Grinnell®

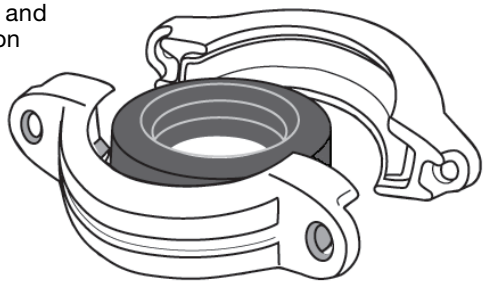
Worldwide Contacts | www.grinnell.com

Grinnell Mechanical Products Design Data Seismic Applications

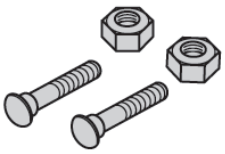
Grinnell was established in 1850 and since then has spearheaded the development of new technology to meet the demands of the industry. Grinnell Mechanical Products include grooved couplings, fittings, valves and accessories that are used in a variety of applications including installations where seismic considerations must be addressed.

THE ENGINEERED COUPLING

Grinnell Mechanical Piping Products are designed for grooved end pipe and are available in nominal sizes of 1 in./DN25 to 24 in./DN600 depending on the coupling required. The Grinnell Coupling design provides economic advantages when compared to welded or flanged systems. They also provide a universal means for the connection of pipe, fittings and pipe system components.



Grinnell Couplings and Gaskets permit the selection of suitable combinations for specific applications. Field modifications are easily accommodated with Grinnell Grooved Couplings, as the couplings can easily be rotated, eliminated and/or added to facilitate modifications.



Flexible Couplings act as an "expansion joint", allowing linear and angular movement of the pipe. They are designed with the coupling keys engaging the pipe without gripping on the bottom of the grooves, while still providing a restrained mechanical joint. In seismic areas this allows for pipe expansion or contraction, piping misalignment, and reduced stresses in piping systems.

Rigid Couplings provide rigid gripping of the pipe. They are designed to bring the pipe ends closely together while the coupling clamps firmly onto the pipe OD and also onto the bottom of the grooves. Because Rigid Couplings clamp around the entire pipe surface, they provide resistance to flexural loads and, therefore, permit increased spacing to ASME/ANSI B31.1 (Power Piping) and ASME/ANSI B31.9 (Building Services) requirements.

BOLTS AND NUTS

Coupling bolts and nuts are heat treated carbon steel, oval-neck track head bolts and heavy hex nuts, conforming to the physical properties of ASTM A-183 minimum tensile strength of 110,000 psi (758,422 kPa). Bolts and nuts are Zinc electroplated.

Gold color coded metric bolts conforming to the physical properties of ASTM F568M are available upon request. Contact Johnson Controls.

The oval neck design allows for tightening the hex nut with a single wrench.

GASKETS

Grade "E" EPDM gaskets have a green color code identification and conform to ASTM D-2000 for service temperatures from -30°F (-34°C) to 230°F (110°C). They are recommended for hot water not to exceed 230°F (110°C), dilute acids, alkalies, oil free air and many chemical services. They are not recommended for petroleum services. For freezer and vacuum systems a Tri-Seal Grade "E" EPDM Gasket with rigid coupling is recommended.

Grade "T" Nitrile gaskets have an orange color code identification and conform to ASTM D-2000 for service temperatures from -20°F (-29°C) to 180°F (82°C). They are recommended for petroleum products, vegetable oils, mineral oils, and air with oil vapors. They are not recommended for hot water systems or hot dry air systems.

Grade "O" Fluoroelastomer gaskets have a blue color code identification and conform to ASTM D-2000 for service temperatures from +20°F (-7°C) to +300°F (+149°C). They are recommended for oxidizing acids, petroleum products, hydraulic fluids, lubricants, and halogenated hydrocarbons.

