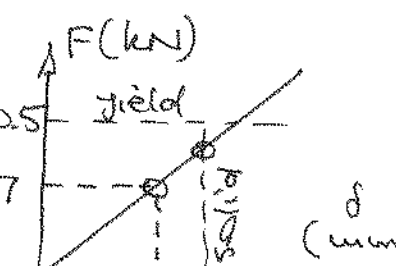
Safety factor of 1.5 at highest operating point (7 kN, 50 mm). So yield at 10.5 kN. Take solidification at ~~[illegible]~~ say 9 kN, so that yield impossible.



Essentially static – use K_s

from (1) $\tau = K_s \cdot 8FC/\pi d^2 \le S_{ys}/n$

∴ $K_s \cdot 8 \times 7e3\; C/\pi d^2 \le 690/1.5$

i.e. $d^2 \ge 38.75\, C K_s = 38.75(C + \frac{1}{2})$

For a practical first choice take $5 \le C \le 10$

∴ $14.6 \le d \le 20.2$ mm.

So consider two trial solutions of d in this range:

d :	16	20 mm
∴ C_{max} from above	6.1	$\frac{20^2}{38.75} - \frac{1}{2} = 9.8$

From (2) $n_a \ge Gd/8kC^3$ (since δ_{max} given)

* $= 79 \times 10^3 d / 8 \times (7000/50)\, C^3$

∴ n_a (min).	5.0	1.5 too low
$D_o = (C+1)d$ (mm)	114 < 150 so OK.	

Completing the specification $d = 16$ mm $C = 6.1$

$D = Cd = 6.1 \times 16 = 98$ mm.

$D_o = D + d = 98 + 16 = 114 < 150$ mm, so OK.

Assuming squared & ground ends.

$n_T = n_a + 2 = 5 + 2 = 7$

From the characteristic, when solid

$\delta_s = 9 \times (50/7) = 64$ mm.

$L_s = n_T d$. (table 1) $= 7 \times 16 = 112$ mm.

∴ $L_o = L_s + \delta_s = 112 + 64 = 176$ mm.

$L_o = n_a p + 2d = 5p + 2 \times 16$ (table 1)

$\Rightarrow p = 28.8$ mm

i.e. $\alpha = \arctan p/\pi D = \arctan \frac{28.8}{98\pi}$

$= 5.3°$ – close coiled OK

The solution is fairly satisfactory though active turns is rather low. Might try smaller index, eg $D = 90$ mm $C = 90/16 = 5.62 \Rightarrow n_a = 6.34$ (from *) – and so on.

There appear to be no criteria which could further fine the design.

So $d = 16$ mm $D = 98$ mm $n_T = 7$

$L_o = 176$ mm