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Electromagnetic Distance Measurement Formulas

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List of 23 Electromagnetic Distance Measurement Formulas

Electromagnetic Distance Measurement

EDM Corrections

1) Barometric Pressure given Group Refractive Index

Open Calculator

fx $$P_b = \left((n-1)+\left(\left(\frac{11.27\cdot 10^{-6}\cdot e}{273.15+t}\right)\right)\right)\cdot\left(\frac{273.15+t}{0.269578\cdot(n_0-1)}\right)$$

ex $$6884.118 = \left((2-1)+\left(\left(\frac{11.27\cdot 10^{-6}\cdot 1006\text{mbar}}{273.15+98}\right)\right)\right)\cdot\left(\frac{273.15+98}{0.269578\cdot(1.2-1)}\right)$$

2) Corrected Slope Distance for Refractive Index

Open Calculator

fx $$D_c = \left(\frac{n_s}{RI}\right)\cdot D_m$$

ex $$135.4089\text{m} = \left(\frac{1.9}{1.333}\right)\cdot 95\text{m}$$

3) Essen and Froome Formula for Group Refractive Index

Open Calculator

fx $$n = 1+\left(77.624\cdot P_b\cdot\frac{10^{-6}}{273.15+t}\right)+\left(\left(\frac{0.372}{(273.15+t)^2}\right)-\left(12.92\cdot\frac{10^{-6}}{273.15+t}\right)\right)\cdot e$$

ex $$1.269616 = 1+\left(77.624\cdot 6921.213\cdot\frac{10^{-6}}{273.15+98}\right)+\left(\left(\frac{0.372}{(273.15+98)^2}\right)-\left(12.92\cdot\frac{10^{-6}}{273.15+98}\right)\right)\cdot 100$$

4) Group Refractive Index at Standard Conditions

Open Calculator

fx $$n_0 = 1+\left(287.604+\left(\frac{4.8864}{\lambda^2}\right)+\left(\frac{0.068}{\lambda^4}\right)\right)\cdot 10^{-6}$$

ex $$1.000288 = 1+\left(287.604+\left(\frac{4.8864}{(20\text{m})^2}\right)+\left(\frac{0.068}{(20\text{m})^4}\right)\right)\cdot 10^{-6}$$

5) Group Refractive Index if Temperature and Humidity are different from Standard Values

Open Calculator

$$n = 1 + \left(\frac{0.269578 \cdot (n_0 - 1) \cdot P_b}{273.15 + t}\right) - \left(\left(\frac{11.27}{273.15 + t}\right) \cdot 10^{-6} \cdot e\right)$$

$$2.005389 = 1 + \left(\frac{0.269578 \cdot (1.2 - 1) \cdot 6921.213}{273.15 + 98}\right) - \left(\left(\frac{11.27}{273.15 + 98}\right) \cdot 10^{-6} \cdot 1006\text{mbar}\right)$$

6) IUCG Formula for Refractive Index

Open Calculator

$$n = 1 + \left(0.000077624 \cdot \frac{P_b}{273.15 + t}\right) - \left(\left(\left(\frac{12.924}{273.15 + t}\right) + \left(\frac{371900}{(273.15 + t)^2}\right)\right) \cdot 10^{-6} \cdot e\right)$$

$$0.998697 = 1 + \left(0.000077624 \cdot \frac{6921.213}{273.15 + 98}\right) - \left(\left(\left(\frac{12.924}{273.15 + 98}\right) + \left(\frac{371900}{(273.15 + 98)^2}\right)\right) \cdot 10^{-6} \cdot 1006\text{m}\right)$$

7) Overall Standard Error

Open Calculator

$$\sigma_D = \sqrt{E_s^2 + \left(D \cdot p \cdot 10^{-6}\right)^2}$$

$$60 = \sqrt{(60)^2 + \left(50\text{m} \cdot 65 \cdot 10^{-6}\right)^2}$$

8) Partial Pressure of Water Vapour when Temperature Effects are Considered

Open Calculator

$$e = e_w - 0.7 \cdot \Delta T$$

$$1006\text{mbar} = 1013\text{mbar} - 0.7 \cdot 10$$

9) Temperature Difference given Partial Pressure

Open Calculator

$$\Delta T = \frac{e_w - e}{0.7}$$

$$10 = \frac{1013\text{mbar} - 1006\text{mbar}}{0.7}$$

10) Wave Velocity in Medium

Open Calculator

$$V = \frac{V_0}{RI}$$

$$150.0375\text{m/s} = \frac{200\text{m/s}}{1.333}$$

11) Wave Velocity in Vacuum

Open Calculator

fx $V_0 = V \cdot RI$

ex $198.617\text{m/s} = 149\text{m/s} \cdot 1.333$

EDM Lines

12) Reduced Distance

Open Calculator

fx $K = R \cdot \sqrt{\frac{(D - (H_2 - H_1)) \cdot (D + (H_2 - H_1))}{(R + H_1) \cdot (R + H_2)}}$

ex $49.21355\text{m} = 6370 \cdot \sqrt{\frac{(50\text{m} - (100\text{m} - 101\text{m})) \cdot (50\text{m} + (100\text{m} - 101\text{m}))}{(6370 + 101\text{m}) \cdot (6370 + 100\text{m})}}$

