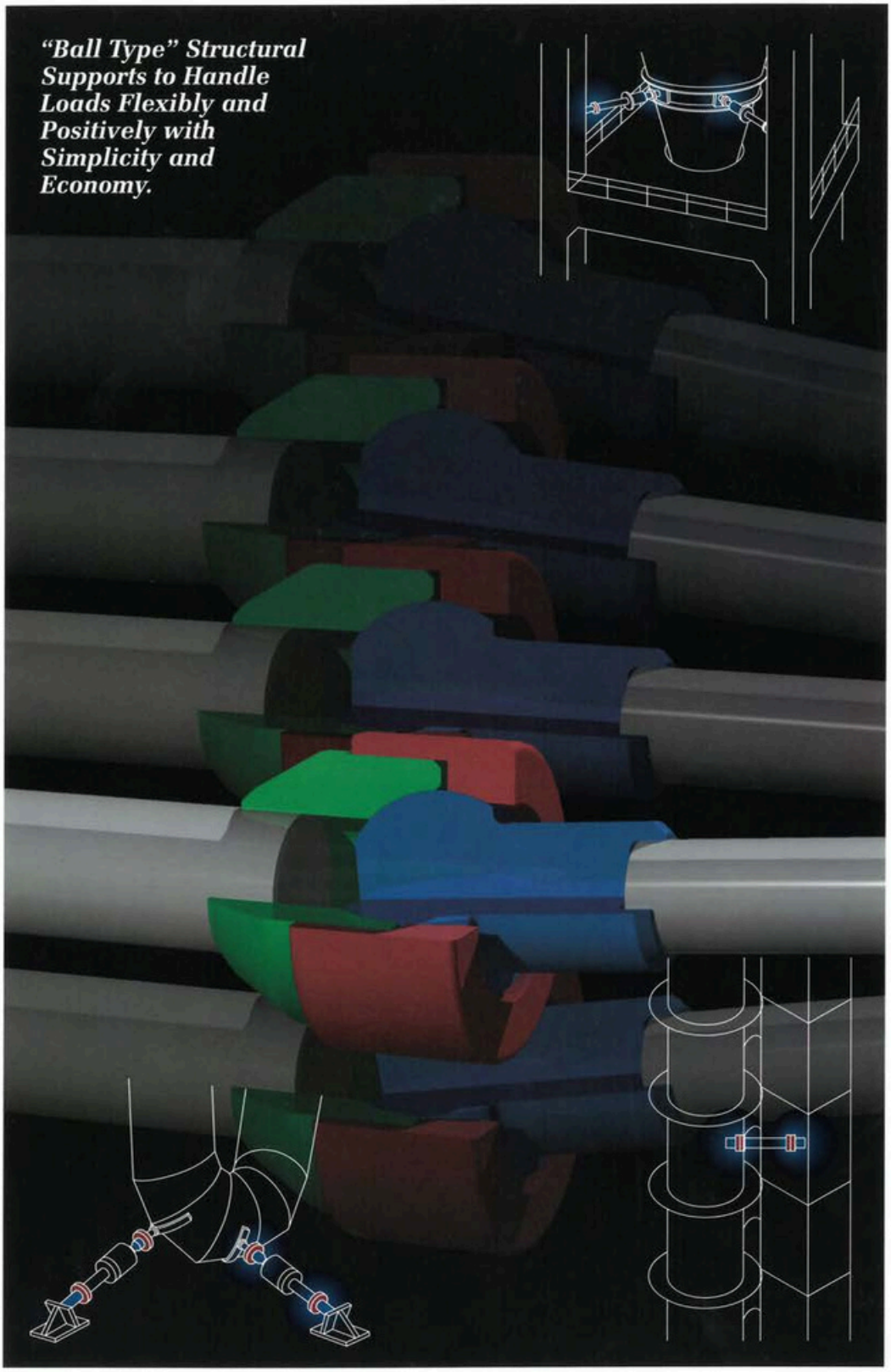
Catalog 3000B
Rev A

SERIES 6800
HYSPAN BARCO
FLEXIBLE STRUT JOINTS AND VIBRASNUBS



Hyspan Barco "Ball Type" Flexible Strut Joints and Vibrasnub™ Hydraulic Snubbers provide the Direct Method to . . .

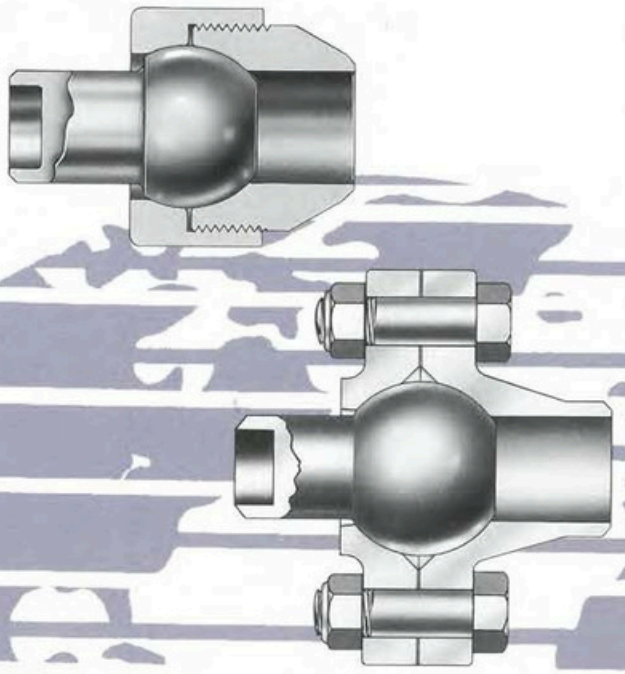
SUPPORT structures and system components

RESTRAIN unwanted structural movements

ACCOMMODATE high tensile and compressive loads

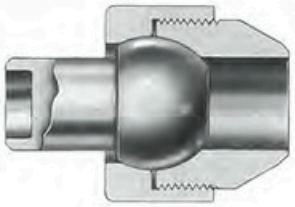
ABSORB dynamic vibration and shock loads

HANDLE compound motion due to torque and rotation

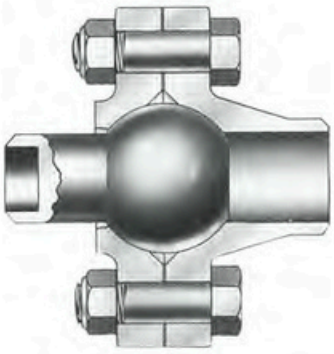


Product Index

Hyspan Barco "Ball Type" Flexible Strut Joints



BB-35500-XX
FOR SIZES: 3/4" x 1"; 1" x 1 1/4"; 1 1/2" x 2"; 2" x 2 1/2"; 3" x 4"



BB-35000-XX
FOR SIZES: 5" x 6"; 6" x 8"; 10" x 12"

Advantages:

Double Acting—Handles both tensile and compressive loads. Accommodates push, pull and slide movement with positive control.