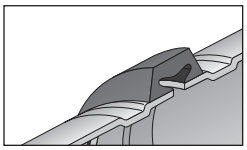
Grade "L" Silicone gaskets are red and conform to ASTM D-2000 for service temperatures from -30°F (-34°C) to +350°F (+177°C). They are recommended for air without hydrocarbons and dry heat.

For additional information on gasket selection, please refer to Data Sheet G610.

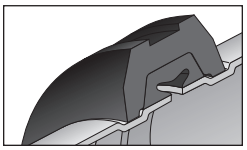
IMPORTANT
Refer to Technical Data Sheet G1100 for warnings pertaining to regulatory and health information.

COATINGS

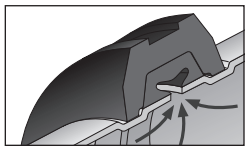
All housings are coated with orange, non-lead waterbased paint, RAL Red non-lead waterbased paint or hot dipped zinc galvanized.



First seal
C-shaped rubber gasket seals on pipe ends.



Second seal
The housings compress the gasket to increase the sealing capacity.



Third seal
The system pressure or vacuum will then maximize the leak-tight seal.

SUPERIOR QUALITY

Grinnell Mechanical Piping Products are manufactured according to the ISO 9001:2000 Quality Management System.

QUICK

Grinnell Mechanical Piping Products result in time savings compared to welding, flanging or threading.

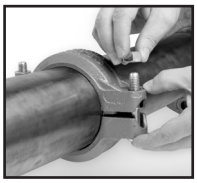
EASY

Grinnell Mechanical Piping Products only require a wrench for installation. No special expensive equipment or skilled labor is required for installation as compared to welded or flanged systems.

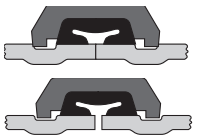
COST SAVINGS

Total installed costs for Grinnell Mechanical Piping Products will be well below any other method currently available.

ISO 9001:2000

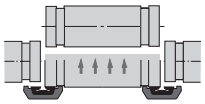


FLEXIBILITY



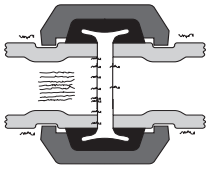
Grinnell flexible couplings are able to absorb linear movement of the pipework due to temperature changes and help to minimize pipeline stress that occurs during seismic movement. This eliminates or minimizes the use of expansion joints.

RETROFIT



The Grinnell Mechanical Piping Products allow for quick economical changes as necessary for field retrofit, with the ability to isolate equipment and piping systems for tenant changes and system repair.

NOISE AND VIBRATION



The resiliency of Grinnell grooved couplings with various elastomer gaskets provide excellent noise and vibration dampening. The engineering design of the couplings provide for pipe end gapping which helps to dissipate, isolate, and minimize noise and vibration transmission throughout the piping system.

MATERIAL SPECIFICATIONS

The applicable material specifications for ductile iron, galvanizing and rubber gaskets apply:

Ductile Iron Housing Specifications:
ASTM A-536 - Standard Specification for Ductile Iron Castings Grade 65-45-12 Tensile Strength, minimum 65,000 psi (MPa-448)Yield Strength, minimum 45,000 psi (MPa-310) Elongation in 2" (50mm), minimum 12%ASTM A-153 - Standard Specification for Hot Dip Galvanizing

Gasket Specifications:
Grade "E" EPDM gaskets have a green color code identification and conform to ASTM D-2000.

Grade "T" Nitrile gaskets have an orange color code identification and conform to ASTM D-2000.

Grade "O" Fluoroelastomer gaskets have a blue color code identification and conform to ASTM D-2000.

Grade "L" Silicone gaskets are red and conform to ASTM D-2000.

Bolt / Nut Specifications:
Carbon steel oval neck bolts and nuts are heat treated and conform to the physical properties of ASTM A-183 with a minimum tensile strength of 110,000 psi (758,422 kPa). Bolts and nuts are Zinc electroplated to ASTM B633.