13) Spheroidal Distance

Open Calculator

fx $S = K + \left(\frac{K^3}{24 \cdot R^2}\right)$

ex $49.50012\text{m} = 49.5\text{m} + \left(\frac{(49.5\text{m})^3}{24 \cdot (6370)^2}\right)$

14) Spheroidal Distance for Geodimeters

Open Calculator

fx $S = K + \left(\frac{K^3}{38 \cdot R^2}\right)$

ex $49.50008\text{m} = 49.5\text{m} + \left(\frac{(49.5\text{m})^3}{38 \cdot (6370)^2}\right)$

15) Spheroidal Distance for Tellurometers

Open Calculator

fx $S = K + \left(\frac{K^3}{43 \cdot R^2}\right)$

ex $49.50007\text{m} = 49.5\text{m} + \left(\frac{(49.5\text{m})^3}{43 \cdot (6370)^2}\right)$

Phase Difference Method

16) Double Path Measurement

Open Calculator

fx $2D = M \cdot \lambda + \delta\lambda$

ex $649.6\text{m} = 32 \cdot 20\text{m} + 9.6\text{m}$

17) Fraction Part of Wavelength

Open Calculator

fx $\delta\lambda = \left(\frac{\Phi}{2 \cdot \pi}\right) \cdot \lambda$

ex $9.549297\text{m} = \left(\frac{3}{2 \cdot \pi}\right) \cdot 20\text{m}$

18) Fraction Part of Wavelength given Double Path Measurement

Open Calculator

fx $\delta\lambda = (2D - (M \cdot \lambda))$

ex $9.6\text{m} = (649.6\text{m} - (32 \cdot 20\text{m}))$

19) Integer Part of Wavelength for given Double Path

Open Calculator

fx $M = \frac{2D - \delta\lambda}{\lambda}$

ex $32 = \frac{649.6\text{m} - 9.6\text{m}}{20\text{m}}$

20) Wavelength given Double Path

Open Calculator

fx $\lambda = \frac{2D - \delta\lambda}{M}$

ex $20\text{m} = \frac{649.6\text{m} - 9.6\text{m}}{32}$

Pulse Method

21) Completion Time for given Distance of Path

Open Calculator

fx $\Delta t = 2 \cdot \frac{D}{c}$

ex $0.502513 = 2 \cdot \frac{50\text{m}}{199\text{m/s}}$

22) Distance Measured

Open Calculator

fx $$D = c \cdot \frac{\Delta t}{2}$$

ex $$49.75\text{m} = 199\text{m/s} \cdot \frac{0.5}{2}$$

23) Velocity in Medium given Distance

Open Calculator

fx $$c = 2 \cdot \frac{D}{\Delta t}$$

ex $$200\text{m/s} = 2 \cdot \frac{50\text{m}}{0.5}$$

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Variables Used

- **2D** Double Path *(Meter)*
- **c** Velocity of Light wave *(Meter per Second)*
- **D** Distance Traveled *(Meter)*
- D_c Corrected Slope *(Meter)*
- D_m Measured Distance *(Meter)*
- **e** Partial Pressure of Water Vapour *(Millibar)*
- E_s Standard Error e
- e_w Saturated Vapor Pressure of Water *(Millibar)*
- H_1 Elevation of a *(Meter)*
- H_2 Elevation of b *(Meter)*
- **K** Reduced Distance *(Meter)*
- **M** Integer part of Wave Length
- **n** Group Refractive Index
- n_0 Group Refractive Index for Standard Condition
- n_s Standard Refractive Index
- **p** Standard Error p
- P_b Barometric Pressure
- **R** Earth Radius in km
- **RI** Refractive Index
- **S** Spheroidal Distance *(Meter)*
- **t** Temperature in Celsius
- **V** Wave Velocity *(Meter per Second)*
- V_0 Velocity in Vacuum *(Meter per Second)*
- Δt Time Taken
- ΔT Temperature Change
- $\delta\lambda$ Fraction of Wavelength *(Meter)*
- λ Wavelength *(Meter)*
- σ_D Overall Standard Error
- Φ Phase Difference

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Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Pressure** in Millibar (mbar)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion

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