Precision Built—Factory machined to close tolerances and rigidly inspected. Reduces the possibility of dangerous errors in field construction.

Lower Cost—Lower initial cost compared to other motion control and restraint methods, and economical operation.

Maintenance Free—Lubricated for life. No adjusting or service required.

Simple—Simplifies structural designing and eliminates the need for special struts, tie-rods, or clevis-and-pin arrangements which are not as flexible, and are subject to stress and binding.

Safety—High load carrying capacity for reliable service in severe conditions, combined with easy calculation of proper sizes to promote safety in structural design.

HYSPAN BARCO "Ball Type" Flexible Strut Joints function as positive restraints in process systems where the restraint is required in one direction, yet some movement must be allowed in other directions. This is accomplished by using a flexible ball type joint located at each end of a solid strut.

HYSPAN BARCO "Ball Type" Flexible Strut Joints may be applied for static or dynamic loads. They are equally rated for tensile or compressive loads. The most common uses are:.

1. structural sway bracing for hot stacks and pipes;
2. supports or hangers for horizontal piping;
3. stability supports for tall or slender towers, structures or vessels;
4. restraints to direct and control thermal expansion away from components that should not be stressed, such as turbine nozzles and pump flanges.

HYSPAN BARCO "Ball Type" Flexible Strut Joints have been used for years by many leading engineering and construction firms. Compared to other restraint methods like sliding plate guides, A-frames or clevis-and-pin arrangements "Ball Type" Flexible Strut Joints are simple to apply, economical to erect and less cumbersome.

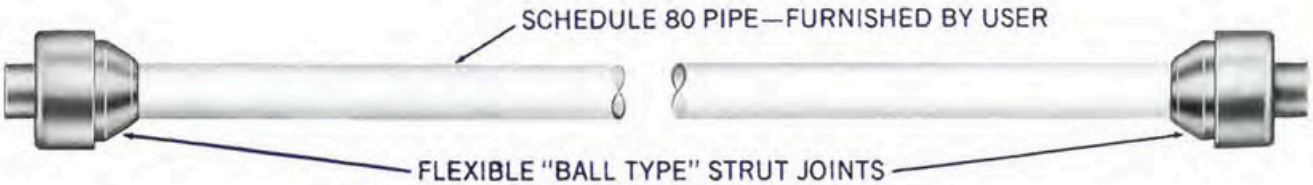
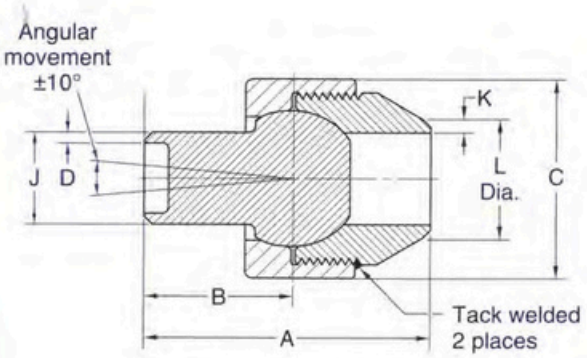


Table 1 Standard sizes – Inches(mm)

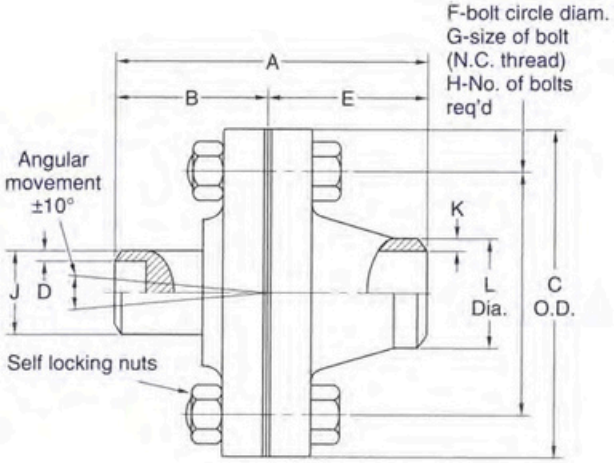
Ball End Inches	3/4	1	1 1/2	2	3	5*	6*	10
mm	(20)	(25)	(40)	(50)	(80)	(125)	(150)	(250)
Pipe Schedule Ball End	160	160	80	80	80	80	80	120
Casing End Inches	1	1 1/4	2	2 1/2	4	6	8	12
mm	(25)	(32)	(50)	(65)	(100)	(150)	(200)	(300)
Pipe Schedule Casing End	80	80	80	80	80	80	80	80

*Sizes: 5" (125mm) x 6" (150mm); 6" (150mm) x 8" (200mm); 10" (250mm) x 12" (300mm) available on special order only, other sizes carried in stock.

