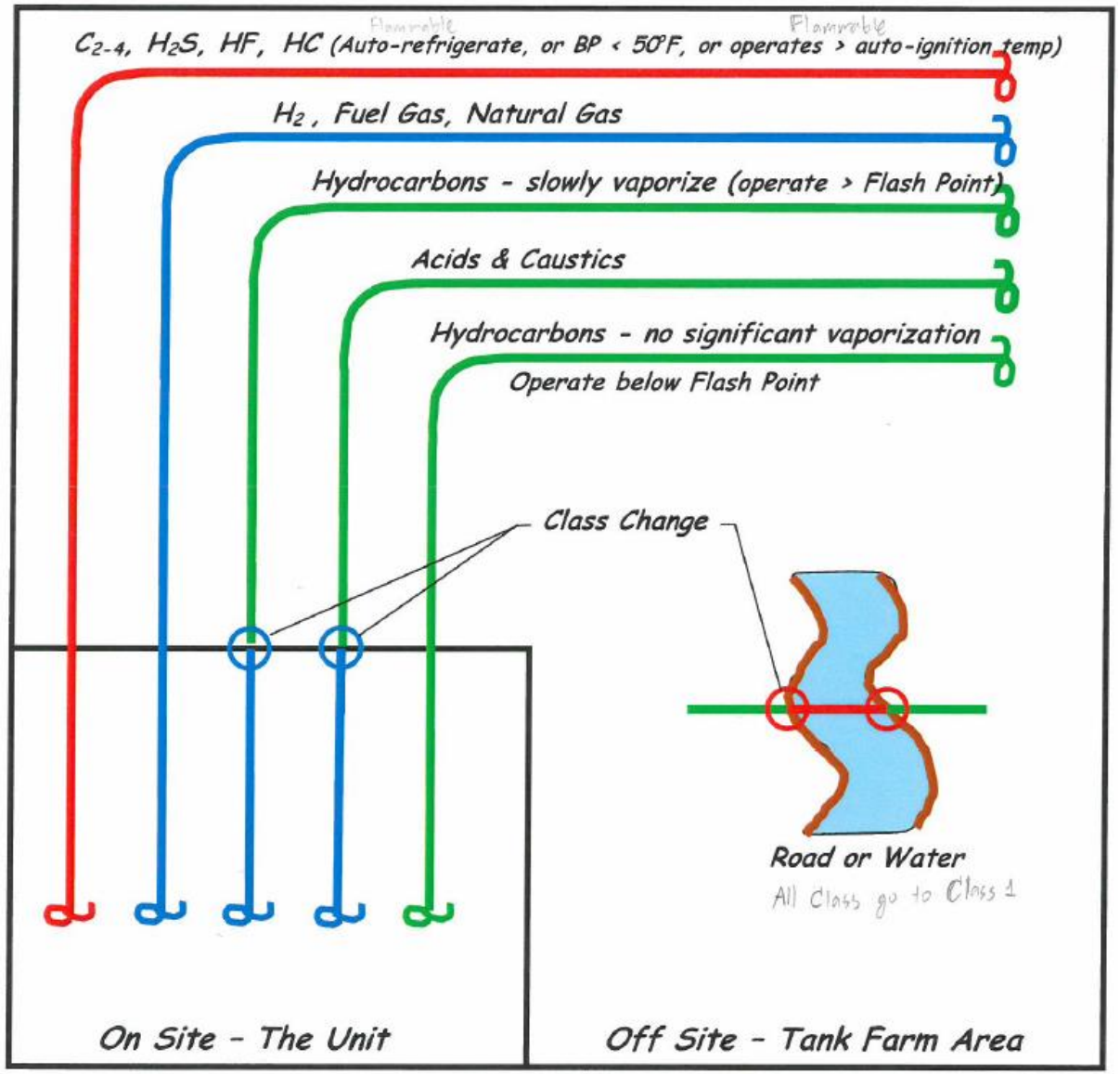
Spring Hanger and Support Inspection Practice

Piping Service Classes



Services that are essentially nonflammable and nontoxic are in Class 4, as are most utility services.

Piping Criticality

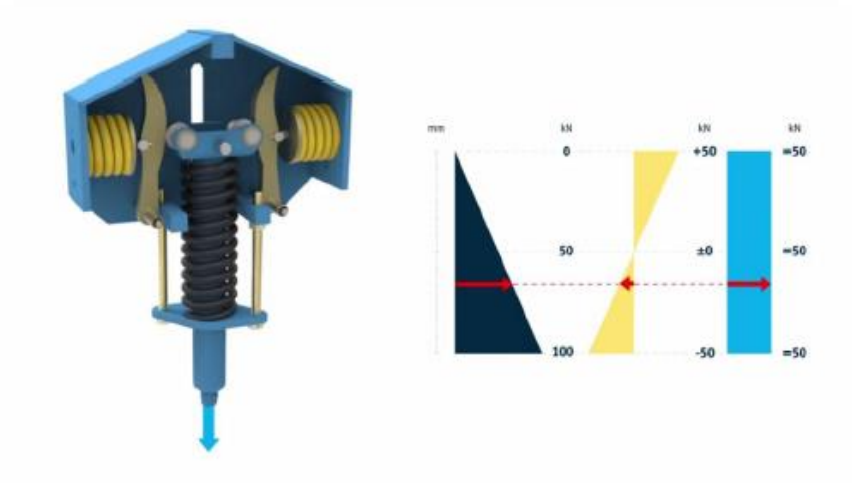
Priority	History / Existing Configuration			Piping Criticality (GCEP-PP-013, item 10)
	Changes of Operating Condition	Heat Exposure (API RP 579, Fitness-for-service)	External Environment (API RP 571, Section 4, item 4.3) (TAB No.IR.2017.004 CUI Management Strategy)	
Low	No Operating Flow Load Change **OR** Increasing Flow Load < 25% for Variable Spring Support	T < 65°C	Inside buildings **OR** Arid, Dry rural	Category 4
Medium	-	65 < T < 205°C	Moderate Climate (20-50% Wetting rate in a year)	Category 3
High	Increasing Flow Load > 25% for Variable Spring Support	T > 205°C	Coastal Marine **OR** Severe Climate (> 50% Wetting rate in a year) **OR** Located near cooling tower, deluge system	Category 1 **OR** 2