Gold color coded metric bolts conforming to the physical properties of ASTM F568M are available.

Coatings:
Orange - non lead
RAL Red - non lead
Hot Dipped Zinc Galvanized

INDUSTRY STANDARDS

GOVERNMENT AGENCIES

Coast Guard
Approved each vessel individually

Corps of Engineers (COE)
GEGS 15000

Federal Aviation Administration (FAA)
HVAC, Plumbing and Fire Protection

Federal Housing Administration (FHA)
General Services Administration (GSA)
15000 Series

Military Specifications (MIL)
MIL P - 10388 Fittings;

MIL - C - 10387 Couplings;

MIL - P - 11087A (CE) Steel Pipe,

Grooved MIL - I - 45208 Inspection Procedure

National Aeronautics and Space Administration (NASA)
Naval Facilities Engineering Command (NAVFAC)
NFGS 15000 Series

National Institute of Health (NIH)
Dept. of Health - 15000 Series

Veterans Affairs (VA)
15000 Series

GENERAL CODE GROUPS, ASSOCIATIONS, LABORATORIES AND APPROVAL BODIES

American Bureau of Shipping (ABS)
American National Standards Institute / American Water Works Association (ANSI / AWWA)
American Petroleum Institute (API)
API Std. 5L, Sect. 7.5

American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
American Society of Mechanical Engineers (ASME)
Power Piping, B-31.1;

Chemical Plant and Petroleum Refinery Piping, B-31.3;

Refrigeration Piping, B-31.5;

Building Services Piping, B31.9

Building Officials and Code Administrators (BOCA)
Bureau Veritas (BV)
Centrum Naukowo-Badawcze Ochrony Przeciwpozarowe (CNBOP) (Poland)
FM Global (FM)
Approved for Fire Protection Services

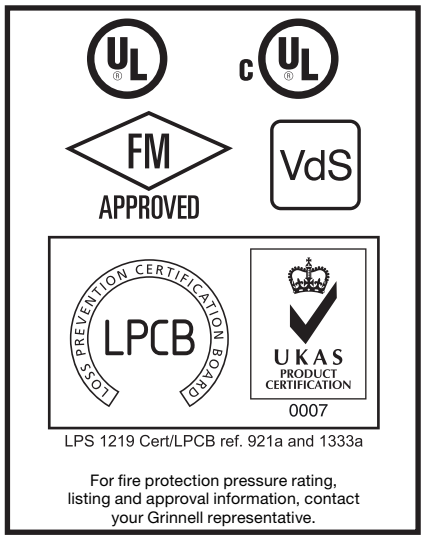
Loss Prevention Certification Board (LPCB)
Approved for Fire Protection Services

Material Equipment and Acceptance (MEA)
National Fire Protection Association (NFPA)
Southern Building Code Congress International
(SBCCI) - Standard Plumbing

Underwriter's Laboratories, Inc. (UL)
Listed for Fire Protection Services

Underwriters Laboratories of Canada (ULC)
Listed for Fire Protection Services

Verband der Sachversichere e.V. (VdS)
Approved for Fire Protective Service



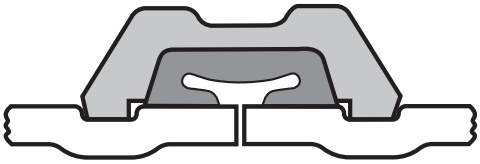
LPS 1219 Cert/LPCB ref. 921a and 1333a

For fire protection pressure rating, listing and approval information, contact your Grinnell representative.

PIPE MOVEMENT AND SUPPORT

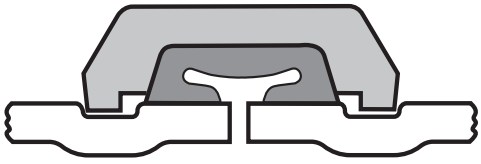
The designer has a choice in the selection of grooved couplings to meet the requirements of the seismic application. Where flexibility is not desired, rigid couplings may be used.

