Important Electromagnetic Distance Measurement Formulas PDF

Formulas
Examples
with Units

List of 23
Important Electromagnetic Distance Measurement Formulas

1) EDM Corrections Formulas

1.1) Barometric Pressure given Group Refractive Index Formula

Evaluate Formula

Formula

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

Example with Units

$$6884.1177 = \left(\left(2 - 1 \right) + \left(\left(\frac{11.27 \cdot 10^{-6} \cdot 1006\,\text{mbar}}{273.15 + 98} \right) \right) \right) \cdot \left(\frac{273.15 + 98}{0.269578 \cdot \left(1.2 - 1 \right)} \right)$$

1.2) Corrected Slope Distance for Refractive Index Formula

Evaluate Formula

Formula

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

Example with Units

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

1.3) Essen and Froome Formula for Group Refractive Index Formula

Evaluate Formula

Formula

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

Example with Units

$$1.2696 = 1 + \left(77.624 \cdot 6921.213 \cdot \frac{10^{-6}}{273.15 + 98} \right) + \left(\left(\frac{0.372}{\left(273.15 + 98 \right)^2} \right) - \left(12.92 \cdot \frac{10^{-6}}{273.15 + 98} \right) \right) \cdot 1006\,\text{mbar}$$

1.4) Group Refractive Index at Standard Conditions Formula

Evaluate Formula

Formula

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

Example with Units

$$1.0003 = 1 + \left(287.604 + \left(\frac{4.8864}{20\,\text{m}^2}\right) + \left(\frac{0.068}{20\,\text{m}^4}\right)\right) \cdot 10^{-6}$$

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

Evaluate Formula

Formula

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

Example with Units

$$2.0054 = 1 + \left(\frac{0.269578 \cdot \left(1.2 - 1\right) \cdot 6921.213}{273.15 + 98}\right) - \left(\left(\frac{11.27}{273.15 + 98}\right) \cdot 10^{-6} \cdot 1006\,\text{mbar}\right)$$

1.6) IUCG Formula for Refractive Index Formula

Evaluate Formula

Formula

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

Example with Units

$$0.9987 = 1 + \left(0.000077624 \cdot \frac{6921.213}{273.15 + 98}\right) - \left(\left(\left(\frac{12.924}{273.15 + 98}\right) + \left(\frac{371900}{\left(273.15 + 98\right)^2}\right)\right) \cdot 10^{-6} \cdot 1006\,\text{mbar}\right)$$

1.7) Overall Standard Error Formula

Evaluate Formula

Formula

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

Example with Units

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

1.8) Partial Pressure of Water Vapour when Temperature Effects are Considered Formula

Evaluate Formula

Formula

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

Example with Units

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

1.9) Temperature Difference given Partial Pressure Formula

Evaluate Formula

Formula

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

Example with Units

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

1.10) Wave Velocity in Medium Formula

Evaluate Formula

Formula

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

Example with Units

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

1.11) Wave Velocity in Vacuum Formula

Evaluate Formula

Formula

$$V_0 = V \cdot RI$$

Example with Units

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

2) EDM Lines Formulas

2.1) Reduced Distance Formula

Evaluate Formula

Formula

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

Example with Units

$$49.2136\,\text{m} = 6370 \cdot \sqrt{\frac{\left(50\,\text{m} - \left(100\,\text{m} - 101\,\text{m}\right)\right) \cdot \left(50\,\text{m} + \left(100\,\text{m} - 101\,\text{m}\right)\right)}{\left(6370 + 101\,\text{m}\right) \cdot \left(6370 + 100\,\text{m}\right)}}$$

2.2) Spheroidal Distance Formula

Evaluate Formula

Formula

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

Example with Units

$$49.5001\,\text{m} = 49.5\,\text{m} + \left(\frac{49.5\,\text{m}^3}{24 \cdot 6370^2}\right)$$

2.3) Spheroidal Distance for Geodimeters Formula

Evaluate Formula

Formula

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

Example with Units

$$49.5001\,\text{m} = 49.5\,\text{m} + \left(\frac{49.5\,\text{m}^3}{38 \cdot 6370^2}\right)$$

2.4) Spheroidal Distance for Tellurometers Formula

Evaluate Formula

Formula

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

Example with Units

$$49.5001\,\text{m} = 49.5\,\text{m} + \left(\frac{49.5\,\text{m}^3}{43 \cdot 6370^2}\right)$$

3) Phase Difference Method Formulas

3.1) Double Path Measurement Formula

Evaluate Formula

Formula

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

Example with Units

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

3.2) Fraction Part of Wavelength Formula

Evaluate Formula

Formula

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

Example with Units

$$9.5493\,\text{m} = \left(\frac{3}{2 \cdot 3.1416}\right) \cdot 20\,\text{m}$$

3.3) Fraction Part of Wavelength given Double Path Measurement Formula

Evaluate Formula

Formula

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

Example with Units

$$9.6\,\text{m} = \left(649.6\,\text{m} - \left(32 \cdot 20\,\text{m}\right)\right)$$

3.4) Integer Part of Wavelength for given Double Path Formula

Evaluate Formula

Formula

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

Example with Units

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

3.5) Wavelength given Double Path Formula

Evaluate Formula

Formula

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

Example with Units

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

4) Pulse Method Formulas

4.1) Completion Time for given Distance of Path Formula

Evaluate Formula

Formula

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

Example with Units

$$0.5025 = 2 \cdot \frac{50\,\text{m}}{199\,\text{m/s}}$$

4.2) Distance Measured Formula

Evaluate Formula

Formula

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

Example with Units

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

4.3) Velocity in Medium given Distance Formula

Evaluate Formula

Formula

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

Example with Units

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

Variables used in list of Electromagnetic Distance Measurement Formulas above

- **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
- **δλ** Fraction of Wavelength *(Meter)*
- **λ** Wavelength *(Meter)*
- σ_D Overall Standard Error
- **Φ** Phase Difference

Constants, Functions, Measurements used in list of Electromagnetic Distance Measurement Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- 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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