1) Determine and/or Compute ϕ, λ, θ, x, y, k … for all known points

2) Zenith Angle Correction: $ZA = Z\angle + \text{asin}\left(\dfrac{\left[(HT - HR) - (HI - HM) \right] \cdot \sin(Z\angle)}{SD} \right)$

3) Curvature and Refraction: $Q = \dfrac{ZA + ZB - 180°}{2}$ $\qquad C + R = \dfrac{3600 \cdot Q}{SD \cdot \sin(ZA)}$

$(C + R)$ should be between 0.004" and 0.005" per foot and *must be estimated!*

Plane Zenith (both ends): $PZ = ZA - Q$ or $PZ = \dfrac{ZA - ZB + 180°}{2}$

Plane Zenith (one end): $PZ = ZA - \dfrac{(C + R) \cdot SD \cdot \sin(ZA)}{3600}$

4) Horizontal Distance (at mean elevation): $HD = SD \cdot \sin(PZ)$

Vertical Difference: $VD = SD \cdot \cos(PZ)$

Change in Elevation: $\Delta E = \dfrac{HM_A + HR_B}{2} + VD - \dfrac{HM_B + HR_A}{2}$

5) Traverse and Determine Preliminary x, y, ϕ, k

6) Scale Factor (7 places): $\dfrac{k_1 + k_2}{2}$ or $\dfrac{k_1 + 4 \cdot k_m + k_2}{6}$

Must use correction to natural scale radius if latitudes differ by 4' or more.

Sea Level Factor (7 places): $\dfrac{R}{R + E}$

R (mean radius of earth) = 20,906,000 feet
E (point elevation or mean elevation of line)

Grid Factor (7 places): $GF = \dfrac{k \cdot R}{R + E}$ (Note: $GF = SF \cdot SLF$)

Grid Distance: $GD = HD \cdot GF$

7) Second Term (2 places): $\theta' = A \cdot (x_2 - x_1) \cdot \left(y_1 - y_0 + \dfrac{y_2 - y_1}{3} \right)$ *seconds!*

$A = 2.36 \cdot 10^{-10}$ for all NAD27 zones in the United States
(Note: $Grid\,AZI = Geod.AZI - \theta + \theta'$)

Grid Angle: $\beta = \alpha - \theta'_{BS} + \theta'_{FS}$

α (geodetic angle)
β (grid angle)

8) Balance Angles, Traverse and Compass Rule Adjust