Spring Hanger/Support Function

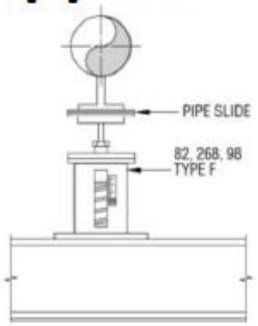
There are two types of Spring Hangers:

1. Variable Effort Spring Hangers: Load varies throughout its operating range

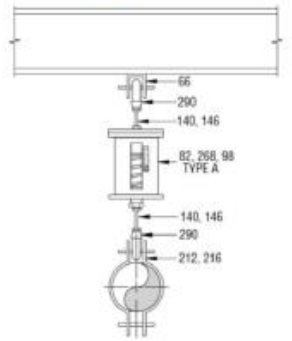
2. Constant Effort Spring Hangers: Load remains constant throughout its operating range



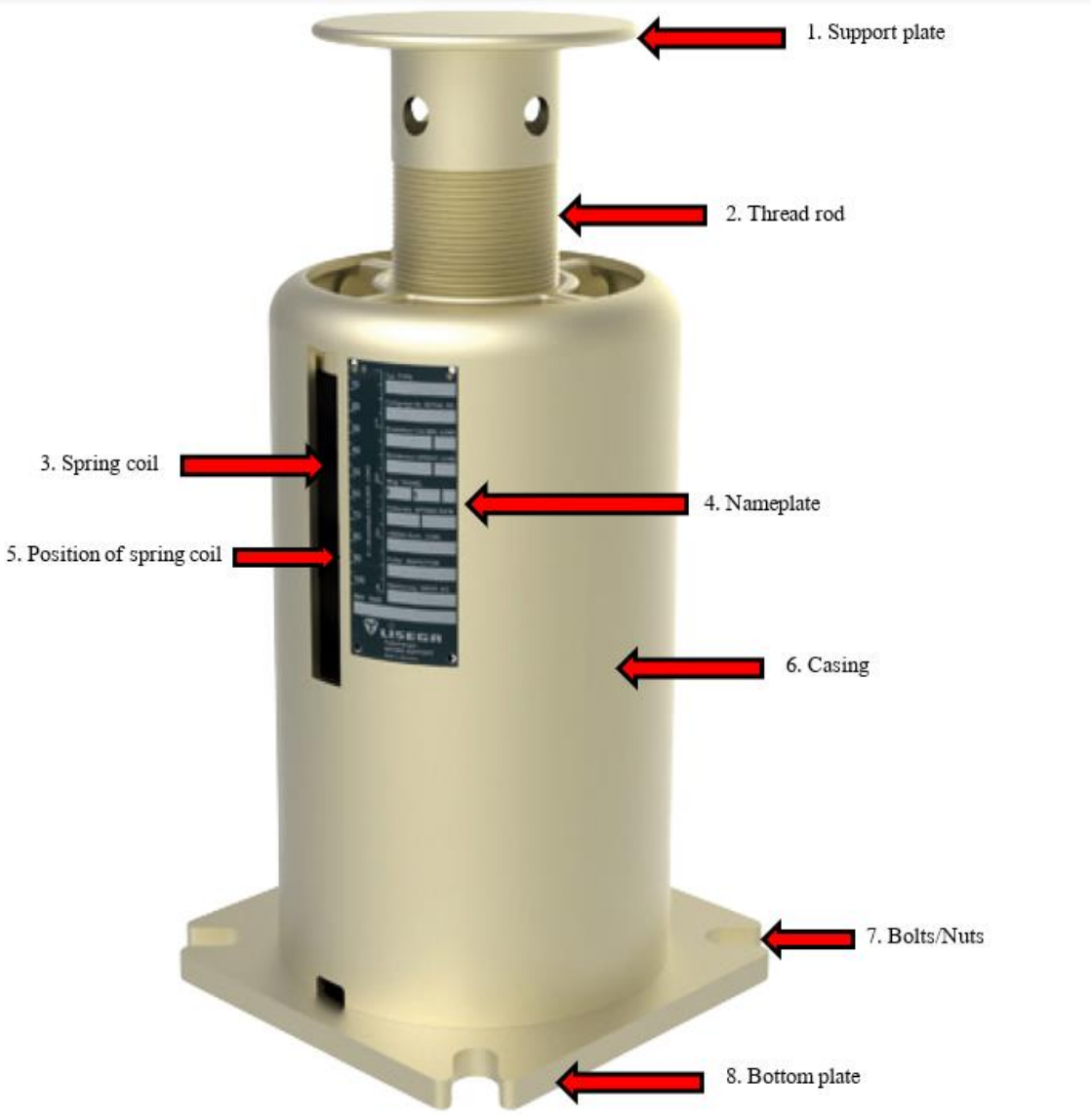
Spring Support



Spring Hanger



Variable spring support



Terminology

- Cold Load : This refers to the load on the spring hanger when the system is in standby or non-operating condition.