"Ball Type" Flexible Strut Joints



BB-35500-XX



BB-35000-XX

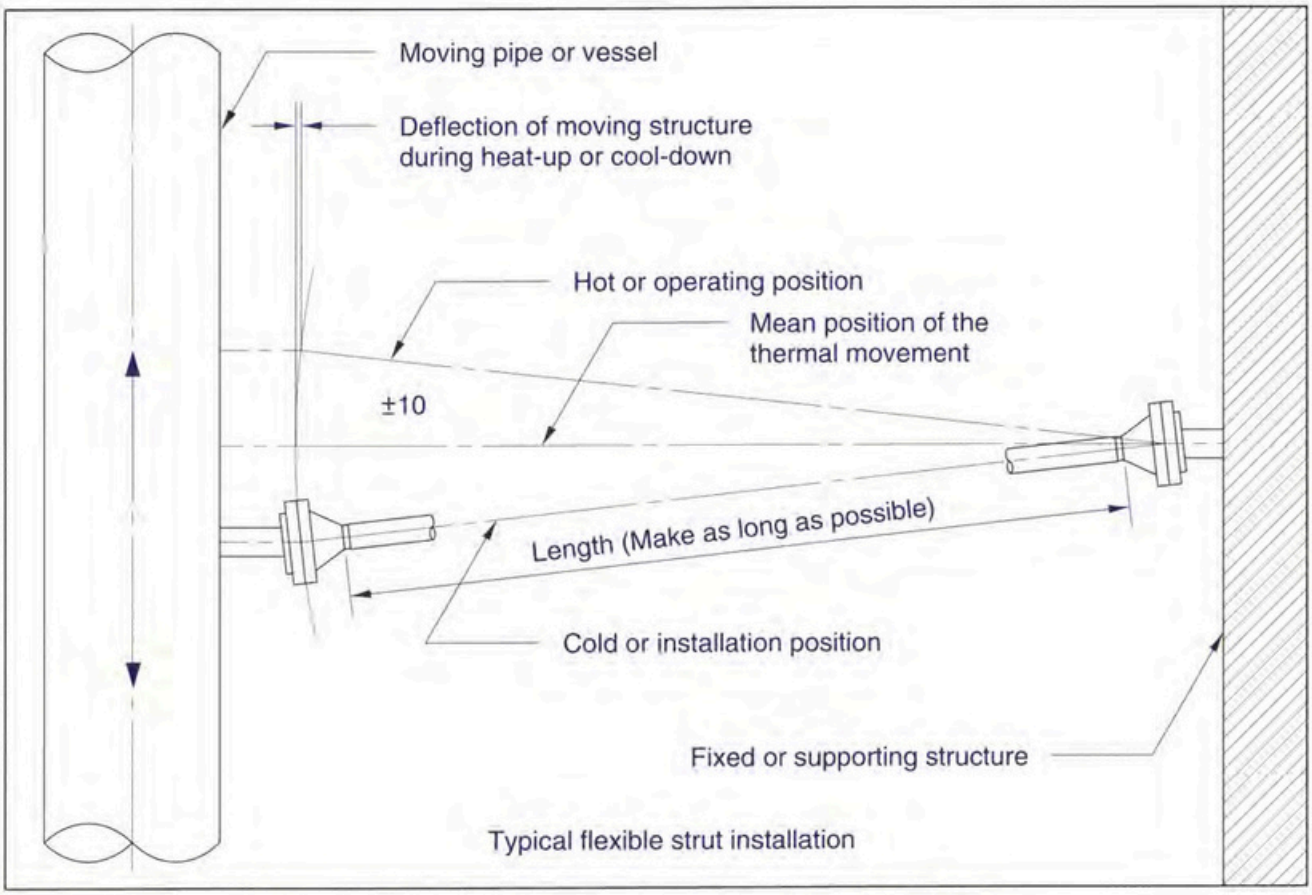
Table 2 Maximum Loading — Tension or Compression: Lbs (kN)

Ball End Inches mm	3/4 (20)	1 (25)	1 1/2 (40)	2 (50)	3 (80)	5 (125)	6 (150)	10 (250)
Loading: Lbs. (kN)	7,000 (31.2)	10,000 (44.5)	14,500 (64.5)	20,000 (89.0)	40,000 (178)	80,000 (356)	120,000 (534)	250,000 (1112)

Table 3 Dimensional Data

Assembly Part No.	Size: In. (mm)	A	B	C	D	F	G	H	J	K	L	Shipping Wt:. Lbs. (kg)
BB-35500-16	3/4x1 (20x25)	3.50 (88,9)	1.75 (44,5)	2.63 (66,8)	.218 (5,5)	N/A	N/A	N/A	1.05 (26,7)	.179 (4,5)	1.32 (33,5)	3.0 (1,4)
BB-35500-20	1x1-1/4 (25x32)	4.25 (108,0)	2.12 (53,8)	3.25 (82.6)	.250 (6,4)	N/A	N/A	N/A	1.32 (33.5)	.191 (4.8)	1.66 (42.2)	6.0 (2,7)
BB-35500-32	1-1/2x2 (40x50)	5.75 (146,1)	3.00 (76,2)	4.25 (108,0)	.200 (5,1)	N/A	N/A	N/A	1.90 (48,3)	.218 (5,5)	2.38 (60,5)	12.5 (5,7)
BB-35500-40	2x2-1/2 (50x65)	6.00 (152,4)	3.00 (76,2)	5.00 (127,0)	.218 (5,5)	N/A	N/A	N/A	2.38 (60,5)	.276 (7,0)	2.88 (73,2)	19.0 (8,6)
BB-35500-64	3x4 (80x100)	6.62 (168,1)	3.25 (82,6)	6.50 (165,1)	.300 (7,6)	N/A	N/A	N/A	3.50 (88,9)	.337 (8,6)	4.50 (114,3)	35.0 (15,8)
BB-35000-66	5x6 (125x150)	7.50 (190,5)	3.63 (92,2)	12.50 (317,5)	.375 (9,5)	10.63 (270,0)	3/4"-10	12 12	5.56 (141,2)	.432 (11,0)	6.63 (168,4)	120.0 (54,5)
BB-35000-68	6x8 (150x200)	8.88 (225,6)	4.50 (114,3)	15.00 (381,0)	.432 (11,0)	13.0 (330,2)	7/8"-9	12 12	6.63 (168,4)	.500 (12,7)	8.63 (219,2)	225.0 (102,2)
BB-35000-72	10x12 (250x300)	14.38 (365,2)	8.25 (209,6)	22.00 (558,8)	.843 (21,4)	19.25 (489,0)	1-1/4"-7	20 20	10.75 (273,1)	.687 (17,4)	12.75 (323,9)	650 (294,8)

For fabricated assemblies complete with extention pipe, contact Hyspan.



Typical flexible strut installation

Design and Engineering Notes

HYSPAN BARCO "Ball Type" Flexible Strut Joints can be installed in any position from vertical to horizontal. The joints at either end can be attached to a pipe, vessel or flatplate steel structure by butt-welding. Flexible strut joints should be located at a distance from any hot mass or surface to maintain their operating temperature below a maximum of 650°F (343°C).

The total load to which the joints will be subjected will determine the selection of the proper size. The total load includes: 1)normal operating load(s); 2)sudden or wind-shock loads; 3)the forces or loads involved in decreasing the distance between the supporting and supported structures when one or the other structure must move, like periodic thermal expansion and contraction. The distance decrease is a result of the supported pipe or structure moving axially. That causes the ball strut joint attached to it to describe an arc about the ball strut joint attached at the anchor point (see illustration above). This change in distance causes a positive deflection in the moving structure — it must be considered in design.

These deflections can be minimized by: 1)make the rigid strut between the joints as long as possible, consistent with good structural practice and considering the acceptable L/R ratio; 2)install the strut arrangement in the cold position so that this deflection takes place only during heat-up or cool-down (see illustration above).

For additional engineering assistance, please contact **HYSPAN.**

How to Order

1. Determine tensile or compression load for your application. Select the ball end size to handle this load from the "Maximum Loading" table (see table 2).
2. Find the correct size in the "Dimensional Data" table (see table 3). Determine the strut joint Assembly Part Number and specifiy accordingly.

Shipping Notes: Each "Ball Type" Strut Joint is shipped separately—two are needed for each flexible strut. The center connecting pipe, weld reducers (if needed) and stubs for ends are to be furnished by the customer.

