System Design

Central Grooved Piping Products
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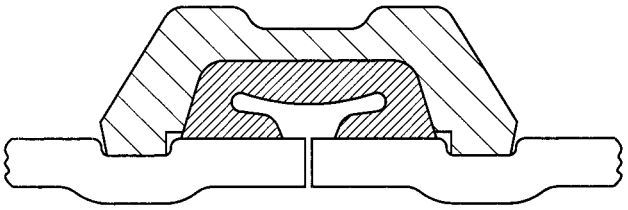
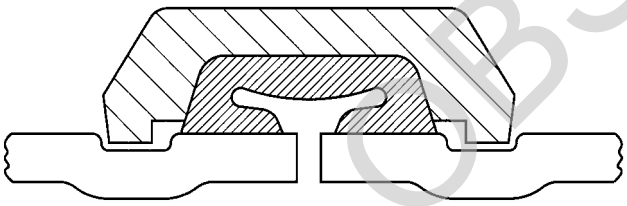
Central Grooved Piping Products provide the versatility required in piping systems through the use of rigid and flexible piping products.

Rigid Joints



Central Rigid Couplings provide rigid gripping of the pipe. 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 B39.1 (Building Services) requirements as well as NFPA 13 (Sprinkler Systems).

Flexible Joints



Central 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 particularly useful to allow for pipe expansion / contraction and piping misalignment.

Pipe Hanger Spacing

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. The following table provides guidelines for grooved steel piping products without concentrated loads between supports.

Rigid Couplings

Nominal Size Inches *mm*	Suggested Maximum Span Between Supports - Feet/*Meters*					
	Water Service			Air Service		
	I	II	III	I	II	III
1	7	9	12	9	9	12
33.4	*2.1*	*2.7*	*3.7*	*2.7*	*2.7*	*3.7*
$1^1/_4$	7	11	12	9	11	12
42.2	*2.1*	*3.4*	*3.7*	*2.7*	*3.4*	*3.7*
$1^1/_2$	7	12	15	9	13	15
48.3	*2.1*	*3.7*	*4.6*	*2.7*	*4*	*4.6*
2	10	13	15	13	15	15
60.3	*3*	*4*	*4.6*	*4*	*4.6*	*4.6*
$2^1/_2$	11	14	15	14	16	15
73.0	*3.4*	*4.3*	*4.6*	*4.3*	*4.9*	*4.6*
76.1mm	11	14	15	14	16	15
	3.4	*4.3*	*4.6*	*4.3*	*4.9*	*4.6*
3	12	15	15	15	17	15
88.9	*3.7*	*4.6*	*4.6*	*4.6*	*5.2*	*4.6*
4	14	17	15	17	21	15
114.3	*4.3*	*5.2*	*4.6*	*5.2*	*6.4*	*4.6*
5	16	19	15	20	24	15
141.3	*4.9*	*5.8*	*4.6*	*6.1*	*7.3*	*4.6*
165.1mm	17	20	15	21	25	15
	5.2	*6.1*	*4.6*	*6.4*	*7.6*	*4.6*
6	17	20	15	21	25	15
168.3	*5.2*	*6.1*	*4.6*	*6.4*	*7.6*	*4.6*
8	19	21	15	24	28	15
219.1	*5.8*	*6.4*	*4.6*	*7.3*	*8.5*	*4.6*
10	19	21	15	24	31	15
273.0	*5.8*	*6.4*	*4.6*	*7.3*	*9.4*	*4.6*
12	23	21	15	30	33	15
323.9	*7*	*6.4*	*4.6*	*9.1*	*10.1*	*4.6*
14	23	21	15	30	33	15
355.6	*7*	*6.4*	*4.6*	*9.1*	*10.1*	*4.6*
16	27	21	15	35	33	15
406.4	*8.2*	*6.4*	*4.6*	*10.7*	*10.1*	*4.6*
18	27	21	15	35	33	15
457.2	*8.2*	*6.4*	*4.6*	*10.7*	*10.1*	*4.6*
20	30	21	15	39	33	15
508.0	*9.1*	*6.4*	*4.6*	*11.9*	*10.1*	*4.6*
24	32	21	15	42	33	15
610.0	*9.8*	*6.4*	*4.6*	*12.8*	*10.1*	*4.6*

I - Spacing by ANSI B31.1 Power Piping Code
II - Spacing by ANSI B39.1 Building Piping Code
III - Spacing by NFPA 13 Sprinkler Systems

Flexible Joints

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

Size Inches *mm*	Pipe Length in Feet/*Meters*							
	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							
$1^1/_4$ - 2 *42.2 - 60.3*	2	2	2	3	4	4	5	6
2½ - 4 *73.0 - 114.3*	1	2	2	2	2	3	4	4
5 - 24 *141.3 - 610.4*	1	1	2	2	2	3	3	3

