# Dimensioning of compression spring for height adjustable crutch

| **Specifications of springs** | | **Spring 1 60/3** | **Spring 2 62/3** |
|---|---|---|---|
| Shear module | G [MPa] | 82500 | 82500 |
| Diameter wire | d [mm] | 1.6 | 2 |
| Diameter spring | D [mm] | 12.5 | 16 |
| Slope spring | s [mm] | 6 | 7.5 |
| Max. force for L0 = 1m | FN [N] | 139.8 | 202.94 |
| Weight for L0=1m | m [g] | 107 | 175 |
| Diameter for casing | De [mm] | 14.1 | 18 |
| Costs per 1m | [CHF] | 10 | 16 |

| Design space | | |
|---|---|---|
| Duct | Diameter | Length |
| Upper | 20.5 mm | 350 mm |
| Lower | 17 mm | 310 mm |

| length together | |
|---|---|
| long | 690 mm |
| short | 490 mm |

| **Requirements** | | Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|---|---|
| Max. force for max. displacement | Fmax [N] | 150 | 150 | 100 | 100 |
| max. displacement | S [mm] | 200 | 150 | 200 | 150 |

| | **Spring 1** | | | |
|---|---|---|---|---|
| | **Option 1** | **Option 2** | **Option 3** | **Option 4** |
| Number of windings | 48.137344 | 34.603008 | 69.206016 | 51.904512 |
| Springcoefficient | 0.75 | 1 | 0.5 | 0.66666667 |
| L0 = relaxed length | 288.824064 | 207.618048 | 415.236096 | 311.427072 |
| L1 = length after preloading to 25N | 255.490731 | 182.618048 | 365.236096 | 273.927072 |
| L2 = length at coil-bound deflexion | 77.0197504 | 55.3648128 | 110.7296256 | 83.0472192 |
| dL = possible suspension | 178.47098 | 127.253235 | 254.5064704 | 190.879853 |
| Smin = preloading suspension | 33.3333333 | 25 | 50 | 37.5 |
| Weight per spring [g] | 30.9041748 | 22.2151311 | 44.43026227 | 33.3226967 |

| | **Spring 2** | | | |
|---|---|---|---|---|
| | **Option 1** | **Option 2** | **Option 3** | **Option 4** |
| Number of windings | 53.7109375 | 42.2832031 | 80.5664063 | 60.4248047 |
| Springcoefficient | 0.75 | 1 | 0.5 | 0.66666667 |
| L0 = relaxed length | 402.832031 | 317.124023 | 604.248047 | 453.186035 |
| L1 = length after preloading to 25N | 369.498698 | 292.124023 | 554.248047 | 415.686035 |
| L2 = length at coil-bound deflexion | 107.421875 | 84.5664063 | 161.132813 | 120.849609 |
| dL = possible suspension | 262.076823 | 207.557617 | 393.115234 | 294.836426 |
| Smin = preloading suspension | 33.3333333 | 25 | 50 | 37.5 |
| Weight per spring [g] | 70.4956055 | 55.4967041 | 105.743408 | 79.3075562 |

L1 is the space needed in the crutch --> limiting factor due to amount of space available