Engineering Applications

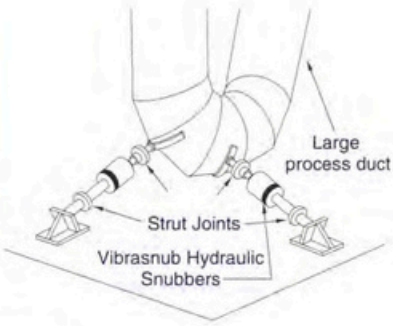


Fig.1 — This illustrates a typical use for "VIBRASNUB" Hydraulic Snubbers in a two-plane assembly on a large U-bend in a modern refinery. The snubbers allow slow expansion movements to occur but dampen out shock and vibratory movements.

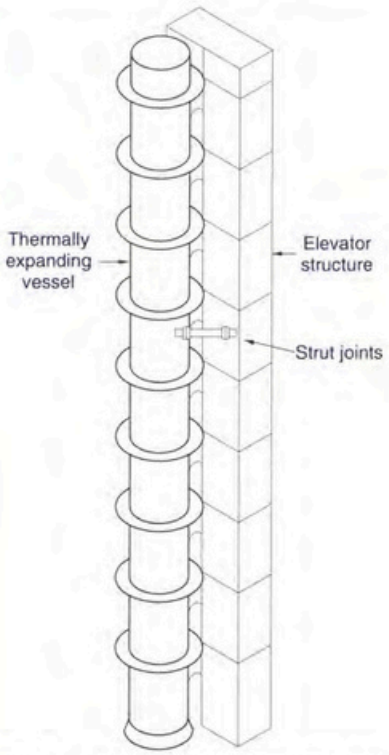


Fig.2 — This drawing illustrates the use of one pair of Flexible Strut Joints to provide lateral stability to an otherwise unstable, narrow elevator structure. Although the structure is over 200 feet (61.2m) high, overturning movement due to wind load was greatly reduced. This resulted in a savings in both the design of the foundation and in the structure. Flexible Strut Joints also provide a positive compression-or-tension member which flexes to accommodate the thermal expansion of the supporting vessel.

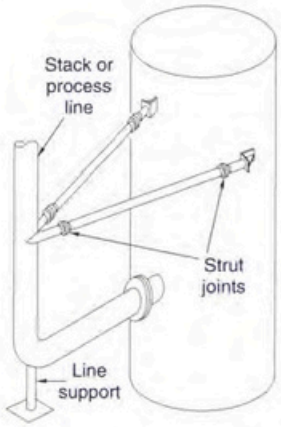


Fig.3 — Two "Ball Type" Flexible Struts in "A" frame arrangement allow vertical expansion of the stack or process line. They also prevent excessive horizontal movements due to wind forces and give stability to the line.

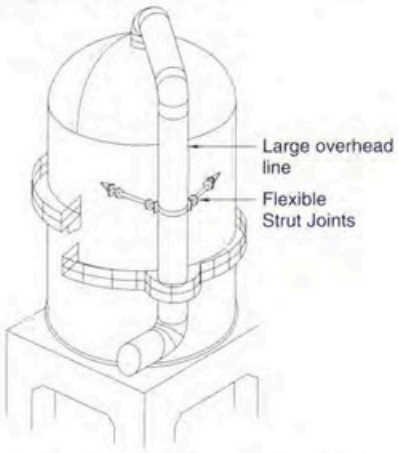


Fig.4 — Two Flexible Struts allow thermal expansion movements of the vessel and line without restraint and provide rigid support of the large overhead line. They are used in place of noisy and cumbersome sliding plate guides and structural brackets.

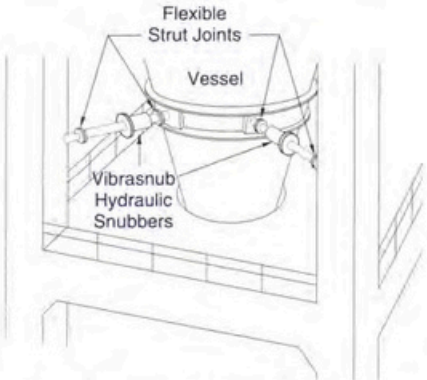


Fig.5 — "VIBRASNUB" Hydraulic Snubbers allow vertical expansion of the hot vessel and provide a tight mechanical connection to transmit high-frequency vibrations to the snubbers.

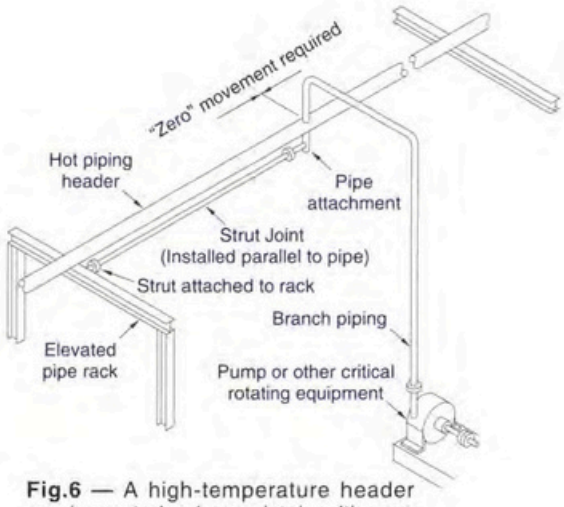


Fig.6 — A high-temperature header can be restrained completely with zero axial movement by using Strut Joints at a point relatively distant from the resisting structure. This is important where the branch piping is not flexible enough to absorb extraneous movement from the header without overstressing the equipment to which it is attached.

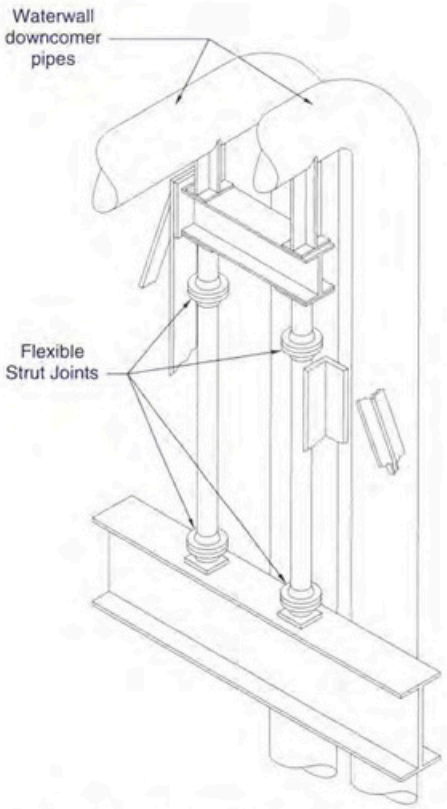


Fig.7 — This is a supporting arrangement for boiler water wall downcomer pipes in a large steam generating station. Two Flexible Strut Joints are used as compression members. They eliminate the need for overhead hanger steel which would cantilever beyond the column. Conical action of the strut joints accommodates lateral and axial movement of piping.