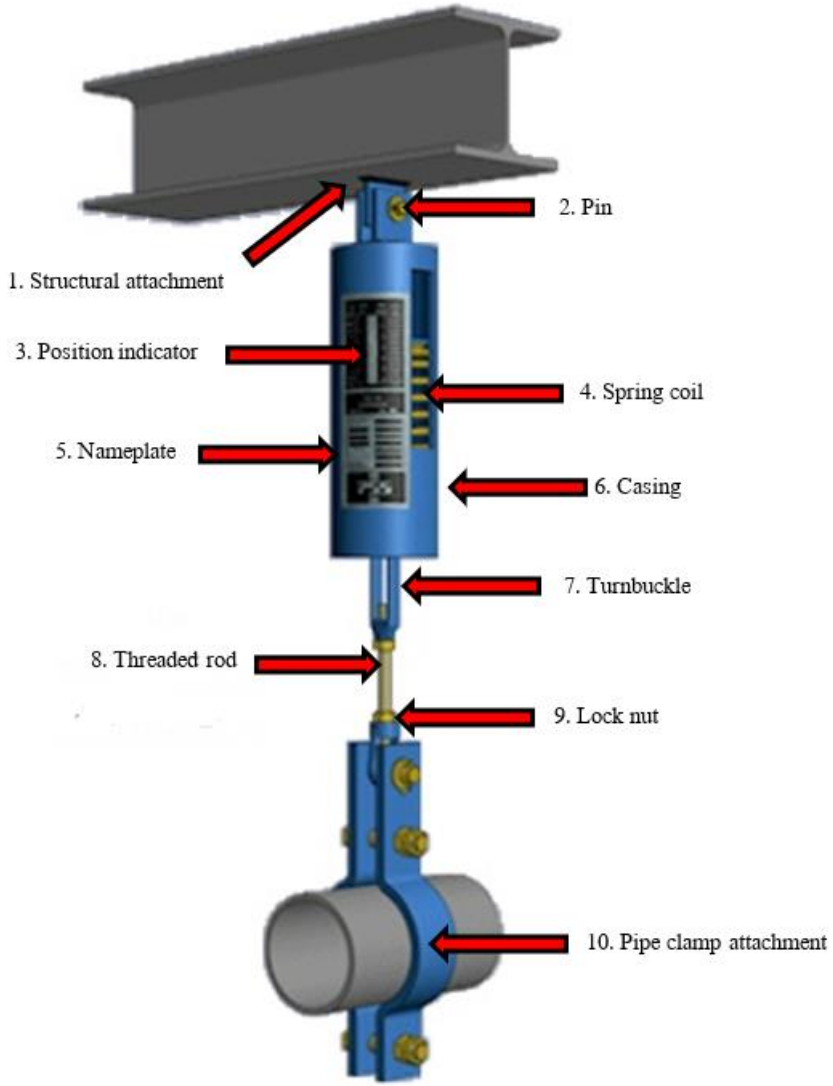
- Hot Load : This refers to the actual load on the spring hanger during operating conditions

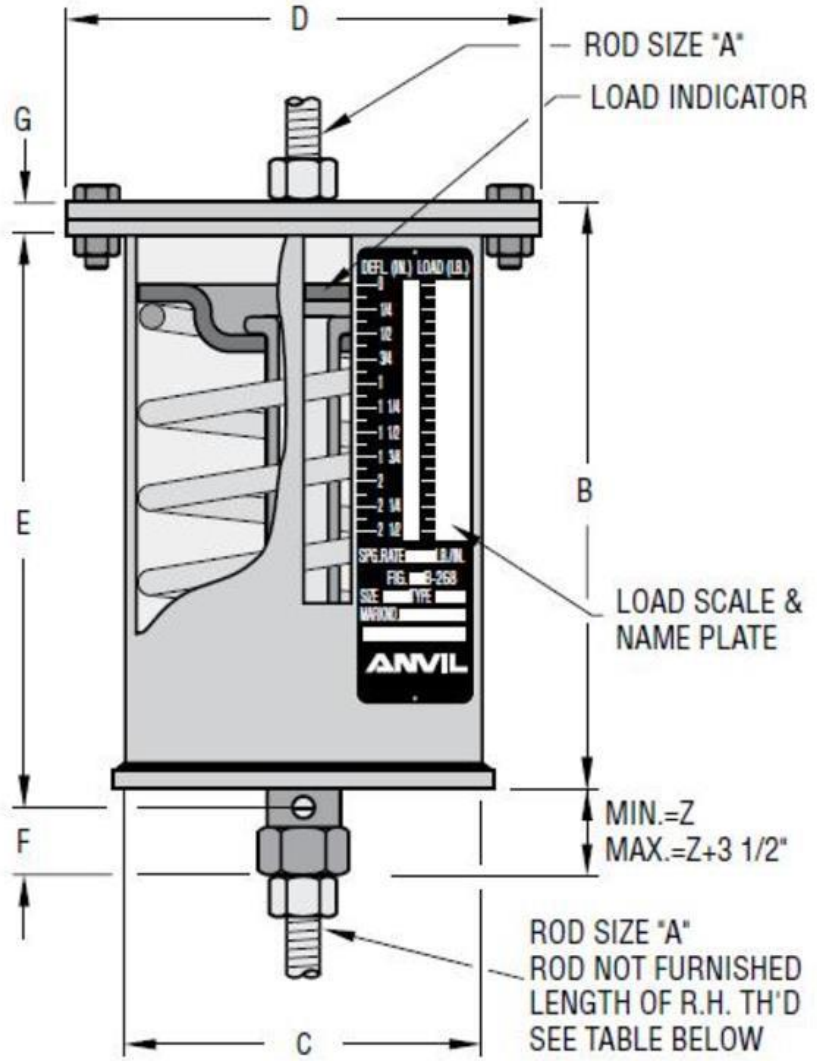
- Spring Rate/ Stiffness : This refers to the spring rate, force per unit length in N/mm, kg/mm, etc. determined from flexibility analysis.

- Spring Travel : (Installed to operating): This refers to the maximum vertical movement of the spring due to piping loads at operating conditions determined from flexibility analysis.

