

## → Propagação de Incertezas

$$\textcircled{1} \begin{aligned} d &= \bar{d} \pm \sigma_{Fd} \\ h &= \bar{h} \pm \sigma_{Fh} \end{aligned} \quad \textcircled{2} \begin{aligned} p &= d + h \\ p &= d - h \end{aligned} \quad \textcircled{3} \sigma_p = \sqrt{\sigma_{Fd}^2 + \sigma_{Fh}^2}$$

### ① DIÂMETRO

$$\begin{aligned} d &= (16,37 \pm 0,00979) \text{ mm} \\ d &= 16,37979 \text{ mm} \\ d &\approx 16,379 \text{ mm} // \end{aligned}$$

$$\begin{aligned} d &= (16,37 - 0,00979) \text{ mm} \\ d &= 16,36021 \text{ mm} \\ d &\approx 16,360 \text{ mm} // \end{aligned}$$

### ① ALTURA

$$\begin{aligned} h &= (22,91 \pm 0,002984) \text{ mm} \\ h &= 22,912984 \text{ mm} \\ h &\approx 22,912 \text{ mm} // \end{aligned}$$

$$\begin{aligned} h &= (22,91 - 0,002984) \text{ mm} \\ h &= 22,907016 \text{ mm} \\ h &\approx 22,907 \text{ mm} // \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad p &= d + h \\ p &= 16,379 + 22,912 \\ p &= 39,291 \text{ mm} // \end{aligned}$$

$$\begin{aligned} p &= d - h \\ p &= 16,360 - 22,907 \\ p &= -6,547 \text{ mm} // \end{aligned}$$

$$\textcircled{3} \sigma_p = \sqrt{\sigma_{Fd}^2 + \sigma_{Fh}^2}$$

$$\begin{aligned} \sigma_p &= \sqrt{(0,00979)^2 + (0,002984)^2} \\ \sigma_p &\approx \sqrt{1,047 \cdot 10^{-4}} \\ \sigma_p &\approx 1,023 \cdot 10^{-4} // \end{aligned}$$

## → Cálculo da Densidade

$$\bar{\rho} = \frac{4 \cdot \bar{m}}{\pi \cdot \bar{d}^2 \cdot \bar{h}}$$

$$\begin{aligned} \bar{\rho} &= \frac{4 \cdot 40,82}{\pi \cdot (16,37)^2 \cdot 22,91} \\ \bar{\rho} &\approx 8,466 \cdot 10^{-3} \text{ g/mm}^3 // \end{aligned}$$

## → Incerteza Final da Densidade

$$\sigma_{\rho} = \rho = \sqrt{\left(\frac{\sigma_{Fm}}{\bar{m}}\right)^2 + \left(2 \frac{\sigma_{Fd}}{\bar{d}}\right)^2 + \left(\frac{\sigma_{Fh}}{\bar{h}}\right)^2}$$