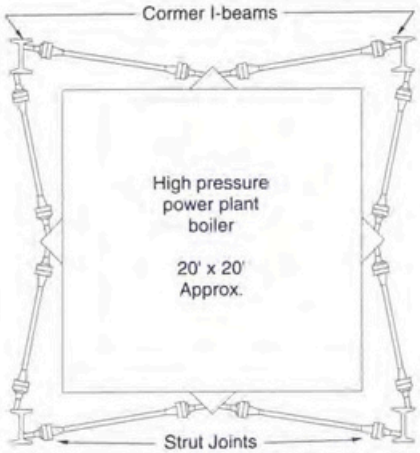


Fig.8 — Engineers needed to brace a 60ft (18.3m) high power plant boiler against wind sway and allow for downward thermal expansion of the boiler and its integral furnace. The boiler is supported by hanging from the top, within four I-beam corner columns. Eight Flexible Struts, in opposite pairs at 35ft (10.7m) and 50ft (15.3m) were used to meet these requirements efficiently and economically. The use of eight struts allowed the construction of a lighter steel structure at the anchor points.

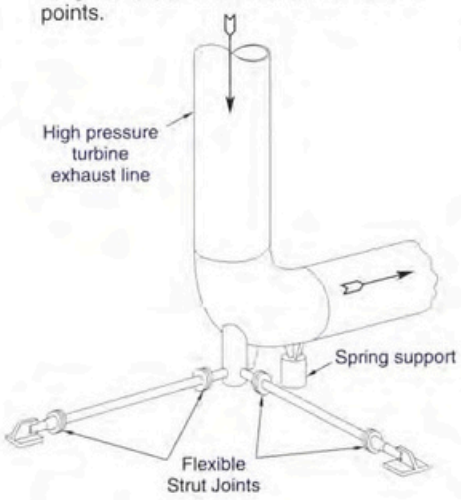


Fig.9 — Spring support and restraint for a 30" (750mm) exhaust pipe from a high-pressure turbine. Two Flexible Strut Joints permit vertical expansion movement of the exhaust pipe, but prevent any horizontal movement of the vertical sectionof pipe.

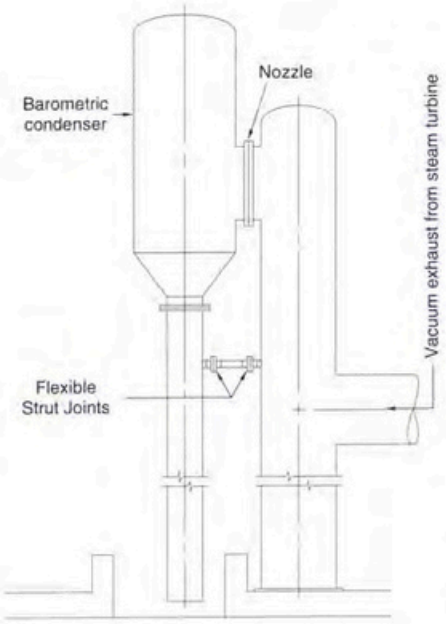


Fig.10 — A single Flexible Strut Joint is used as a compression member to eliminate weight-moment at the barometric condenser nozzle, thus permitting the nozzle to be the only support required for the condenser and barometric leg.

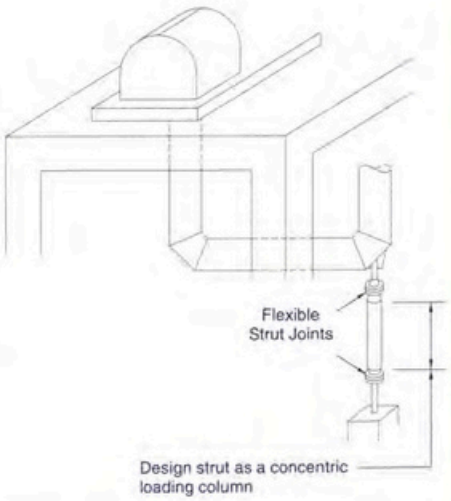
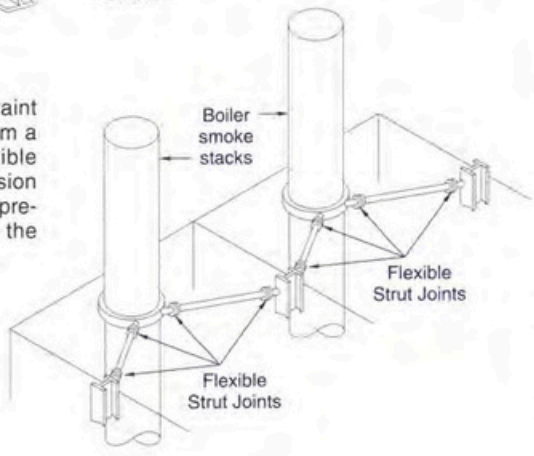


Fig.12 — A single Flexible Strut provides frictionless support for a large air blower intake pipe. Negligible forces are transmitted back to the blower due to free expansion movement. The use of flexible struts eliminates the need and cost of an expansion joint at the blower nozzle.

Fig. 11 — Builders of electric power plants use Flexible Strut Joints as guides to stabilize 200ft. (61.2m) high, steel boiler smoke stacks. This economical and efficient structural design maintains axial alignment and resists wind sway while accommodating thermal expansion and contraction. Additional beams and columns were eliminated by the use of Barco Flexible Struts.



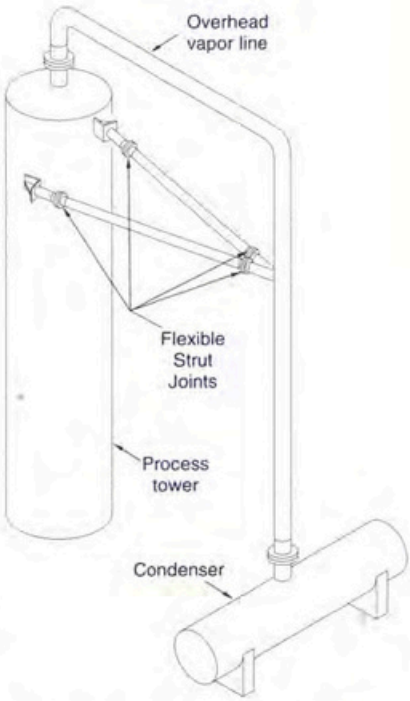
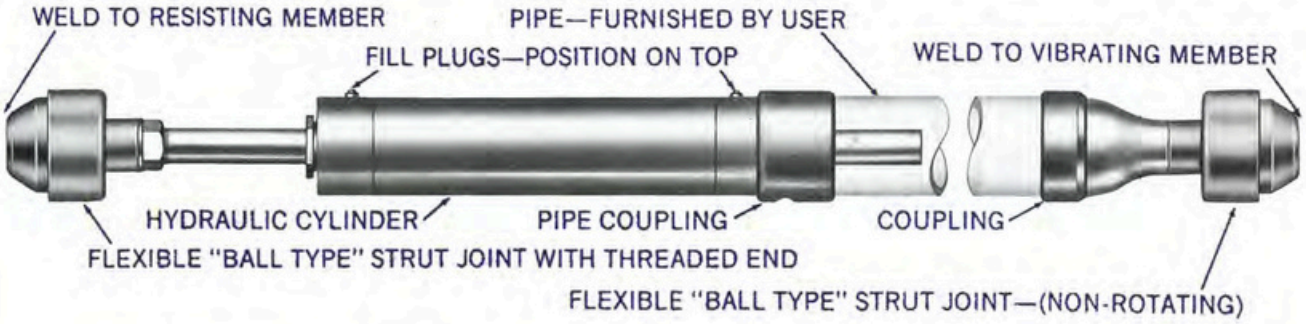