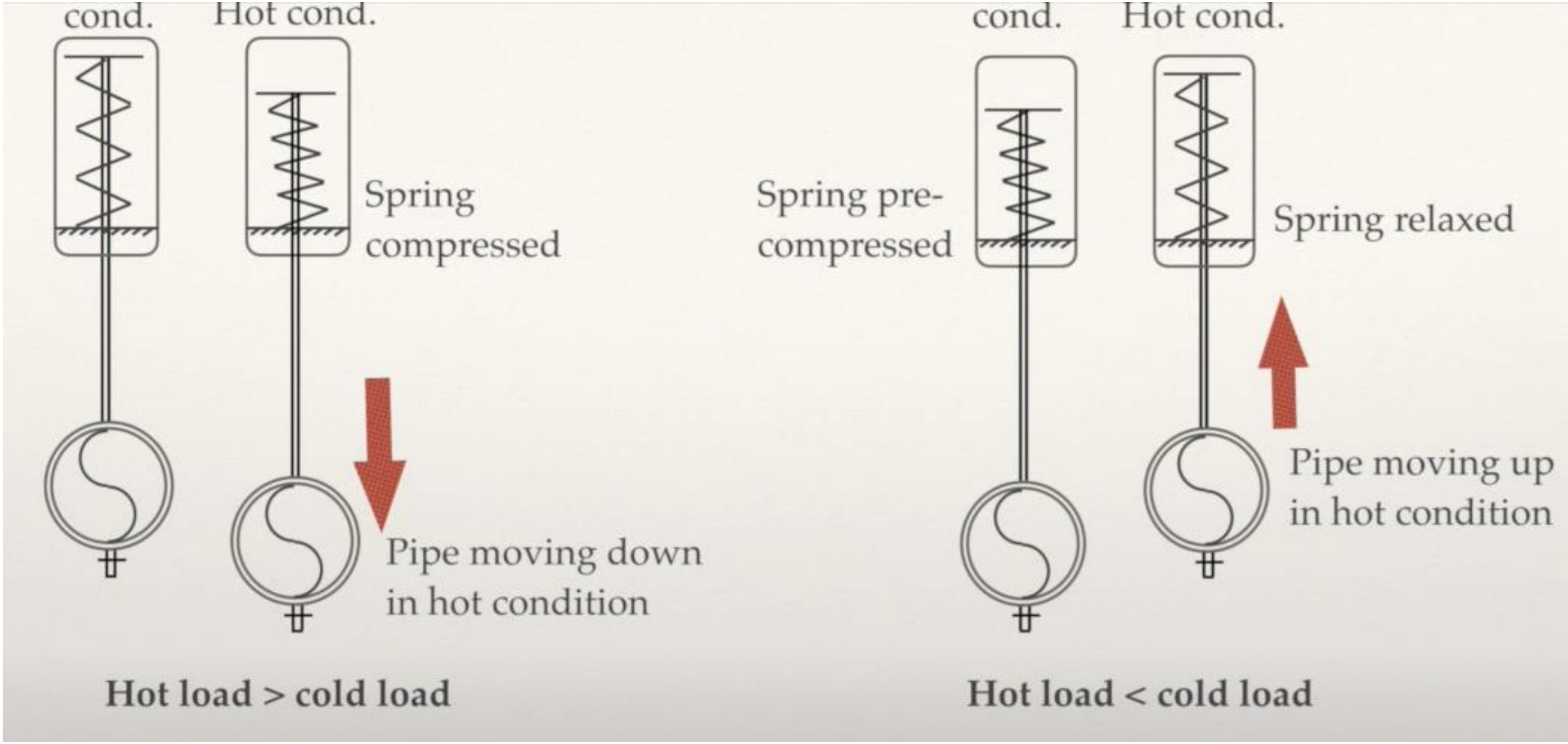
- Load Variation or Variation : This refers to the allowed variations between the hot load and cold loads. < 25%

Variable spring hanger





Working of spring hanger



Selection of spring hanger

Inputs from stress calculation-

1. Hot load in normal operating load case (N)
2. Travel in vertical direction (mm)

Step-1

Calculate Spring rate-

$$\text{Spring rate (N/mm)} = \frac{\text{Variability x Hot load}}{\text{Travel}}$$

Select the spring rate < calculated spring rate.

Step-2

Select the column in the catalogue where the hot load appear in the mid range.

Selection of spring hanger

For Example-

Operating load = 6000N
Travel = 15 mm up
Variability = 25%

$$\text{Spring rate} = \frac{0.25 \times 6000}{15}$$

$$= 100\ \text{N/mm}$$

					21 C2 19	21 D. 19	21 1. 18	21 2. 18	21 3. 18	21 4. 18	21 5. 18	21 6. 18	21 7. 18	21 8. 18	21 9. 18
						25 D. 19	25 1. 18	25 2. 18	25 3. 18	25 4. 18	25 5. 18	25 6. 18	25 7. 18	25 8. 18	25 9. 18
					29 C2 19	29 D. 19	29 1. 18	29 2. 18	29 3. 18	29 4. 18	29 5. 18	29 6. 18	29 7. 18	29 8. 18	29 9. 18
				②		20 D. 19	20 1. 14	20 2. 14	20 3. 14	20 4. 14	20 5. 14	20 6. 14	20 7. 14	20 8. 14	20 9. 14
...1..	...2..	...3..	...4..	...5..						load [kN]					
spring travel [mm]															
0	0	0	0	0	0.04	0.12	0.41	0.83	1.66	3.33	6.66	13.33	20.00	26.66	33.33
2.5	5	10	15	20	0.05	0.14	0.45	0.91	1.83	3.66	7.33	14.66	22.00	29.33	36.66
5.0	10	20	30	40	0.06	0.16	0.50	1.00	2.00	4.00	8.00	16.00	24.00	32.00	40.00
7.5	15	30	45	60	0.07	0.18	0.54	1.08	2.16	4.33	8.66	17.33	26.00	34.66	43.33
10.0	20	40	60	80	0.08	0.20	0.58	1.16	2.33	4.66	9.33	18.66	28.00	37.33	46.66
12.5	25	50	75	100	0.09	0.22	0.62	1.25	2.50	5.00	10.00	20.00	30.00	40.00	50.00
15.0	30	60	90	120	0.10	0.24	0.66	1.33	2.66	5.33	10.66	21.33	32.00	42.66	53.33
17.5	35	70	105	140	0.11	0.26	0.70	1.41	2.83	5.66	11.33	22.66	34.00	45.33	56.66
20.0	40	80	120	160	0.12	0.28	0.75	1.50	3.00	6.00	12.00	24.00	36.00	48.00	60.00
22.5	45	90	135	180	0.13	0.30	0.79	1.58	3.16	6.33	12.66	25.33	38.00	50.66	63.33
25.0	50	100	150	200	0.14	0.32	0.83	1.66	3.33	6.66	13.33	26.66	40.00	53.33	66.66
27.5	55	110	165	220	0.16	0.34	0.87	1.75	3.50	7.00	14.00	28.00	42.00	56.00	70.00
30.0	60	120	180	240	0.17	0.36	0.91	1.83	3.66	7.33	14.66	29.33	44.00	58.66	73.33
32.5	65	130	195	260	0.18	0.38	0.95	1.91	3.83	7.66	15.33	30.66	46.00	61.33	76.66
35.0	70	140	210	280	0.19	0.40	1.00	2.00	4.00	8.00	16.00	32.00	48.00	64.00	80.00
37.5	75	150	225	300	0.20	0.42	1.04	2.08	4.16	8.33	16.66	33.33	50.00	66.66	83.33
40.0	80	160	240	320	0.21	0.44	1.08	2.16	4.33	8.66	17.33	34.66	52.00	69.33	86.66
42.5	85	170	255	340	0.22	0.46	1.12	2.25	4.50	9.00	18.00	36.00	54.00	72.00	90.00
45.0	90	180	270	360	0.23	0.48	1.16	2.33	4.66	9.33	18.66	37.33	56.00	74.66	93.33
47.5	95	190	285	380	0.24	0.50	1.20	2.41	4.83	9.66	19.33	38.66	58.00	77.33	96.66
50.0	100	200	300	400	0.25	0.52	1.25	2.50	5.00	10.00	20.00	40.00	60.00	80.00	100.00
									spring rate c [N/mm]						
											33.3	66.6	100.0	133.3	166.6
										11.1	22.2	44.4	88.9	133.3	177.8	222.2
									2.1	4.1	8.3	16.6	33.3	66.6	133.3	200.0	266.6	333.3
								2.1	4.1	8.3	16.6	33.3	66.6	133.3	266.6	400.0	533.3	666.6
									8.3	16.6	33.3	66.6	133.3	266.6	533.3	800.0	1066.6	1333.3

