# Important Turning Operation Formulas PDF

Formulas
Examples
with Units

**List of 17**
**Important Turning Operation Formulas**

## 1) Basic Setup time given Non-productive Time in Turning Formula

Evaluate Formula

Formula

$$t_s = \left( NPT - t_{ln} - \left( t_{pt} \cdot n_0 \right) \right) \cdot N_b - \left( N_t \cdot t_{st} \right)$$

Example with Units

$$20.507\,\text{min} = \left( 28.169\,\text{min} - 30\,\text{s} - \left( 1.50\,\text{min} \cdot 5 \right) \right) \cdot 3 - \left( 4 \cdot 10\,\text{min} \right)$$

## 2) Batch Size given Non-productive Time in Turning Formula

Evaluate Formula

Formula

$$N_b = \frac{t_s + N_t \cdot t_{st}}{\left( NPT - t_{ln} - \left( t_{pt} \cdot n_0 \right) \right)}$$

Example with Units

$$2.9997 = \frac{20.50\,\text{min} + 4 \cdot 10\,\text{min}}{\left( 28.169\,\text{min} - 30\,\text{s} - \left( 1.50\,\text{min} \cdot 5 \right) \right)}$$

## 3) Constant for given Cylindrical Turning Formula

Evaluate Formula

Formula

$$K = \pi \cdot d \cdot \frac{L_{cut}}{f}$$

Example with Units

$$2393.8936\,\text{mm} = 3.1416 \cdot 76.20\,\text{mm} \cdot \frac{9\,\text{mm}}{0.9\,\text{mm}}$$

## 4) Diameter of Turned Parts given Length-to-Diameter Ratio Formula

Evaluate Formula

Formula

$$d = \left( \frac{1.67}{l_r} \right)^{\frac{1}{0.68}}$$

Example with Units

$$76.3671\,\text{mm} = \left( \frac{1.67}{0.79} \right)^{\frac{1}{0.68}}$$

## 5) Diameter of Workpiece given Constant for Cylindrical Turning Formula

Evaluate Formula

Formula

$$d = K \cdot \frac{f}{\pi \cdot L_{cut}}$$

Example with Units

$$76.2\,\text{mm} = 2393.894\,\text{mm} \cdot \frac{0.9\,\text{mm}}{3.1416 \cdot 9\,\text{mm}}$$

## 6) Feed given Constant for Cylindrical Turning Formula

Evaluate Formula

Formula

$$f = \pi \cdot d \cdot \frac{L_{cut}}{K}$$

Example with Units

$$0.9\,\text{mm} = 3.1416 \cdot 76.20\,\text{mm} \cdot \frac{9\,\text{mm}}{2393.894\,\text{mm}}$$

## 7) Feed Rate for Turning Operation given Machining Time Formula

Evaluate Formula

Formula

$$f_r = \frac{L_{cut}}{t_m \cdot \omega}$$

Example with Units

$$0.7162\,\text{mm/rev} = \frac{9\,\text{mm}}{0.6\,\text{s} \cdot 200\,\text{rev/min}}$$

## 8) Length of Cut using Machining Time Formula

Evaluate Formula

Formula

$$L_w = f_r \cdot t_{m°} \cdot \omega_w$$

Example with Units

$$26165.6315\,\text{mm} = 0.7\,\text{mm/rev} \cdot 62.6224\,\text{min} \cdot 95\,\text{rev/min}$$

## 9) Length-to-diameter Ratio given diameter of turned parts Formula

Evaluate Formula

Formula

$$l_r = \frac{1.67}{d^{0.68}}$$

Example with Units

$$0.7912 = \frac{1.67}{76.20\,\text{mm}^{0.68}}$$

## 10) Loading and Unloading Time given Non-productive Time in Turning Formula

Evaluate Formula

Formula

$$t_{ln} = NPT - \left(\frac{t_s + N_t \cdot t_{st}}{N_b}\right) - \left(t_{pt} \cdot n_0\right)$$

Example with Units

$$30.14\,\text{s} = 28.169\,\text{min} - \left(\frac{20.50\,\text{min} + 4 \cdot 10\,\text{min}}{3}\right) - \left(1.50\,\text{min} \cdot 5\right)$$

## 11) Machining Time for Turning Operation Formula

Evaluate Formula

Formula

$$t_m = \frac{L_{cut}}{f_r \cdot \omega}$$

Example with Units

$$0.6139\,\text{s} = \frac{9\,\text{mm}}{0.7\,\text{mm/rev} \cdot 200\,\text{rev/min}}$$