RIGID JOINTS



Grinnell Rigid Couplings provide rigid gripping of the pipe and may be used in seismic applications where flexibility is not required. They are designed to bring the pipe ends closely together and the coupling clamps firmly onto the pipe OD and also into the bottom of the grooves. Because rigid couplings clamp around the entire pipe surface, they provide resistance to flexural and torsional loads and therefore permit longer spacing to ASME/ANSI B31.1 (Power Piping) and ASME/ANSI B31.9 (Building Services) requirements.

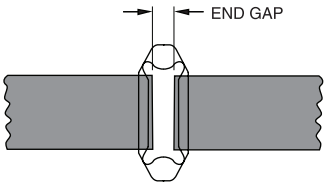
FLEXIBLE JOINTS



Grinnell Flexible Couplings act as an “expansion joint”, allowing linear and angular movement of the pipe. They are designed with the coupling keys engaging the pipe without gripping on the bottom of the grooves, while still providing for a restrained mechanical joint. This is allows for pipe expansion / contraction and piping misalignment.

LINEAR MOVEMENT (FLEXIBLE COUPLINGS)

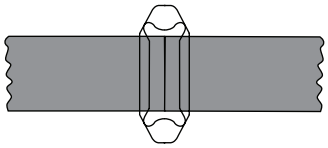
For expansion with flexible couplings, the pipe ends at each joint should be fully gapped to the maximum end gap. This can be accomplished by pressurizing the system and then anchoring the system.



Pipe Ends Gapped for Expansion

For contraction with flexible couplings, the pipe ends at each joint should be at the minimum end gap. The system can then be anchored in place to prevent the pipe ends from spreading to the maximum end gap when pressurized.

The following values should be used as available pipe end movements for Grinnell Figure 405, 705, and 707 flexible couplings:



Pipe Ends Butted or Minimum End Gap for Contraction

For design purposes, the maximum pipe end gap should be reduced to account for field practices as follows:

End Gap Reduction	
Pipe Size ANSI Inches / DN	**Maximum Pipe End Gap Reduction**
1-3 DN25 - DN80	50%
4-24 DN100 - DN600	25%

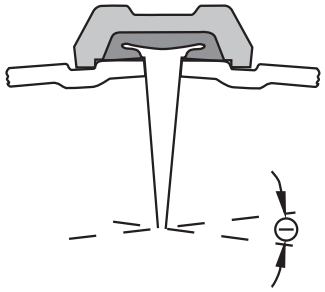
Pipe End Movements		
Pipe Size ANSI Inches DN	**Cut Grooved ANSI inches (mm)**	**Roll Grooved[1] ANSI inches (mm)**
1-3 DN25 - DN80	0 - 0.063 (0 - 1,6)	0 - 0.031 (0 - 0,8)
4-24 DN100 - DN600	0 - 0.188 (0 - 4,8)	0 - 0.094 (0 - 2,4)

NOTES
1. Roll grooved joints provide ½ the available movement of cut grooved joints.

Grinnell Flexible Couplings																					
Pipe Size	**Nominal ANSI Inches DN**	1 DN25	1¼ DN32	1½ DN40	2 DN50	2½ DN65	- DN65	3 DN80	4 DN100	– DN125	5 DN125	– DN150	6 DN150	8 DN200	10 DN250	12 DN300	14 DN350	16 DN400	18 DN450	20 DN500	24 DN600
	O. D. Inches (mm)	1.315 (33,7)	1.660 (42,4)	1.900 (48,3)	2.375 (60,3)	2.875 (73,0)	3.000 (76,1)	3.500 (88,9)	4.500 (114,3)	5.500 (139,7)	5.563 (141,3)	6.500 (165,1)	6.625 (168,3)	8.625 (219,1)	10.750 (273,0)	12.750 (323,9)	14.000 (355,6)	16.000 (406,4)	18.000 (457,2)	20.000 (508,0)	24.000 (609,6)
Activation Force Lbs./N		30 (134)	35 (156)	45 (200)	70 (311)	100 (645)	110 (489)	145 (645)	240 (1068)	375 (1668)	375 (1668)	500 (2224)	520 (2313)	880 (3914)	1365 (6072)	1915 (8518)	2310 (10,275)	3020 (13,434)	3820 (16,992)	4715 (20,973)	6790 (30,203)