Selection of spring hanger

Step-3

Ensure that col load lies within the working range of spring.
Cold load can also be calculated as-

Cold load = Operating load+ Travel x Spring rate (If pipe is moving up)
Cold load = Operating load - Travel x Spring rate (If pipe is moving down)

In this case

Cold load = 6000 + 15 x 66.666
= 7000 N

Step-4

If the cold load lies beyond the travel range of spring then switch to next higher spring size or next travel range.

Example calculation variable spring hanger

When spring rate and hot load are **available**

$$Variation = \frac{|(Travel)(Spring\ rate)|}{Hot\ load} \times 100$$

$$Variation = \frac{|(Cold\ position - Hot\ position)(Spring\ rate)|}{Hot\ load} \times 100$$

When spring rate and hot load are **unavailable**

$$Variation = \frac{|Cold\ position - Hot\ position|}{Hot\ position} \times 100$$

Case 1: Actual position 18 mm (exceed travel range on **hot position side**)

$$Variation = \frac{|(Cold\ position - Actual\ position)(Spring\ rate)|}{Hot\ load} \times 100$$

$$Variation = \frac{|(11.8 - 18)(28.4)|}{1742} \times 100$$

$$Variation = 10.1\% \rightarrow Minor\ damage$$

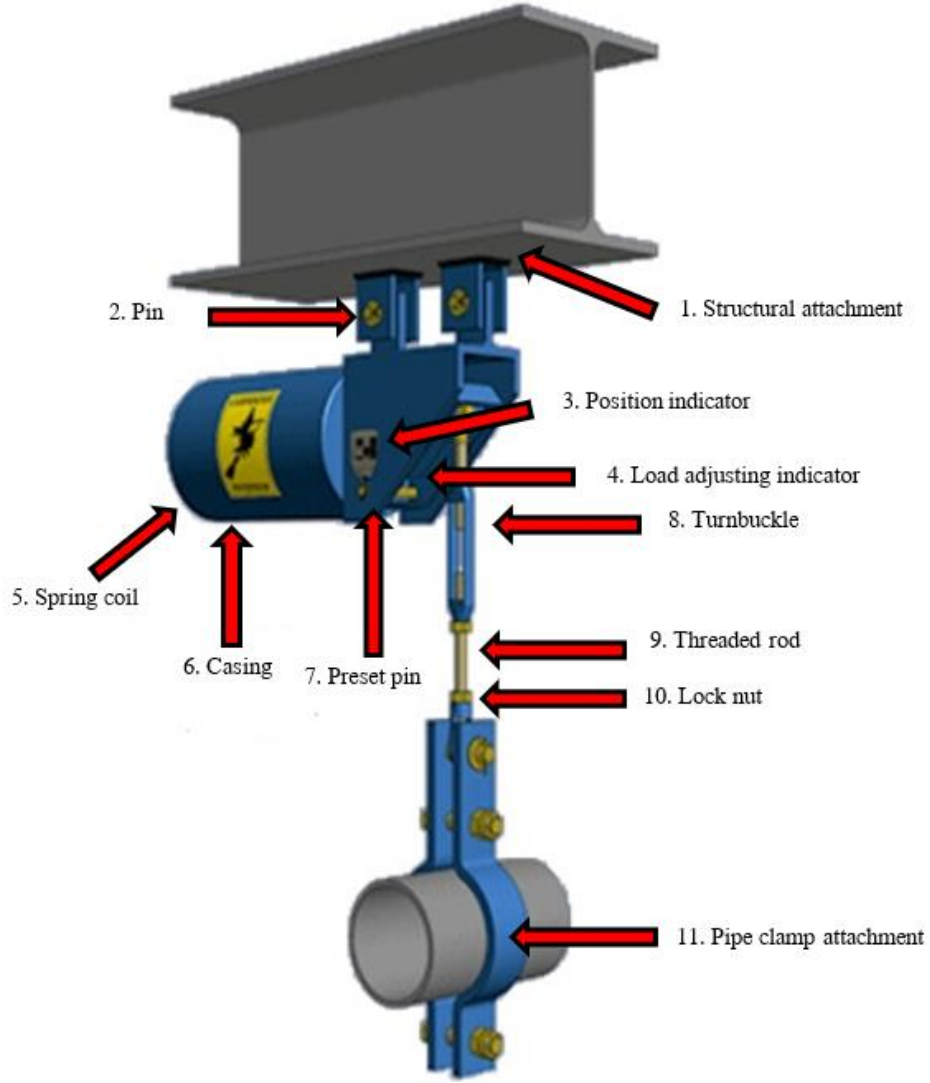
Case 2: Actual position 8 mm (exceed travel range on **cold position side**)

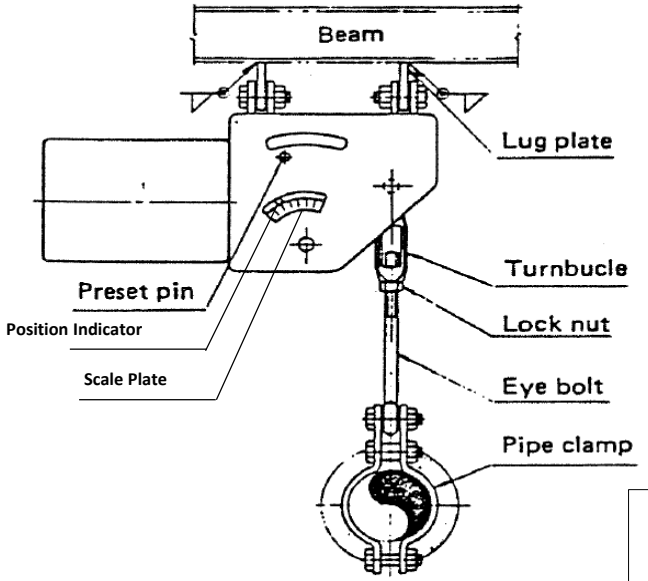
$$Variation = \frac{|(Actual\ position - Hot\ position)(Spring\ rate)|}{Hot\ load} \times 100$$

