Solutions

2.1

- $C_p = (USL - LSL)/6\sigma = 0.06/0.048 = \mathbf{1.25}$.
- $C_{pk} = (USL - \mu)/3\sigma = (12.030 - 12.006)/0.024 = \mathbf{1.00}$.

2.2

- Above: $z = (USL - \mu)/\sigma = (12.030 - 12.006)/0.008 = 3.0$, tail 0.00135: **1350** ppm.
- Below: $z = (\mu - LSL)/\sigma = (12.006 - 11.970)/0.008 = 4.5$: **3.4** ppm.

2.3

- $\mu \pm 3\sigma/\sqrt{n} = 12.006 \pm 3 \times 0.008/2 = 12.006 \pm 0.012$: **11.994** to **12.018** mm.

3.1

- Centred: $C_{pk} = C_p = \mathbf{1.25}$.
- Each side $z = 0.03/0.008 = 3.75$: total $2 \times 88.4 = \mathbf{177}$ ppm.
- $C_{pk} = 0.03/3\sigma \geq 1.33$ gives $\sigma \leq 0.03/4 = \mathbf{0.0075}$ mm.
- Reduce the spread: a stiffer set-up, a sharper or more stable tool, temperature control, or a finishing pass.