ANGULAR DEFLECTION

Grinnell Flexible Couplings are capable of accommodating angular deflection.

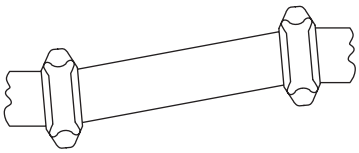


The deflection published is a maximum value. For design purposes the maximum deflection should be reduced to account for field practices as shown:

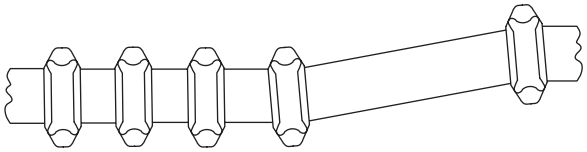
Deflection	
Nominal Pipe Size ANSI Inches DN	**Maximum Pipe Deflection Reduction**
1¼ - 3 DN32 - DN80	50%
4 - 24 DN100 - DN600	25%

EXPANSION/CONTRACTION

Grinnell Flexible Couplings are capable of accommodating pipe movements provided they are properly gapped, anchored, and a sufficient quantity of flexible couplings are used. Note that flexible couplings will not accommodate both full maximum linear movement and the maximum available angular deflection concurrently at the same joint.



If both deflection and linear movement are required, then the system should have sufficient flexible joints to accommodate the requirement.



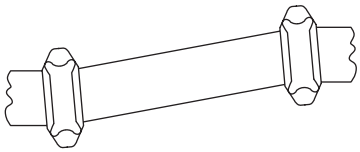
MISALIGNMENT AND DEFLECTION

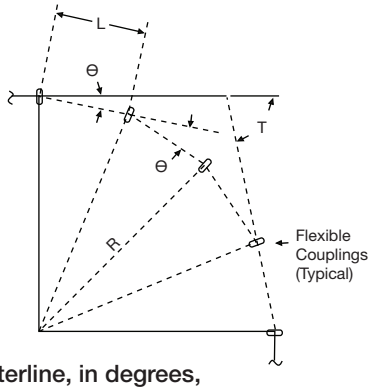
Grinnell Flexible Couplings provide for restrained joints and allow for deflection to aid where the pipe or equipment is misaligned.

Note that flexible couplings will not accommodate both full maximum linear movement and the maximum available angular deflection concurrently at the same joint.

Flexible couplings are also useful in laying out curved piping systems.

Design Deflection for Roll Grooved Pipe			
Pipe Size			Figures 705 & 707
Nominal ANSI Inches	DN	O. D. Inches / (mm)	
1	*DN25*	*1.35 (33,7)*	1.38°
1¼	*DN32*	*1.600 (42,2)*	1.08°
1½	*DN40*	*1.900 (48,3)*	0.94°
2	*DN50*	*2.375 (60,3)*	0.75°
2½	*DN65*	*2.875 (73,0)*	0.62°
–	DN65	3.000 (76,1)	0.60°
3	*DN80*	*3.500 (88,9)*	0.51°
4	*DN100*	*4.500 (114,3)*	1.19°
5	*DN125*	*5.563 (141,3)*	0.97°
–	DN150	6.500 (165,1)	0.83°
6	*DN150*	*6.625 (168,3)*	0.81°
8	*DN200*	*8.625 (219,1)*	0.63°
10	*DN250*	*10.750 (273,1)*	0.50
12	*DN300*	*12.750 (323,4)*	0.42°