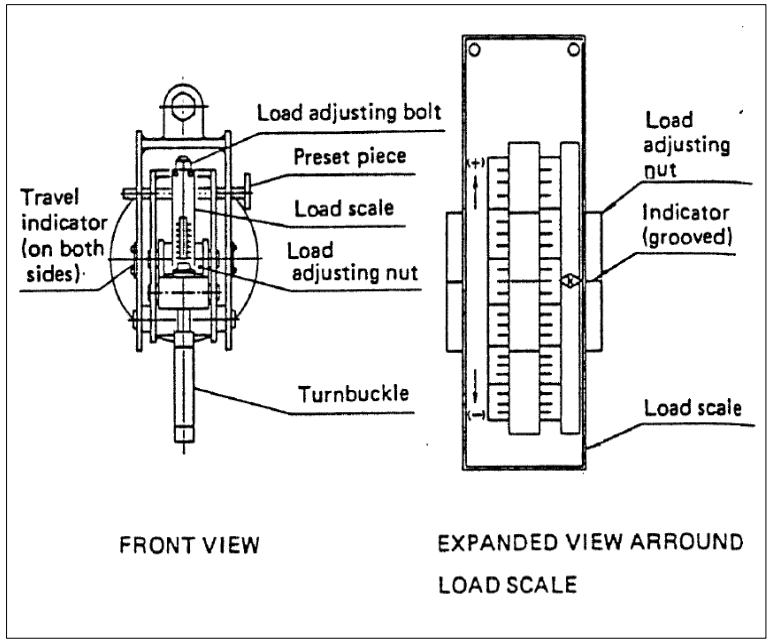
$$Variation = \frac{|(8 - 16.8)(28.4)|}{1742} \times 100$$

$$Variation = 14.3\%$$

Constant spring hanger







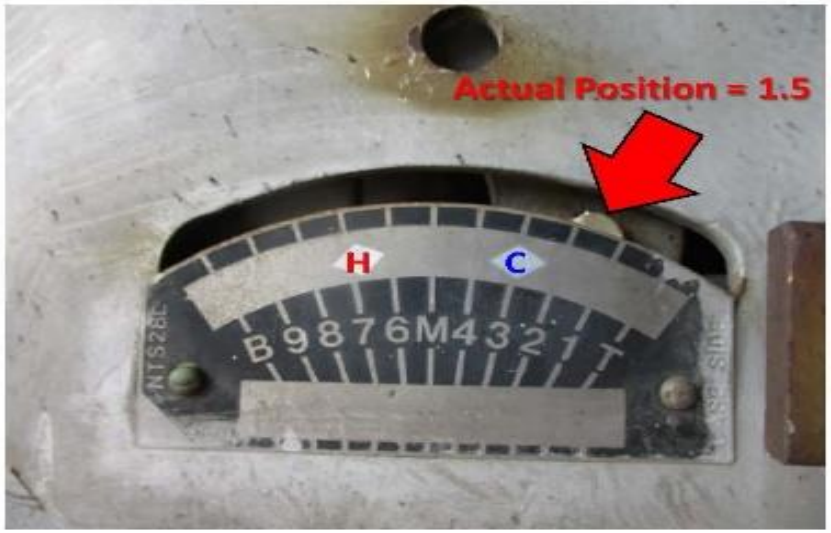
Example calculation constant spring hanger

Position indicator

$$Required\ movement = Cold\ position - Hot\ position$$
$$Actual\ moveable = Top\ position - Actual\ position$$

Major Damage– Within Travel range but cannot move properly (Actual Moveable < Required movement)

DESIGN COLD POSITION	:	24.0 mm. (3)	DESIGN COLD LOAD	:	265.0 kgf.	MAX TRAVEL	: 80 mm
DESIGN HOT POSITION	:	55.0 mm. (6.9)	DESIGN HOT LOAD	:	265.0 kgf.	VERTICAL MOVEMENT	: -31.0 mm



Need to Compare between Required Movement and Actual Moveable:

Required Movement = Cold position – Hot position
= 24 – 55 = -31 mm (move up)
or = 3 – 6.9 = -3.9 divisions (move right in scale)

Actual Moveable = Top position (T) – Actual Position
= 0 – 1.5 = -1.5 mm (move right in scale)

Compare between Required Movement and Actual Moveable

- Actual Moveable < Required movement → Major Damage

Example calculation constant spring hanger

Position Indicator must be with in travel range and preferably within H/C position (It has to move freely)