Fig.13 — Two Flexible Struts form a guide to stabilize a high, overhead vapor line. The struts allow vertical line expansion and reduce forces due to wind, shock loads and earthquakes.

Vibrasnub™ Hydraulic Vibration Snubbers



HYSPAN BARCO "Vibrasnub" Hydraulic Vibration Snubbers function as a stop or restraint for dynamic vibration and shock loads. These rapid movements may (or may not) be accompanied by slower natural movements, like thermal expansion or contraction. Rapid vibration movements are absorbed by the snubber assembly. More gradual thermal movement is accommodated by bypassing hydraulic fluid through a restricted orifice in the piston of the snubber cylinder. The "Ball Type" Flexible Strut Joints on each end of the assembly permit a +/–10° alignment movement to eliminate binding.

The "Vibrasnub" snubber is designed to be used to control dynamic vibration and shock loads. For continuously applied static loads, use **HYSPAN BARCO** "Ball Type" Flexible Strut Joints (see pages 3 through 4).

Advantages:

Lower cost — Simplicity and long life, with minimal maintenance compared to other types of vibration and shock control mechanisms.

Reliable, long service life — Proven superior through years of testing and installed use.

Fast, positive action — Resist and dampen shock and vibration loads instantaneously.

Eliminates binding — Permit +/-10° angular and conical movement of supported structure while dampening vibrations and shock loads.

Handles slower, thermal and seismic movements — Only a nominal pressure drop created across the bypass orifice against slower thermal movements.

Simplfies design and installation — Compared to other more complicated motion control systems.

NOTE: The reaction of "Vibrasnub" snubbers to total applied loads with respect to travel and vibration are shown in the graphs on page 11. Any applications which fall outside of the range of this data should be referred to Hyspan.

Engineering Data

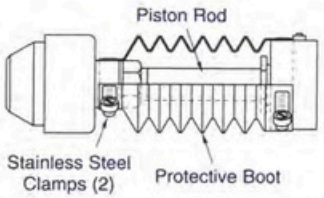
How to Install "Vibrasnsub" Snubbers

The "Vibrasnub" assembly can be installed in any position from horizontal to vertical. They should be used in pairs with an acute (less than 90°) interior angle. If only one snubber is installed, it must be installed directly in line with the thrust force and the moving member must be guided to eliminate any possible lateral movement.

The Strut Joints at the end of each "Vibrasnub" assembly can be welded to pipe or steel structure. The anchor points should be designed to withstand the total loadings and minimize secondary vibrations.

The "Vibrasnub" cylinder should be isolated from heat (or hot member of structure) with the pipe extension toward the heat source to prevent cylinder temperature from exceeding +150°F (+66°C).

Available Option



Neoprene boot to protect exposed piston rod area against damage from dust, weather and corrosive atmosphere.

Features:

Cylinder: bored, honed, polished chrome-plated bore. **Pistons:** furnished with metal piston rings, O-rings and a fluid bypass orifice. **Piston rods:** double-ended, ground, polished, hard chrome plated. **Cylinder heads:** 1/4" (8mm) standard pipe tap ports for filling with fluid; internal bleed duct for air elimination; fitted with gland packing nuts. **Hydraulic Fluid:** high-grade, petroleum-base fluid similar to U.S. Govt. Spec. MIL-H-6083 for -20°F (-29°C) to +200°F (93°C). **Strut Joints:** joints permit +/- 10° angular or conical movement. Ends bevelled for butt-welding joints are described on page 3. One joint is tapped for piston rod; other joint has half pipe coupling for connection to pipe extension and is non-rotating to keep cylinder ports on top. Shipment: all component parts (except extension pipe)* shipped in one (1) container, cylinder filled with fluid.

*For fabricated assemblies complete with extension pipe, inquire Hyspan.

CYLINDER REPAIR KITS AVAILABLE.

Table 4 Specifications

"Vibrasnub" Size: In. (mm)	1-1/2" (40mm)	2-1/2" (65mm)	4" (100mm)
Nominal Pipe Size of Extension In. (mm)	2" (50mm)	2-1/2" (65mm)	4" (100mm)
Maximum Load: Lbs (kN)	7,000 (31.2)	12,000 (53.4)	30,000 (133.5)
Frictional Resistance:* Lbs (kN)	75 (.33)	100 (.45)	200 (.90)
Shipping Weight: Lbs (kg)	70 (32)	90 (41)	175 (79)

