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Viscosity and Density of Lubricant Formulas

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List of 12 Viscosity and Density of Lubricant Formulas

Viscosity and Density of Lubricant

1) Absolute Viscosity of Oil in Terms of Tangential Force

$$\text{fx } \mu_o = P \cdot \frac{h}{A_{po} \cdot V_m}$$

Open Calculator 

$$\text{ex } 489.1429\text{cP} = 214\text{N} \cdot \frac{0.02\text{mm}}{1750\text{mm}^2 \cdot 5\text{m/s}}$$

2) Area of moving plate of sliding contact bearing given absolute viscosity

$$\text{fx } A_{po} = P \cdot \frac{h}{\mu_o \cdot V_m}$$

Open Calculator 

$$\text{ex } 1746.939\text{mm}^2 = 214\text{N} \cdot \frac{0.02\text{mm}}{490\text{cP} \cdot 5\text{m/s}}$$

3) Density in Terms of Kinematic Viscosity and Viscosity for Sliding Contact Bearing

$$\text{fx } \rho = \frac{\mu_l}{z}$$

Open Calculator 

$$\text{ex } 0.88\text{g/cm}^3 = \frac{220\text{cP}}{250\text{cSt}}$$



4) Density of Lubricating Oil in Terms of Temperature Rise Variable

$$\text{fx } \rho = \text{TRV} \cdot \frac{p}{C_p \cdot \Delta t_r}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$\text{ex } 0.867769\text{g/cm}^3 = 21 \cdot \frac{0.96\text{MPa}}{1.76\text{kJ/kg}^{\circ}\text{C} \cdot 13.2^{\circ}\text{C}}$$

5) Kinematic Viscosity given Viscosity and Density for Sliding Contact Ball Bearing

$$\text{fx } z = \frac{\mu_l}{\rho}$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$\text{ex } 250\text{cSt} = \frac{220\text{cP}}{0.88\text{g/cm}^3}$$

6) Kinematic Viscosity in Centi-Stokes in Terms of Viscosity in Saybolt's Universal Seconds

$$\text{fx } z_k = (0.22 \cdot t) - \left(\frac{180}{t} \right)$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$\text{ex } 34.075 = (0.22 \cdot 160) - \left(\frac{180}{160} \right)$$



7) Velocity of Moving Plate in Terms of Absolute Viscosity 

$$fx \quad V_m = P \cdot \frac{h}{\mu_o \cdot A_{po}}$$

Open Calculator 

$$ex \quad 4.991254m/s = 214N \cdot \frac{0.02mm}{490cP \cdot 1750mm^2}$$

8) Viscosity in Terms of Absolute Temperature for Sliding Contact Bearing 

$$fx \quad \mu_o = 10^{\left(A + \left(\frac{B}{T_{abs}}\right)\right)}$$

Open Calculator 


$$ex \quad 485.695cP = 10^{(-6.95 + (\frac{3180}{330}))}$$

9) Viscosity in Terms of Flow Coefficient and Flow of Lubricant 

$$fx \quad \mu_l = q_f \cdot W \cdot \frac{h^3}{A_p \cdot Q_{bp}}$$

Open Calculator 

$$ex \quad 219.9185cP = 11.80 \cdot 1800N \cdot \frac{(0.02mm)^3}{450mm^2 \cdot 1717mm^3/s}$$

10) Viscosity in Terms of Kinematic Viscosity and Density for Sliding Contact Bearing 

$$fx \quad \mu_l = z \cdot \rho$$

Open Calculator 

$$ex \quad 220cP = 250cSt \cdot 0.88g/cm^3$$



11) Viscosity of Lubricant in Terms of Flow of Lubricant

$$\text{fx } \mu_1 = \Delta P \cdot b \cdot \frac{h^3}{12 \cdot l \cdot Q_{\text{slot}}}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$\text{ex } 231.3889\text{cP} = 5.1\text{MPa} \cdot 49\text{mm} \cdot \frac{(0.02\text{mm})^3}{12 \cdot 48\text{mm} \cdot 15\text{mm}^3/\text{s}}$$