$R = \frac{L}{(2)\ (\sin\frac{\Theta}{2})}$

$L = (2)\ (R)\ (\sin\frac{\Theta}{2})$

$N = \frac{T}{\Theta}$

R = Radius of curve
L = Pipe length
Θ = Deflection from centerline, in degrees, for each coupling (see table)
N = Number of flexible couplings needed
T = Total deflection, in degrees, required

PIPE SUPPORT

All piping systems require that the support system accommodate the weight of the pipe, joint connections, fluid and other system components. In addition, consideration may be necessary in reducing stresses, accommodating thermal expansion or contraction, building settlement, seismic movement, etc. Consideration should be given to incorporating proper bracing to minimize the piping system movement with respect to the structure movement. Seismic separation joints such as depicted in NFPA-13 have been used when crossing a seismic separation joint above ground level. Seismic movement can cause damage to piping systems if not properly braced. The type of bracing and its location needs to be evaluated by the system designer taking into account the magnitude of seismic activity, building structures, branch connections, fixed equipment hookup, code requirements, etc. The following tables provide guidelines for grooved steel piping products without concentrated loads between supports.

FLEXIBLE JOINTS

For pipe runs when linear movement is accommodated by the flexible coupling:

Number of Hangers Per Pipe Length								
Nominal Pipe Size ANSI Inches DN	Pipe Length in Feet (m)							
	10' (3,3)	12' (3,7)	15' (4,6)	22' (6,7)	25' (7,6)	30' (9,1)	35' (10,7)	40' (12,2)
	Avg. Hangers Per Pipe Length							
1 - 2 DN25 - DN50	2	2	2	3	4	4	5	6
2¼ - 4 DN65 - DN100	1	2	2	2	2	3	4	4
5 - 24 DN125 - DN600	1	1	2	2	2	3	3	3

For pipe runs when linear movement is not required:

Distance Between Supports	
Nominal Pipe Size ANSI Inches DN	Maximum Distance Between Supports Feet (m)
1 - 1½ DN25 - DN40	12 (3,7)
2 - 8 DN50 - DN200	15 (4,6)
10 - 12 DN250 - DN300	16 (4,9)
14 - 16 DN350 - DN400	18 (5,5)
18 - 24 DN450 - DN600	20 (6,1)

NOTES
- The requirements of ANSI, ASME or other code groups may require additional supports.

RIGID JOINTS

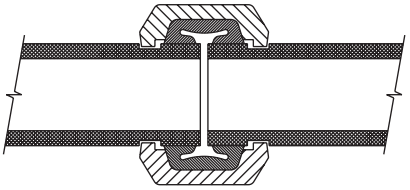
For pipe runs with rigid couplings:

Nominal Pipe Size ANSI Inches DN	Suggested Maximum Span Between Supports - Feet (m)			
	Water Service		Air Service	
	I	II	I	II
1 DN25	7 (2,1)	9 (2,7)	9 (2,7)	10 (3,0)
1¼ DN32	7 (2,1)	11 (3,4)	9 (2,7)	11 (3,4)
1½ DN40	7 (2,1)	12 (3,7)	9 (2,7)	13 (4,0)
2 DN50	10 (3,0)	13 (4,0)	13 (4,0)	15 (4,6)
2½ DN65	11 (3,4)	14 (4,3)	14 (4,3)	16 (4,9)
3 DN80	12 (3,7)	15 (4,6)	15 (4,6)	17 (5,2)
4 DN100	14 (4,3)	17 (5,2)	17 (5,2)	21 (6,4)
5 DN125	16 (4,9)	19 (5,8)	20 (6,1)	24 (7,3)
6 DN150	17 (5,2)	20 (6,1)	21 (6,4)	25 (7,6)
8 DN200	19 (5,8)	21 (6,4)	24 (7,3)	28 (8,5)
10 DN250	19 (5,8)	21 (6,4)	24 (7,3)	31 (9,4)
12 DN300	23 (7,0)	21 (6,4)	30 (9,1)	33 (10,1)
14 DN350	23 (7,0)	21 (6,4)	30 (9,1)	33 (10,1)
16 DN400	27 (8,2)	21 (6,4)	35 (10,7)	33 (10,1)
18 DN450	27 (8,2)	21 (6,4)	35 (10,7)	33 (10,1)
20 DN500	30 (9,1)	21 (6,4)	39 (11,9)	33 (10,1)
24 DN600	32 (9,8)	21 (6,4)	42 (12,8)	33 (10,1)