* due to mechanical parts

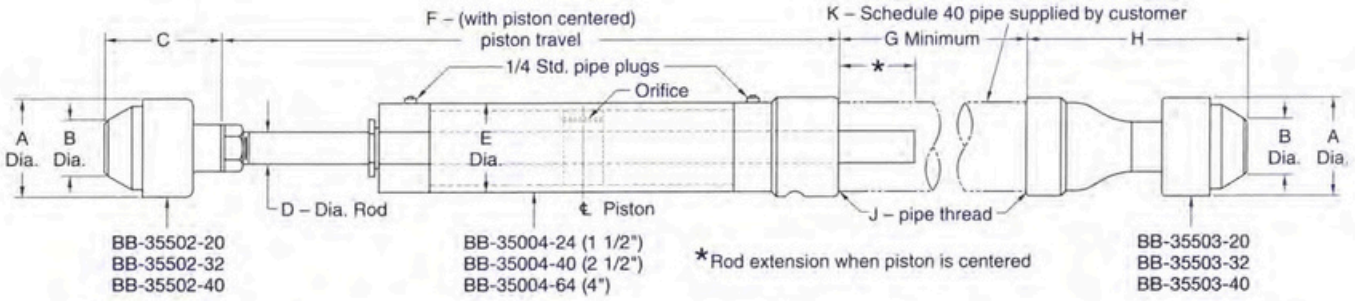


Table 5 Dimensional Data

Size: In(mm)	Part Number	Piston Travel In(mm)	A	B	C	D	E	F	G Min.	G Max	H	J	K	Overall dimension with full load (C+F+G+H) Min.*	Max.**
1-1/2 (40)	BB-35001-24	+/-4 +/-(101.6)	3.25 (82.6)	1.66 (42.2)	4.25 (108.0)	1.00 (25.4)	2.50 (63.5)	22.50 (571.5)	6.00 (152.4)	96.00 (2438.4)	9.00 (228.6)	2.00 (50)	2.00 (50)	41.75 (1060)	131.75 (3346)
2-1/2 (65,0)	BB-35001-40	+/-6 +/-(154,4)	4.25 (108,0)	2.38 (60,5)	5.76 (146,3)	1.13 (28,7)	3.00 (76,2)	28.00 (711,2)	8.06 (204,7)	112.06 (2.846,3)	10.69 (271,5)	2.50 (65)	2.50 (65)	52.51 (1.333,8)	156.51 (3975,4)
4.0 (100,0)	BB-35001-64	+/-6 +/-(152,4)	5.00 (127,0)	2.88 (73,2)	6.00 (152,4)	1.50 (38,1)	4.75 (120,7)	29.19 (741,4)	6.75 (171,5)	181.25 (4603,8)	11.63 (295,4)	4.00 (100)	4.00 (100)	53.56 (1360,4)	228.06 (5792,7)

*1 1/2" size travel is ± 4". 2 1/2", 4" sizes travel is ± 6".
**The maximum overall dimension given above (C+F+G+H) can be increased, but only with a decrease in the allowable load in keeping with the increased L/R of the unit as a column under possible vibration.

Designing for Vibrasnub Snubbers

Situation #1: A hot stack is found to vibrate excessively and is also subject to considerable thermal movement.

Problem: Eliminate excessive vibration of hot stack and provide for thermal movement during heat-up and cool-down.

Solution: Predetermined Facts:

Total vibration load	8000 lbs (35.6kN)
Piston travel due to thermal movements	5 inches (127mm)
Heat-up and cool-down time	20 minutes
Frequency of vibration	60 cycles/min.
Total allowable vibration movement at point of snubber attachment without damage to stack	.125 inches (3.2mm)

From the specifications table, it is seen that one 2 1/2" (65mm) "Vibrasnub" with a maximum allowable load of 12,000lbs (53.4kN) is sufficient. However, two are recommended for better installation (see Typical Installations).

In this example, the required rate of piston travel is 5" (127mm) in 20 minutes or 1/4" (6.4mm) per minute. Graph #1 shows that the resistance to movement is less than 200lbs (.9kN) for each unit (the point of intersection with the slanting rate line is off the graph) and is negligible.

Graph #3 shows that the total vibration movement permited by a 2 1/2" (65mm) "Vibrasnub" snubber (using 2 units, each with 4000lbs (17.8kN) load at 60 cycles/min.) is approximately .08" (2.03mm). That movement is well below the stated allowable movement of .125" (3.2mm). If the frequency of vibration had been 30 cycles/min. the total allowable movement would then be approximately .18" (4.6mm) which is greater than that allowed for a 2 1/2" (65mm) unit. A 4" (100mm) "Vibrasnub" would be required.

Situation #2: A hot process vessel is developing excessive vibration in a large pipe that leads horizontally out of the vessel and then is directed upwards.

Problem: Eliminate excessive vibration in the pipe and provide for differential thermal movement of the pipe and vessel.

Solution: Predetermined facts:

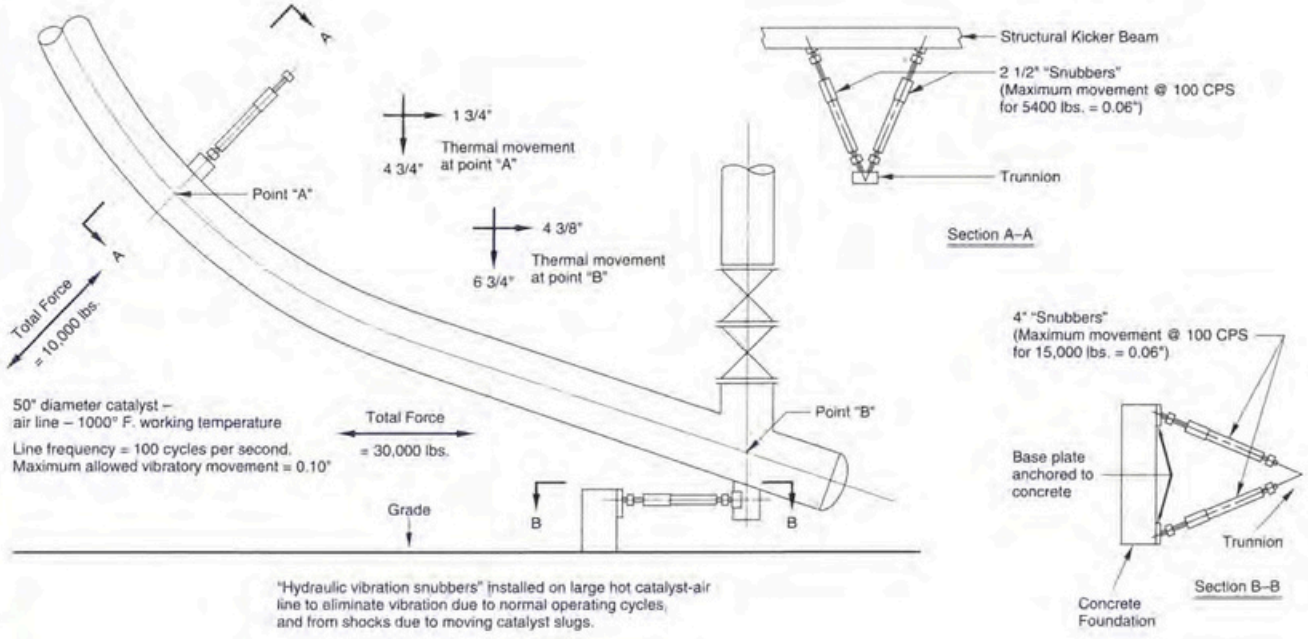
Total vibration load	40,000 lbs(178kN)
Piston travel due to thermal movements	5 inches (127mm)
Heat-up time	10 minutes
Frequency of induced vibration	120 cycles/min.
Total allowable vibration movement without damage to pipe	.15inches (3.8mm)

From the specifications table, the maximum allowable load for a 2 1/2" (65mm) "Vibrasnub" is 12,000lbs (53.4kN). A 4" (100mm) snubber can accommodate 30,000lbs (133.5kN). By using two (2) 4" (100mm) "Vibrasnub" snubbers, the vibration load on each one is 20,000lbs (89kN), well below the maxium load allowed.