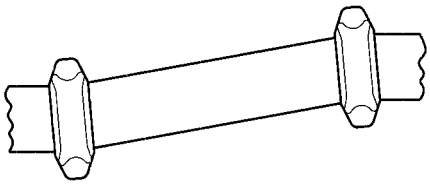
For pipe runs where the linear movement is not required:

Size Inches *mm*	Maximum Distance Between Supports Feet *Meters*
$1^1/_4$ *42.2*	12 *3.7*
2 - 8 *60.3 - 219.1*	15 *4.6*
10 - 12 *273.0 - 323.9*	16 *4.9*
14 - 16 *355.6 - 406.4*	18 *5.5*
18 - 24 *457.2 - 610.0*	20 *6.1*

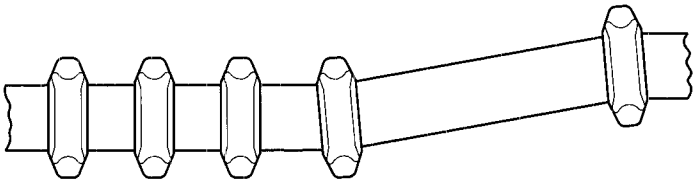
Note: The requirements of NFPA, ANSI, ASME, or other code groups may require additional supports.

Expansion / Contraction

Central Flexible Couplings are capable of accommodating pipe thermal movements provided they are properly gapped 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.



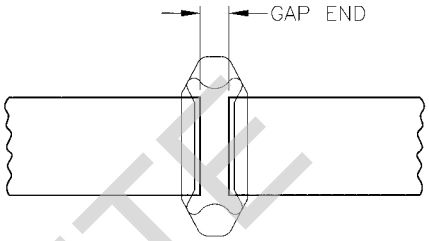
If it is desired to have both deflection and linear movement available, then the system should have sufficient flexible joints to accommodate the requirement.



The following guidelines are similar to any expansion joint:

It is recommended that anchors be installed at changes of direction on the pipe lines to control the pipe movement. The thermal expansion / contraction in the piping system can be accommodated utilizing Central Flexible Couplings. The following general guidelines can be used:

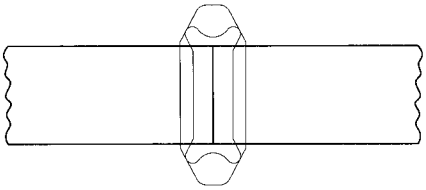
1. For thermal expansion the pipe ends at each joint should be fully gapped to the maximum end gap. This can be accomplished by pressurizing the system and then anchoring the system.



Pipe Ends Gapped for Expansion

2. For thermal contraction, the pipe ends at each joint should by fully butted. The system can then be anchored in place to prevent the pipe ends from opening up to the maximum end gap when pressurized.

Pipe Ends Butted for Contraction



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

Size Inches *mm*	Max. Pipe End Gap Reduction
$1^1/_4$ - 3 *42.2 - 88.9*	50%
4 - 24 *114.3 - 610.0*	25%

Therefore the following values should be used as available pipe end movements for Central Figure 705, 707, and 716 Flexible Couplings:

Size Inches *mm*	Cut Grooved	Roll Grooved*
$1^1/_4$ - 3 *42.2 - 88.9*	0 - 0.063" *0 - 1.6mm*	0 - 0.031" *0 - 0.8mm*
4 - 24 *114.3 - 610.0*	0 - 188" *0 - 4.8mm*	0 - 0.94" *0 - 2.4mm*

*Roll grooved joints provide $^1/_2$ the available movement of cut grooved joints.

In designing anchoring systems, it is suggested that the following be taken into consideration as a minimum:

1. Pressure thrusts.

2. Frictional resistance of any guides or supports.

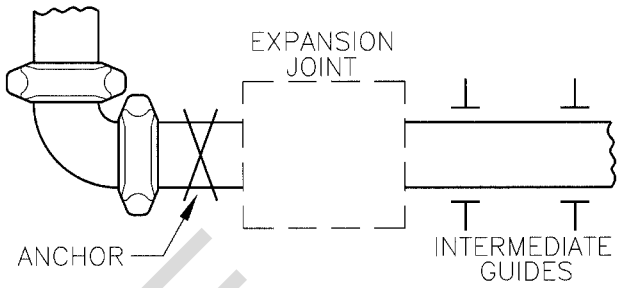
3. Centrifugal thrust due to velocity at changes of direction.