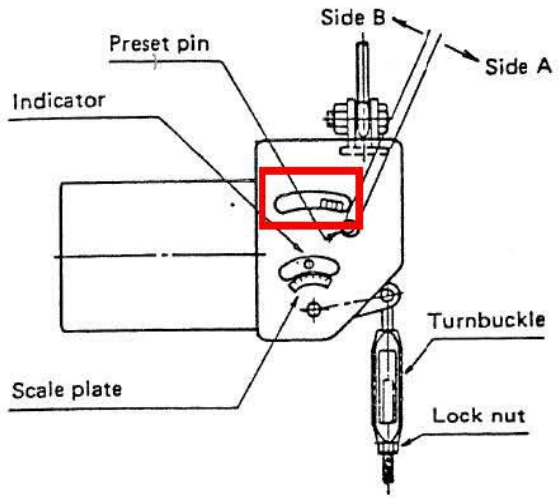


Fig. 3-8

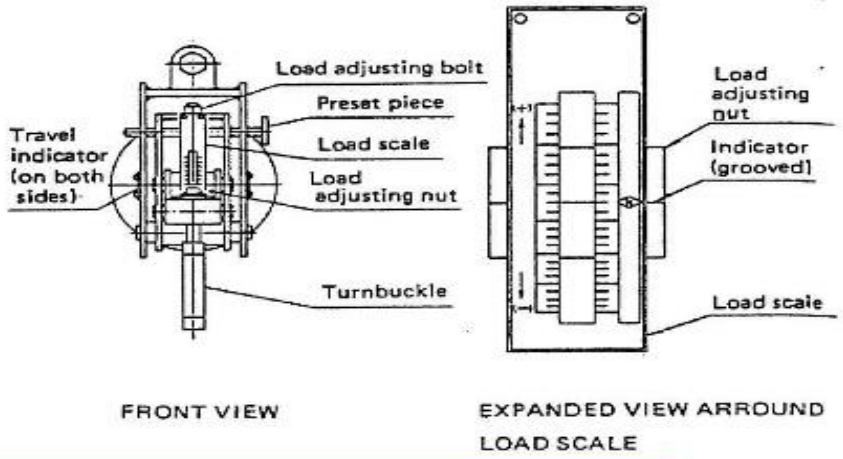
- Within 1 division from H/C position = **Normal**
- Out of 1 division but can move properly (Actual Moveable ≥ Required movement) = **Minor damage**
- Within travel range but cannot move properly (Actual Moveable < Required movement) = **Major damage**
- Stuck at T or B position = **Major damage**

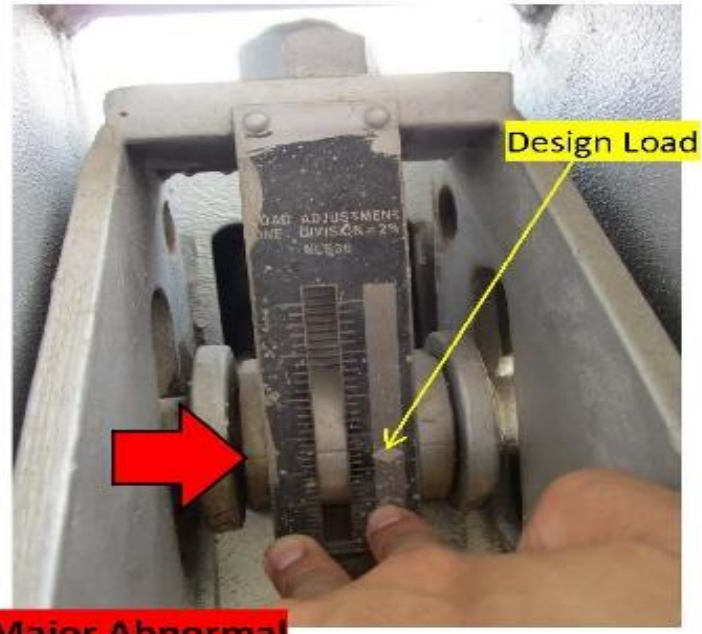
1 division = 2%

Example calculation constant spring hanger

Load adjusting indicator

Load Adjusting Indicator shown be within range of +/-10% of the design load





- Deviate within 1 Division (+/-2%) = **Normal**
- Deviate 1 - 5 Division (+/-2% to 10%) = **Minor Abnormal**
- Deviate > 5 Division (More than +/-10% the design load) = **Major Abnormal**

Position indicator and Load adjusting indicator Criteria[A]

Class Major Damage

- Variable type
  - Actual position exceeds travel range[B] and variation[C] exceeds 25%
- Constant type
  - Position indicator
    - Actual position stuck at Top (T) or Bottom (B)
    - Actual position within travel range but cannot move properly (Actual moveable < Required movement)[D]
  - Load adjusting indicator
    - Deviate >5 division[E] (more than +/-10% the design load)

Class Minor Damage

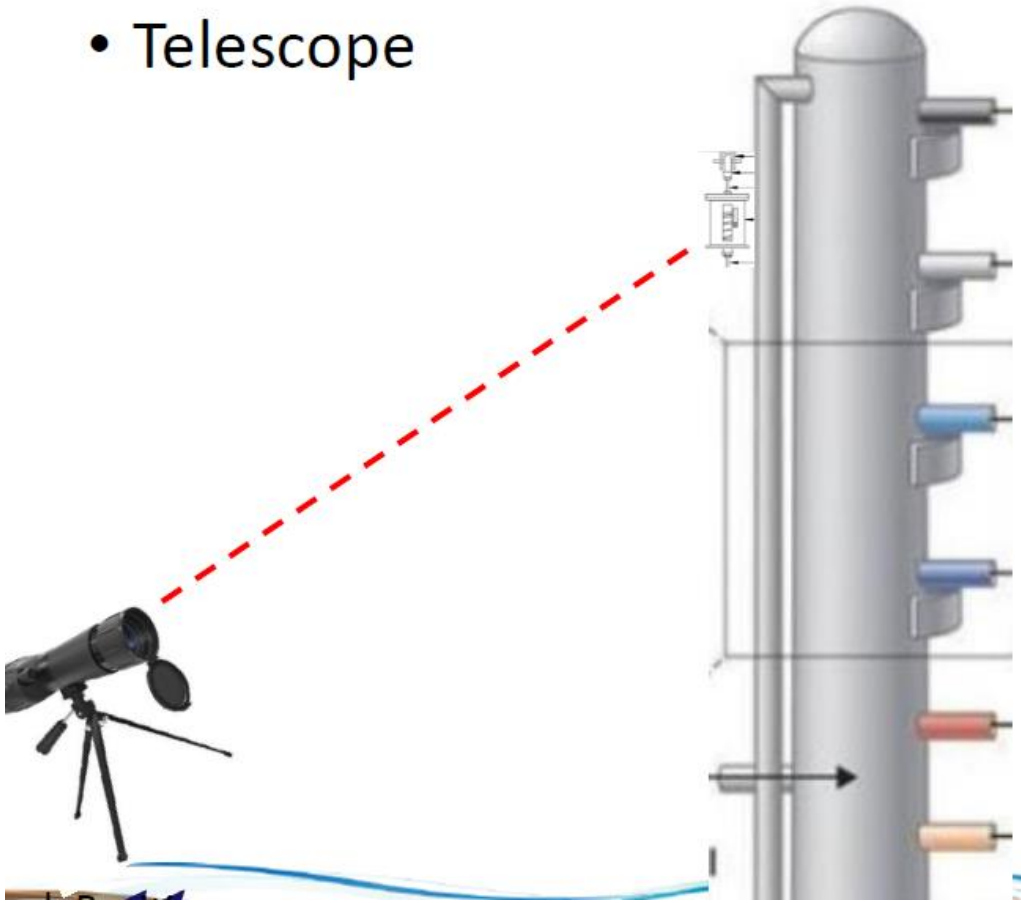
- Variable type
  - Actual position exceeds travel range[B] but variation[C] within 25%
- Constant type
  - Position indicator
    - Out of 1 division but can move properly (Actual moveable >= Required movement)[D]
  - Load adjusting indicator
    - Deviate 1-5 division[E] (+/-2% to 10% the design load)