NOTES
- I - Spacing by ANSI B31.1 Power Piping Code
- II - Spacing by ANSI B31.9 Building Piping Code

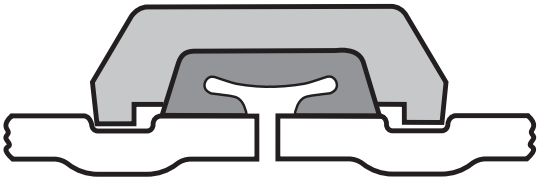
SUPPORT CONSIDERATIONS FOR FLEXIBLE JOINTS

Grinnell Flexible Couplings are suitable for use in seismic as well as other applications. The inherent capability of the flexible coupling to allow for linear movement, angular deflection, and rotational movement, make it an excellent choice for reducing stresses in a piping system.

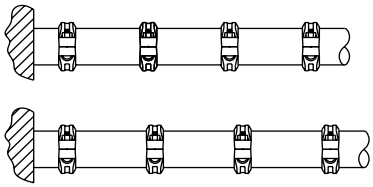


LINEAR MOVEMENT

Flexible couplings are designed with the coupling keys engaging the pipe without gripping on the bottom of the groove while still providing for a restrained mechanical joint.



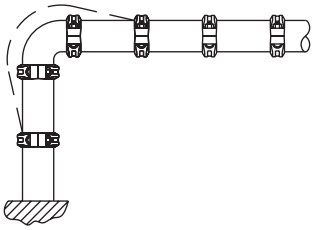
The inherent flexibility of the coupling must be considered when deciding on support arrangements for the piping system as movement can occur in more than one plane (linear movement, angular deflection and rotational movement).



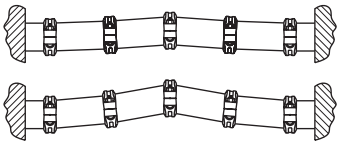
Upon system pressurization, each pipe end within the flexible couplings will expand to the maximum published value. The coupling keys make contact with the face of the groove and restrain the joint. In piping systems, this movement will be cumulative.

ANGULAR MOVEMENT

System movement can be accommodated by providing for sufficient offset lengths. Temperature increases/decreases can further increase this movement.



When systems are anchored with partially deflected joints, the system can move to the fully deflected condition upon pressurization resulting in the “snaking” of the piping system. Light weight hangers may not be suitable to prevent the lateral motion.

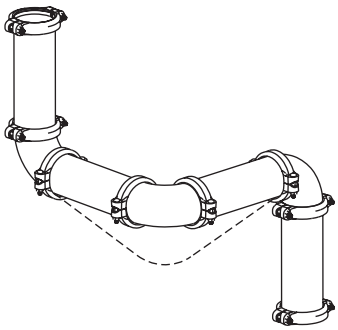


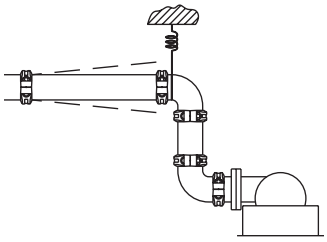
PIPE SUPPORT

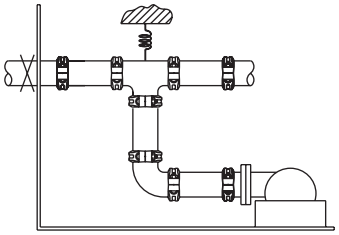
Pipe hanger positioning is important when considering pipe “sagging” due to the flexible nature of the piping system. Proper positioning of hangers near elbows, for example, should be considered.

