard generated by, the piping rather than the use of the structure. There are two levels of importance: 1.0 and 1.5. The importance factor of 1.5 is used under the following conditions:

1) The component is a life-safety component that must function after an earthquake.
2) The component contains hazardous or flammable material in excess of exempted limits.
3) Components needed for continued operation of Group III occupancy structure.
4) Components whose failure could result damage to a system or space required for continued operation of Group III occupancy structure.
5) All other conditions use an importance factor of 1.0.

Using the seismic use group in conjunction with the design spectral response, the seismic design category can be determined from the table below:

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Seismic Design Category based on .2 Second Response Accelerations			
	Seismic Use Group		
S_{DS} Value	I	II	III
S_{DS} < 0.167g	A	A	A
0.167g≤S_{DS}<0.33g	B	B	C
0.33≤S_{DS}<0.50g	C	C	D
0.50g≤S_{DS}	D	D	D
0.75g≤S_1[a]	E	E	F

[a] S_1 is mapped max considered spectral response

Piping Exempt from Restraint Requirements

Piping of all types that does not require seismic restraint per code:

1) Any piping that is placed in a structure that falls into seismic design category A or B (1621.1.1).
2) Any piping that is placed in a structure that falls into seismic design category C and has an importance factor of 1.0 (1621.1.1).
3) Any piping system in any seismic design category that has an importance factor of 1.0, weighs less than 400 lb, is mounted within 4 ft of the floor, is flexibly mounted to all interfacing equipment, and is not critical to the continued operation of the structure (1621.1.1).

Fire-Protection piping that does not require seismic restraint per code:

1) All piping when not “subject to earthquakes” (NFPA 13 6-4). As this definition is not clear, defer back to IBC 1621.1.1 indicating nothing required for design category A or B (only).
2) Lateral bracing not required if the top of the pipe is within 6” of the support structure and the pipe is individually supported. Longitudinal bracing still is required (NFPA 13 6-4.5.3, NFPA 13 6-4.5.4).
3) Branch lines that are under 2.5” diameter require no bracing (NFPA 13 6-4.5.3).

Gas, fuel or other high hazard piping systems that do not require seismic restraint per code:

1) Runs of piping supported by hangers where all rod hangers are a maximum of 12” long (from top anchor position to top of pipe or from top anchor position to top of trapeze bar, whichever is longer). The rods must be fitted with a non-moment generating free swinging connection at the top and adequate flexes at the equipment interfaces must be provided. (Note, all hanger rods on the run must comply with the above to meet this criteria, and the swinging of the pipes must not interfere with other pipes and systems.) (1621.3.10.2.1-2.2.1 and 1621.3.10)
2) High deformability piping (see below for examples) in seismic design category D, E, or

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F if the diameter is 1.0” or less. The piping must also be located such that impacts with other piping or equipment will not occur during a seismic event, and adequate flexes at the equipment interfaces must be provided. (1621.3.10.2.1-2.2.2 and 1621.3.10).

3) High deformability piping (see below for examples) in seismic design category C if the diameter is 2.0” or less. The piping must also be located such that impacts with other piping or equipment will not occur during a seismic event, and adequate flexes at the equipment interfaces must be provided. (1621.3.10.2.1-2.2.3 and 1621.3.10).

Medical gas piping systems that do not require seismic restraint per code:

1) Runs of piping supported by hangers where all rod hangers are a maximum of 12” long (from top anchor position to top of pipe or from top anchor position to top of trapeze bar, whichever is longer). The rods must be fitted with a non-moment generating free swinging connection at the top and adequate flexes at the equipment interfaces must be provided. Note that all hanger rods on the run must comply with the above to meet this criteria, and the swinging of the pipes must not interfere with other pipes and systems (1621.3.10.2.1-2.2.1 and 1621.3.10).
2) High deformability piping (see below for examples) in seismic design category D, E, or F if the diameter is 1.0” or less. The piping must also be located such that impacts with other piping or equipment will not occur during a seismic event, and adequate flexes at the equipment interfaces must be provided (1621.3.10.2.1-2.2.2 and 1621.3.10).
3) High deformability piping (see below for examples) in seismic design category C if the diameter is 2.0” or less. The piping must also be located such that impacts with other piping or equipment will not occur during a seismic event, and adequate flexes at the equipment interfaces must be provided (1621.3.10.2.1-2.2.3 and 1621.3.10).

General Piping Systems that do not require Seismic Restraint per Code:

1) Runs of piping supported by hangers where all rod hangers are a maximum of 12” long (from top anchor position to top of pipe or from top anchor position to top of trapeze bar, whichever is longer). The rods must be fitted with a non-moment generating free swinging connection at the top and adequate flexes at the equipment interfaces must be provided. Note that all hanger rods on the run must comply with the above to meet this criteria and the swinging of the pipes must not interfere with other pipes and systems (1621.3.10.2.1-2.2.1).
2) High deformability piping (see below for examples) in seismic design category D, E, or F and an importance factor of 1.5, if the diameter is 1.0” or less. The piping must also be located such that impacts with other piping or equipment will not occur during a seismic event, and adequate flexes at the equipment interfaces must be provided (1621.3.10.2.1-2.2.2).
3) High deformability piping (see below for examples) in seismic design category C and an importance factor of 1.5, if the diameter is 2.0” or less. The piping must also be located such that impacts with other piping or equipment will not occur during a seismic event, and adequate flexes at the equipment interfaces must be provided (1621.3.10.2.1-2.2.3 and 1621.3.10).

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4) High deformability piping (see below for examples) in seismic design category D, E, or F and an importance factor of 1.0, if the diameter is 3.0" or less. The piping must also be located such that impacts with other piping or equipment will not occur during a seismic event, and adequate flexes at the equipment interfaces must be provided (1621.3.10.2.1-2.2.4).

Piping system deformability Classifications and Flexibility Issues:

The Code identifies piping systems by levels of deformability. Unfortunately the definitions as expressed in the body of the code are difficult to match up to typical hardware that might be used. As a guide, various types of commonly used components and corresponding deformability ratings are listed below.

High deformability: These are comprised of piping made of ductile materials and connected with strain tolerant connections. Steel or copper pipe with welded, brazed or roll formed groove type connections, PVC/PVDF plastic piping with glued connections or ductile iron pipe with no-hub connections can normally be assumed to fall into this category.

Medium deformability: These are systems that are commonly made up of relatively ductile materials, but are connected together with couplings that are less strain resistant. Steel pipe and fittings as well as plastic piping connected with screwed joints or cut groove type connections can normally be assumed to fall into this category.

Low deformability: These systems are made of brittle materials and/or have connectors with a low strain tolerance. Plain cast iron, glass lined and FRP pipe and connectors fall into this group.

Flexibility: Some motion tolerant coupling types, when used in seismic applications, are actually too flexible. On these a reduced restraint spacing (one half that specified by SMACNA) must be used to prevent excessive motion in and resulting damage to the piping system. Examples of these include non-rigid groove type connectors and 2 band no-hub couplings.

Unless noted otherwise, KNC assumes piping installed in seismic areas to meet the high deformability criteria and that measures have been taken to control the system flexibility when sizing and locating restraint components.

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