## 12) Non-Productive Time in Turning Formula

Evaluate Formula

Formula

$$NPT = \left(\frac{t_s + N_t \cdot t_{st}}{N_b}\right) + t_{ln} + \left(t_{pt} \cdot n_0\right)$$

Example with Units

$$28.1667\,\text{min} = \left(\frac{20.50\,\text{min} + 4 \cdot 10\,\text{min}}{3}\right) + 30\,\text{s} + \left(1.50\,\text{min} \cdot 5\right)$$

## 13) Number of Operations given Non-productive Time in Turning Formula

Evaluate Formula

Formula

$$n_0 = \frac{NPT - \left(\frac{t_s + N_t \cdot t_{st}}{N_b}\right) - t_{ln}}{t_{pt}}$$

Example with Units

$$5.0016 = \frac{28.169\,\text{min} - \left(\frac{20.50\,\text{min} + 4 \cdot 10\,\text{min}}{3}\right) - 30\,\text{s}}{1.50\,\text{min}}$$

## 14) Number of Tools given Non-Productive Time in Turning Formula

Evaluate Formula

Formula

$$N_t = \frac{\left(NPT - t_{ln} - \left(t_{pt} \cdot n_0\right)\right) \cdot N_b - t_s}{t_{st}}$$

Example with Units

$$4.0007 = \frac{\left(28.169\,\text{min} - 30\,\text{s} - \left(1.50\,\text{min} \cdot 5\right)\right) \cdot 3 - 20.50\,\text{min}}{10\,\text{min}}$$

## 15) Set-up Time per Tool Terms of Non-Productive Time in Turning Formula

Evaluate Formula

Formula

$$t_{st} = \frac{\left(NPT - t_{ln} - \left(t_{pt} \cdot n_0\right)\right) \cdot N_b - t_s}{N_t}$$

Example with Units

$$10.0018\,\text{min} = \frac{\left(28.169\,\text{min} - 30\,\text{s} - \left(1.50\,\text{min} \cdot 5\right)\right) \cdot 3 - 20.50\,\text{min}}{4}$$

## 16) Tool Positioning Time per Operation given Non-Productive Time in Turning Formula

Evaluate Formula

Formula

$$t_{pt} = \frac{NPT - \left(\frac{t_s + N_t \cdot t_{st}}{N_b}\right) - t_{ln}}{n_0}$$

Example with Units

$$1.5005\,\text{min} = \frac{28.169\,\text{min} - \left(\frac{20.50\,\text{min} + 4 \cdot 10\,\text{min}}{3}\right) - 30\,\text{s}}{5}$$

## 17) Turning Length given Constant for Cylindrical Turning Formula

Evaluate Formula

Formula

$$L_{cut} = K \cdot \frac{f}{\pi \cdot d}$$

Example with Units

$$9\,\text{mm} = 2393.894\,\text{mm} \cdot \frac{0.9\,\text{mm}}{3.1416 \cdot 76.20\,\text{mm}}$$

## Variables used in list of Turning Operation Formulas above

- **d** Diameter of Workpiece *(Millimeter)*
- **f** Feed *(Millimeter)*
- $f_r$ Feed Rate *(Millimeter Per Revolution)*
- **K** Constant For Machining Condition *(Millimeter)*
- $L_{cut}$ Length of Cut *(Millimeter)*
- $l_r$ Length to Diameter Ratio
- $L_w$ Length of Cut in Machining *(Millimeter)*
- $n_0$ Number of Operations
- $N_b$ Batch Size
- $N_t$ Number of Tools Used
- **NPT** Non-Productive Time *(Minute)*
- $t_{ln}$ Loading And Unloading Time *(Second)*
- $t_m$ Turning Time *(Second)*
- $t_{m∘}$ Machining Time in Machining *(Minute)*
- $t_{pt}$ Tool Positioning Time Per Operation *(Minute)*
- $t_s$ Basic Setup Time *(Minute)*
- $t_{st}$ Setup Time Per Tool *(Minute)*
- $\omega$ Angular Velocity of Job or Workpiece *(Revolution per Minute)*
- $\omega_w$ Rotational Frequency of Workpiece *(Revolution per Minute)*

## Constants, Functions, Measurements used in list of Turning Operation Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Measurement: **Length** in Millimeter (mm)
  *Length Unit Conversion*
- Measurement: **Time** in Minute (min), Second (s)
  *Time Unit Conversion*
- Measurement: **Angular Velocity** in Revolution per Minute (rev/min)
  *Angular Velocity Unit Conversion*
- Measurement: **Feed** in Millimeter Per Revolution (mm/rev)
  *Feed Unit Conversion*

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