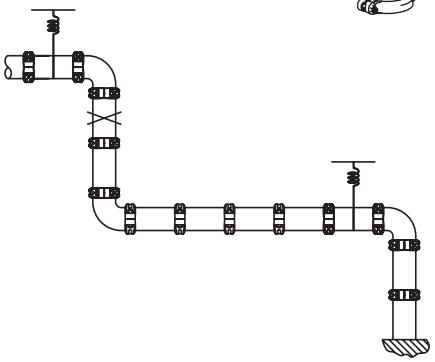
The use of spring hangers or other methods can be considered to accommodate vibrations. Base supports, pressure thrust anchors and pipe offsets can be used to direct pipe movement.

The use of rigid couplings can be considered to reduce the movement available with flexible couplings. Consideration of other methods of accommodation pipe movements may be required.









VERTICAL PIPING

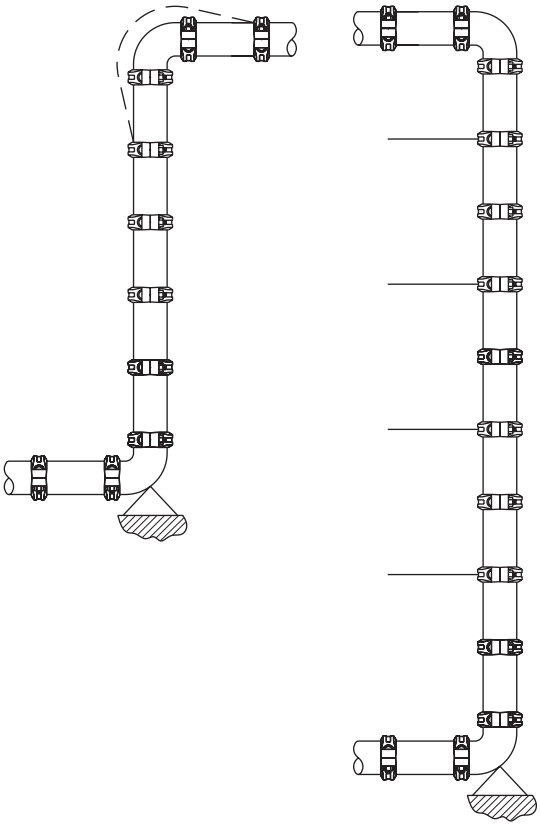
Risers comprised of rigid couplings can be considered similar to welded or flanged systems. Where thermal movement exists, expansion joints and/or flexible couplings with offsets may be required.

When using flexible couplings, the movement that occurs in long lengths of piping needs to be considered. Each joint can move to the maximum pipe end separation published. This movement can accumulate and result in the growth of the piping system, for example, at the top. Offsets may be necessary.

Should the riser contain branch connections, the movement that occurs at these locations with flexible couplings will also need to be considered.

One solution would be to anchor the vertical piping at appropriate locations to prevent movement that can cause stresses at the branches or equipment. The use of rigid couplings can be advantageous.

As always, good piping practice should prevail. It is the Designer’s responsibility to select products suitable for the intended service and to ensure that pressure ratings and performance data are not exceeded. Never remove any piping component nor correct or modify any piping deficiencies without first depressurizing and draining the system. Material and gasket selection should be verified to be compatible for the specific application.



1400 Pennbrook Parkway, Lansdale, PA 19446 | Telephone +1-215-362-0700

Johnson Controls