## Stainless Steel Springs

TAIYO Stainless Spring Co., Ltd.

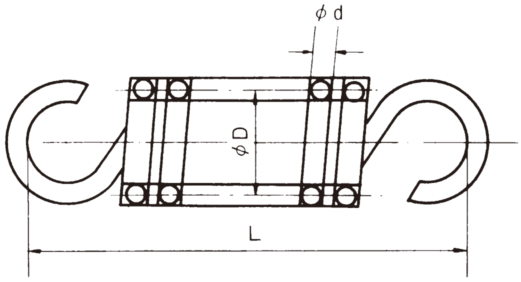
We have corrected the existing defects of surface treatments given to springs made from steel or alloyed metal, as well as other various mechanistic faults. As a result, we are proud to provide products that have earned customers' trust and praise. We hope that you will also appreciate our superior products and technology.

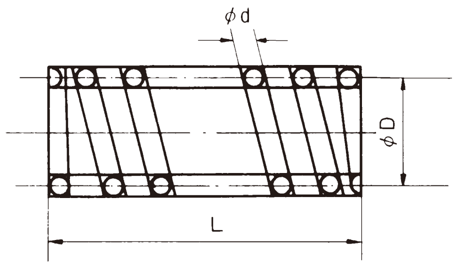
| Elastic Coefficient \ Type of Material | SUS304 | SUS631 | Piano Wire | Nickel Silver Wire | Phosphor Bronze Wire |
|---|---|---|---|---|---|
| Shear Modulus ( G ) | 73,550N/㎟ | 76,492N/㎟ | 78,453N/㎟ | 38,246N/㎟ | 41,188N/㎟ |
| Young's Modulus ( E ) | 186,320N/㎟ | 196,133N/㎟ | 205,940N/㎟ | 101,989N/㎟ | 107,873N/㎟ |

**Mechanical Properties of Age-Hardened High-Tension Stainless Steel SUS631** - Precipitation Hardening

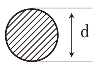
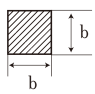
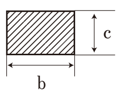
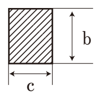
| HRC | Pre-Hardening Mechanical Properties | | | | | Post-Hardening Mechanical Properties | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Treatment | Tensile Test | | Bend Test | | Tensile Test | | Flexural Strength Test | Hardness |
| | | Tensile Strength N/㎟ | Elongation % | Bend Angle | Inside Radius | Tensile Strength N/㎟ | Elongation % | Threshold Limit Kb N/㎟ | HRC |
| 22 | R.H | 892 – 1,030 | 8 – 13 | 180° | 2 × Material Thickness | 1,481 | 6 – 12 | 588 | 47 |
| 38 | C.H | 1,206 or over | 6 – 10 | 180° | | 1,589 | 5 – 9 | 834 | 51 |

## General Formula for Spring Design




d: Wire diameter D: Mean diameter N: Number of active coils W: Axial load δ: Deflection
G: Shear modulus (Stainless Steel Wire = approx. 70,000N/㎟)

| Finding... |  |  |  b≦2C |  b>2C |
|---|---|---|---|---|
| Deflection from load | $\delta=\frac{8WND^3}{Gd^4}$ | $\delta=\frac{5.6WND^3}{Gb^4}$ | $\delta=\frac{2.79WND^3(b^2+c^2)}{Gb^3c^3}$ | $\delta=\frac{2.35WND^3}{Gc^3(b-0.63c)}$ |
| Deflection from shear stress | $\delta=\frac{\pi fsND^2}{Gd}$ | $\delta=\frac{2.35fsND^2}{Gb}$ | $\delta=\frac{3.5fsND^2(b^2+c^2)}{Gbc(2b+c)}$ | $\delta=\frac{2.9fsND^2b^2}{Gc(2b+c)(b-0.63c)}$ |
| Shear stress from load | $fs=\frac{8WD}{\pi d^3}$ | $fs=\frac{2.38WD}{b^3}$ | $fs=\frac{0.8WD(2b+c)}{b^2c^2}$ | $fs=\frac{0.8WD(2b+c)}{b^2c^2}$ |
| Shear stress from deflection | $fs=\frac{\delta Gd}{\pi ND^2}$ | $fs=\frac{0.425\delta Gb}{ND^2}$ | $fs=\frac{0.28\delta G(2b^2c+bc^2)}{ND^2(b^2+c^2)}$ | $fs=\frac{0.34\delta Gc(2b+c)(b-0.63c)}{ND^2b^2}$ |
| Load from estimated shear stress | $W=\frac{fs\pi d^3}{8D}$ | $W=\frac{0.42fsb^3}{D}$ | $W=\frac{1.25fsb^2c^2}{D(2b+c)}$ | $W=\frac{1.23fsb^2c^2}{D(2b+c)}$ |
| Load from deflection | $W=\frac{\delta d^4G}{8ND^3}$ | $W=\frac{\delta Gb^4}{5.6ND^3}$ | $W=\frac{\delta Gb^3c^3}{2.79ND^3(b^2+c^2)}$ | $W=\frac{\delta Gc^3(b-0.63c)}{2.35ND^3}$ |
| The number of active coils | $N=\frac{\delta Gd^4}{8WD^3}$ | $N=\frac{\delta Gb^4}{5.6WD^3}$ | $N=\frac{\delta Gb^3c^3}{2.79WD^3(b^2+c^2)}$ | $N=\frac{\delta Gc^3(b-0.63c)}{2.35WD^3}$ |

With respect to tension springs. the initial tension is set to 0.

Initial tension calculations

$$\delta=\frac{\pi(fs-fso)ND^2}{Gd}$$

Po: Initial tension fso : Residual stress $\left(\frac{G}{100c}\right)$ c: Spring index $\left(\frac{D}{d}\right)$

$$Po=\frac{\pi fsod^3}{8D} \qquad fs=\frac{\delta Gd}{\pi ND^2}+fso$$