$$0 = \phi\,(x_k + \alpha r_k)$$

$$0 = \phi'(x_k + \alpha r_k)\cdot(x_k + \alpha r_k)'$$

$$0 = \phi'(x_k + \alpha r_k)\cdot(r_k)$$

$$0 = (A\cdot(x_k + \alpha r_k) - b)\cdot(r_k)$$

$$0 = (Ax_k + A\alpha r_k - b)\,r_k$$

$$0 = -(r_k + A\alpha r_k)\,r_k$$

$$0 = -r_k r_k + r_k^T A \alpha r_k r_k$$

$$0 = r_k^T r_k + r_k^T A \alpha r_k$$

$$0 = r_k^T r_k + \alpha\, r_k^T A r_k$$

$$-r_k^T \cdot r_k = \alpha \underbrace{r_k^T A r_k}_{\text{escalar}}$$

$$-\frac{r_k^T \cdot r_k}{r_k^T A r_k} = \alpha$$

$$\boxed{r_k r_k = \|r_k\|^2 = r_k^T r_k}$$