4. Activation force required to compress or expand a flexible coupling. This force is tabulated below:

Size Inches *mm*	Activation Force Pounds *N*
$1^1/_4$ *42.2*	35 *156*
$1^1/_2$ *48.3*	45 *200*
2 *60.3*	70 *311*
$2^1/_2$ *73.0*	100 *645*
76.1mm	110 *489*
3 *88.9*	145 *645*
4 *114.3*	240 *1068*
5 *141.3*	375 *1668*
165.1mm	500 *2224*
6 168.3	520 *2313*
8 *219.1*	880 *3914*
10 *273.0*	1365 *6072*
12 *323.9*	1915 *8518*

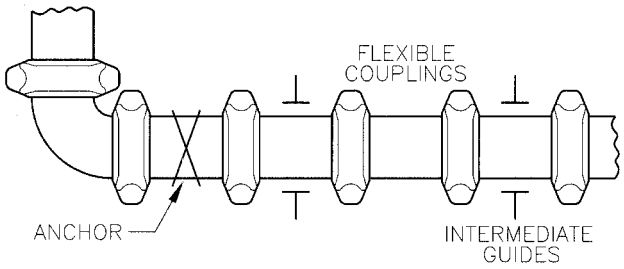
Three methods are available as examples to accommodate thermal expansion / contraction:

1. Design the system with rigid couplings and place expansion joints at the proper locations. Expansion joints may be a series of flexible grooved couplings of a sufficient quantity to accommodate the movement.



2. Design the system with flexible and/or rigid couplings and allow the pipe to move in directions desired, with the use of anchors and guides if so required. With this method, it is important to ensure that movement at branch connections, changes of direction, equipment hookup, etc., will not cause damage or harmful stresses.

3. Design the system with flexible couplings utilizing the expansion / contraction capabilities of these products. The following example illustrates this method:



- 6" Schedule 40 Steel Pipe, Roll Grooved, 150' long, anchored at each end.
- Maximum Temperature = 200°F *(93°C)*
- Minimum Temperature = 40°F *(4°C)*
- Install Temperature = 80°F *(27°C)*

Utilizing the Thermal Expansion Table the following calculations are performed:

Thermal Expansion of Carbon Steel in Inches/100 feet Between 0°F and Indicated Temperature

Temperature, °F	inches/100 feet
-40	-0.30
-30	-0.23
-20	-0.15
-10	-0.08
0	0.00
10	0.08
20	0.15
30	0.23
40	0.30
50	0.38
60	0.46
70	0.53
80	0.61
90	0.68
100	0.76
110	0.84
120	0.91
130	0.99
140	1.06
150	1.14
160	1.22
170	1.29
180	1.37
190	1.44
200	1.52
210	1.60
220	1.67
230	1.75

Mean Coef. of thermal expansion = 0.00000633 in/in/°F
Source: ASME B31.9

Installation temperature to minimum temperature (80°F to 40°F):

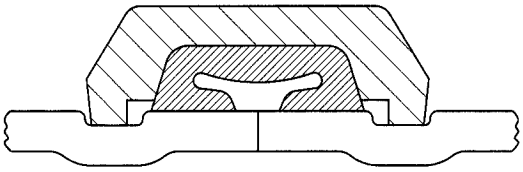
80°F = 0.61" per 100'
40°F = 0.30" per 100'
Difference = 0.31" per 100'
(For 150' of pipe = 0.31" X 1.5 = 0.46" per 150')

Installation temperature to maximum temperature (80°F to 200°F):

200°F = 1.52" per 100'
80°F = 0.61" per 100'
Difference = 0.91" per 100'
(For 150' of pipe = 0.91" X 1.5 = 1.36" per 150')

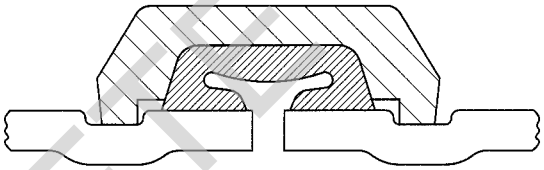
Available linear movement for a 6" Figure 707 on roll grooved pipe = 0.094" per coupling, therefore the number of flexible Figure 707 Couplings required is:

Installation temperature to minimum temperature:
0.46" / 0.094" per coupling = 4.89; use 5 Figure 707 Couplings for pipe contraction with pipe ends fully butted together.



Fully Butted Together - Contraction Only

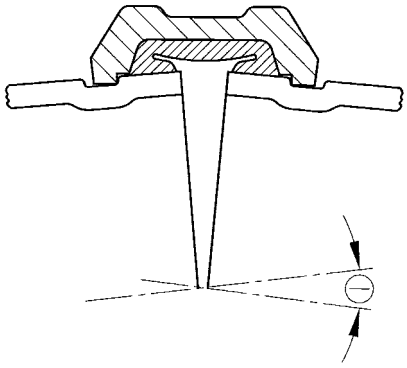
Installation temperature to maximum temperature:
1.36" / 0.094" per coupling = 14.47; use 15 Figure 707 Couplings for pipe expansion with pipe ends fully gapped apart.



Fully Gapped Apart - Expansion Only

Angular Deflection

Central Flexible Couplings are capable of accommodating angular deflection.



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

Size Inches *mm*	Max. Pipe End Gap Reduction
$1^1/_4$ - 3 *42.2 - 88.9*	50%
4 - 24 *114.3 - 610.0*	25%

CENTRAL GROOVED PIPING PRODUCTS