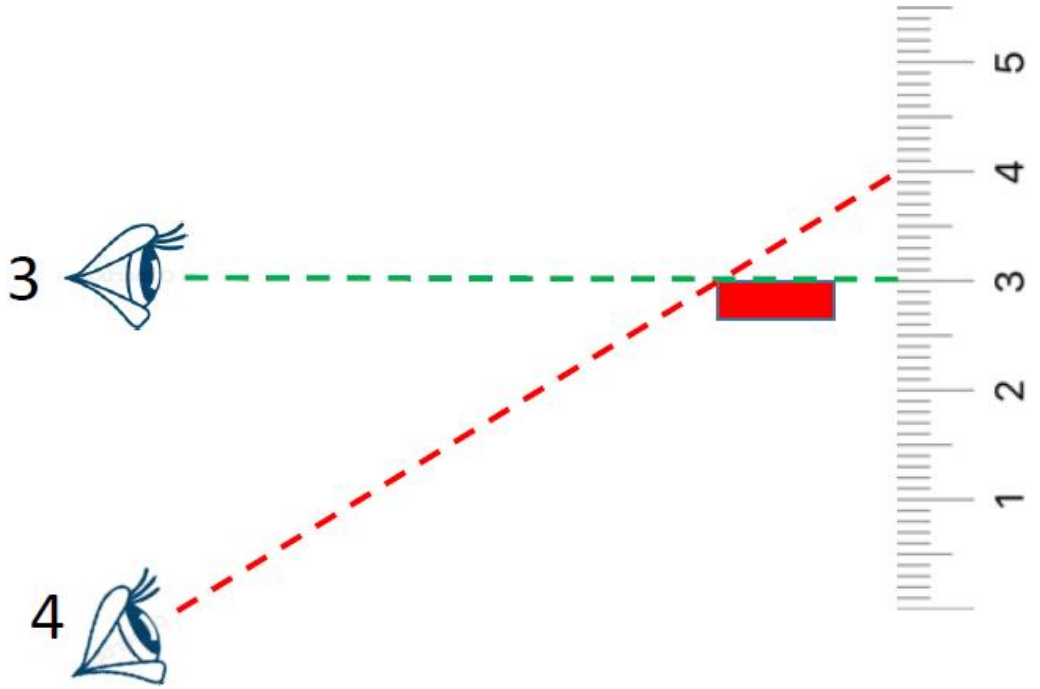
Class Normal

- Variable type
  - Actual position within travel range[B]
- Constant type
  - Position indicator
    - Within 1 division from hot or cold position
  - Load adjusting indicator
    - Deviate within 1 division[E] (+/-2% the design load)

Inspection Technique

- Telescope





Before

After

Classification criteria and action

Class	Description	Action
Major Damage	• Crack of spring coil and hanger component • Significant corrosion/distortion • Position indicator and load adjusting indicator refer to table 4 or Manufacturer recommendation • Bottoming out of spring support • Support shoes displaced from support member (> 50%) • Floating spring support • Locked spring • Missing of spring component (bolt, nut, and others)	• Raise maintenance notification for correction such adjustment, repair or replacement. • As consideration of area inspector
Minor Damage	• Slightly corrosion on casing/coil spring. • Position indicator and load adjusting indicator refer to table 4 or Manufacturer recommendation • Loosen of clamp, nut bolt, and pin. • Incorrect position. • Hit insulation.	• Monitoring and set inspection plan properly • As consideration of area inspector
Normal	• Position indicator and load adjusting indicator refer to table 4 or Manufacturer recommendation • No corrosion, & No loosens of clamp, nut bolt, and pin.	• Set inspection plan
Inaccessible	• Cannot inspect due to located at height or inaccessible area	• Install scaffolding • Rope access • other suitable access method
Unknown	• Missing • painted over nameplate • lack of data	• Recondition • Install nameplate • Contact vendor for recalibration

Major Damage

1. Cracked spring , Beam Attachment , Pin ,

Weld Spring Hanger Attachment

2. Severely corrosion

3. Locked Spring

4. Floating Spring support

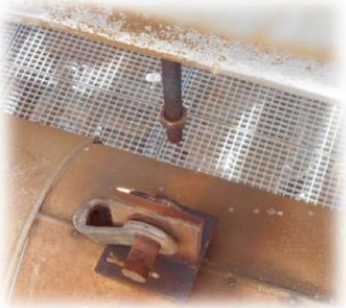
Major Damage

5. Travel Range out of range > 25%

(วิธีการเช่น Cold 36 hot 40 ค่าที่ได้ 45 ไปทางฝั่ง Hot คิดดังนี้
ค่าที่ได้ – Cold / Hot หรือ ค่าที่ได้ 30 ไปทาง Cold คิดดังนี้ Hot – ค่าที่ได้ / Hot)

6. Spring Support out of pipe rack >50% by Area

7. Any Missing of clamp, nut bolt and pin



Minor Damage

1. Spring hanger hit insulation and insulation damage

2. Over Hot/Cold Positon < 25 %

3. Incorrect positior

4. Any loosen of clamp, nut bolt and pin

Minor Damage

1. Spring hanger hit insulation and no insulation damage

2. Slightly Corrosion Casing/Coil Spring

Normal

- No Corrosion, no rust
- Travel Range Between Hot/Cold Positon.

Cannot Inspection Wait for SD

1. Painting cover load scale plate

2. Scale plate damage and missing

3. Wrong position

- หากหน้างานไม่สามารถ Inspect ได้ และที่บริเวณดังกล่าวมีปัญหา Pipe Vibration รุนแรง กรณีนี้จะถูกระบุให้เป็น Class A
- หากหน้างานไม่สามารถ Inspect ได้ แต่ไม่พบปัญหาใดๆ จะเก็บเป็น Backlog ไว้แก้ไขในช่วง Plant Shut Down แทน ซึ่งระยะเวลาอาจจะมากกว่า 180 และ 270 วัน