The required rate of piston travel is 5" (127mm) in 10 minutes, or 1/2" (13mm) per minute. Graph #1 shows the resistance shows the resistance to thermal movement at 1/2" (13mm) per minute is less than 300lbs (1.34kN) for each snubber unit (the point of intersection with the graph is actualy off the graph, to the left). This low resistance would impart no undue strain on the piping system.

From Graph #4 it is seen that the total movement permitted by a 4" (100mm) "Vibrasnub" under 20,000lbs (89kN) vibration load, at a rate of 120 cycles/min., is approximately 0.04" (1.0mm). This is much less than the allowable movement of .25" (3.8mm).

It is possible to use four (4) 2 1/2" (65mm) snubbers. But it is more practical to install only two (2) 4" (100mm) snubbers and this is the proper solution.

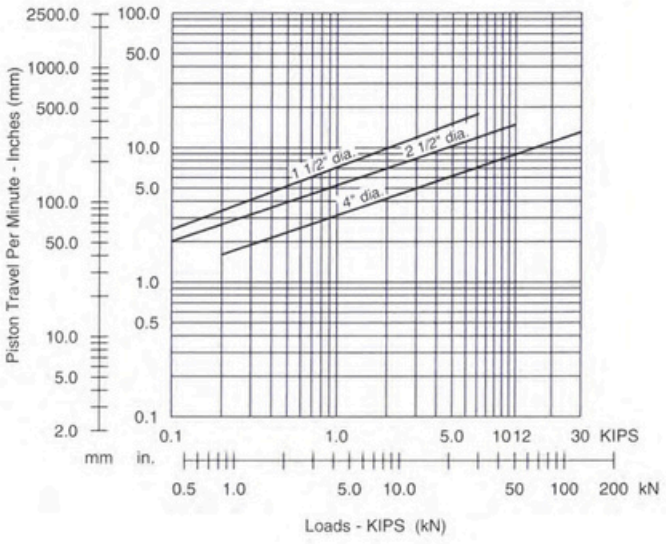


"Hydraulic vibration snubbers" installed on large hot catalyst-air line to eliminate vibration due to normal operating cycles, and from shocks due to moving catalyst slugs.

Force - Frequency - Amplitude Data

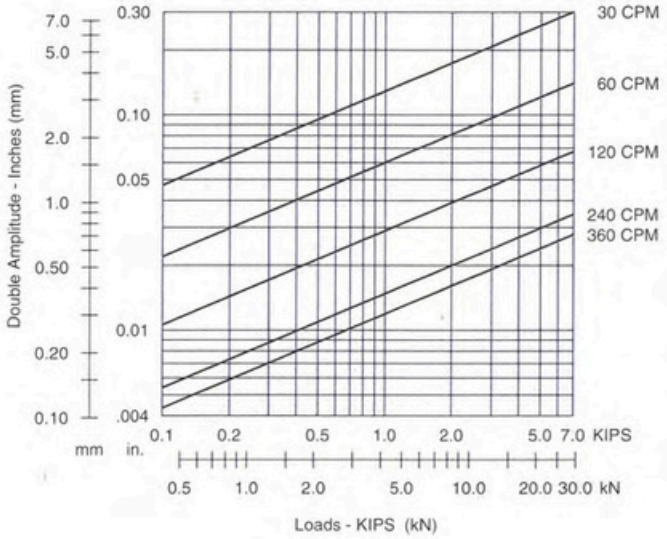
Graph #1

Force Travel Data
1-1/2" (40mm), 2-1/2" (65mm), 3" (80mm), 4" (100mm)



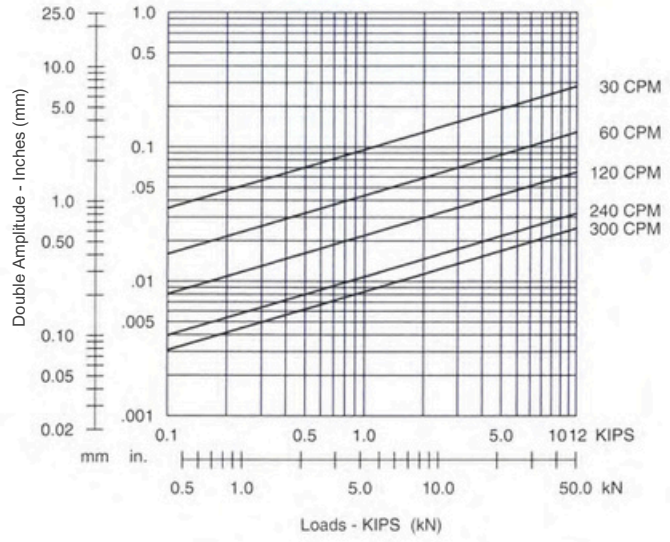
Graph #2

Force-Frequency-Amplitude Data
1-1/2" (40mm)



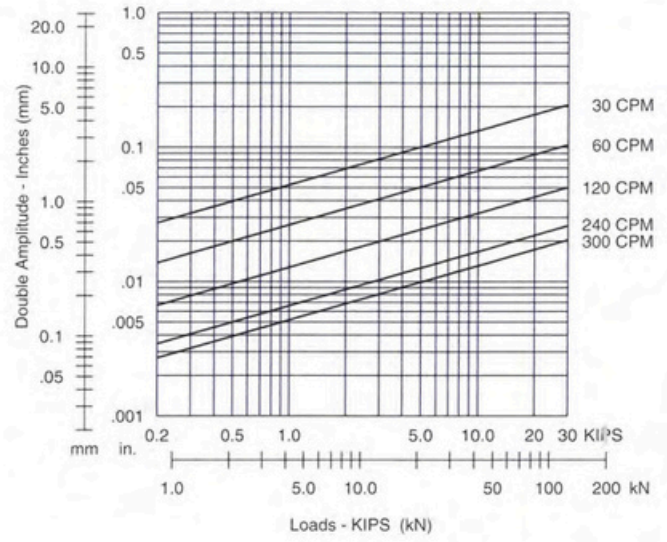
Graph #3

Force-Frequency-Amplitude Data
2-1/2" (65mm)



Graph #4

Force Frequency-Amplitude Data
4"(100mm)



HYSPAN BARCO BALL JOINTS

Chula Vista, California headquarters and manufacturing plant completed in 1983. Total area 54,000 square feet. Office staff performs all company design and production engineering, sales and marketing, accounting and administration. Manufacturing includes ASME code and custom expansion joints, and tooling and equipment fabrication. Expansion joints have been manufactured up to 31'0" diameter.

Tulsa, Oklahoma manufacturing plant completed in 1989. Total area 41,200 square feet. Manufactures and inventories wire braid, bellows pump connectors, packed slip expansion joints, expansion compensators and pipe guides.

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