12) Viscosity of Lubricant in Terms of Sommerfeld Number of Bearing

$$\text{fx } \mu_1 = 2 \cdot \pi \cdot S \cdot \frac{p}{\left(\frac{r}{c}\right)^2 \cdot n_s}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$\text{ex } 219.3982\text{cP} = 2 \cdot \pi \cdot 2.58 \cdot \frac{0.96\text{MPa}}{\left(\frac{25.5\text{mm}}{0.024\text{mm}}\right)^2 \cdot 10\text{rev/s}}$$



Variables Used












- **A** Constant a for Viscosity Relationship
- **A_p** Total Projected Area of Bearing Pad (*Square Millimeter*)
- **A_{po}** Area of Moving Plate on Oil (*Square Millimeter*)
- **b** Breadth of Slot for Oil Flow (*Millimeter*)
- **B** Constant b for Viscosity Relationship
- **c** Radial Clearance for Bearing (*Millimeter*)
- **C_p** Specific heat of bearing oil (*Kilojoule per Kilogram per Celcius*)
- **h** Oil Film Thickness (*Millimeter*)
- **l** Length of Slot in Direction of Flow (*Millimeter*)
- **n_s** Journal Speed (*Revolution per Second*)
- **p** Unit bearing pressure for bearing (*Megapascal*)
- **P** Tangential force on moving plate (*Newton*)
- **Q_{bp}** Flow of Lubricant Across Bearing Pad (*Cubic Millimeter per Second*)
- **q_f** Flow Coefficient
- **Q_{slot}** Flow of Lubricant From Slot (*Cubic Millimeter per Second*)
- **r** Radius of Journal (*Millimeter*)
- **S** Sommerfeld Number of Journal Bearing
- **t** Viscosity in Saybolt Universal Seconds
- **T_{abs}** Absolute Temperature of Oil in Kelvin
- **TRV** Temperature Rise Variable
- **V_m** Velocity of Moving Plate on Oil (*Meter per Second*)
- **W** Load Acting on Sliding Bearing (*Newton*)




- **z** Kinematic Viscosity of Lubricant Oil (*Centistokes*)
- **z_k** Kinematic Viscosity in Centi-Stokes
- **ΔP** Pressure Difference Between Slot Sides (*Megapascal*)
- **Δt_r** Temperature Rise of Bearing Lubricant (*Degree Celsius*)
- **μ_l** Dynamic Viscosity of Lubricant (*Centipoise*)
- **μ_o** Dynamic Viscosity of Oil (*Centipoise*)
- **ρ** Density of Lubricating Oil (*Gram per Cubic Centimeter*)



Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Measurement:** **Length** in Millimeter (mm)
Length Unit Conversion 
- **Measurement:** **Area** in Square Millimeter (mm²)
Area Unit Conversion 
- **Measurement:** **Pressure** in Megapascal (MPa)
Pressure Unit Conversion 
- **Measurement:** **Speed** in Meter per Second (m/s)
Speed Unit Conversion 
- **Measurement:** **Force** in Newton (N)
Force Unit Conversion 
- **Measurement:** **Volumetric Flow Rate** in Cubic Millimeter per Second (mm³/s)
Volumetric Flow Rate Unit Conversion 
- **Measurement:** **Temperature Difference** in Degree Celsius (°C)
Temperature Difference Unit Conversion 
- **Measurement:** **Specific Heat Capacity** in Kilojoule per Kilogram per Celcius (kJ/kg*°C)
Specific Heat Capacity Unit Conversion 
- **Measurement:** **Dynamic Viscosity** in Centipoise (cP)
Dynamic Viscosity Unit Conversion 
- **Measurement:** **Kinematic Viscosity** in Centistokes (cSt)
Kinematic Viscosity Unit Conversion 
- **Measurement:** **Angular Velocity** in Revolution per Second (rev/s)
Angular Velocity Unit Conversion 



- **Measurement: Density** in Gram per Cubic Centimeter (g/cm^3)
Density Unit Conversion 



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