TS-SSC 90-023

Fermilab

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To: SSC 40mm File

From: J. Kerby

Subject: Center Offset of Outside Radius of 40mm Ovalized Collars

The calculation of the desired offset and charge in radius for the outside dimension of the oval collars used with vertically split, 40mm SSC dipole magnets is described.

Because of the vertically split yoke, the stretching of the skin provides support to the collar assembly for increased resistance to excitation loads. To ensure collar/yoke contact at all times at the horizontal plane, the collar design has been modified to provide an interference fit with the yoke at the horizontal, while a clearance between the collar and yoke is maintained at the vertical symmetry plane.

Due to the shaving of the collar in the key region, the collar/yoke interference of 0.006" cannot be achieved for Y less than approximately 0.4 inches. (see Figure 1). A simple means, for approximating the collar shape is to offset the geometry radius center (either along the X or Y axes), and modify the radius accordingly. To ensure that the load applied is mainly horizontal, the nominal cross-over between the round yoke ID and the oval collar OD has been chosen at $\alpha = 30°$.

For a vertical offset (Figure 2), assuming an interference at Y = 0.5" of 6 mils, the necessary equations are:

at 30° $:(R+DR)^2 = (X_1)^2 + (Y_1 + O)^2$

at Y = 0.5 $:(R+DR)^2 = (X_2 + I)^2 + (Y_2 + O)^2$

where

R = nominal yoke IR, 2.181"
I = desired interference, 0.006"
X_1, Y_1, are yoke coordinate @α = 30°
X_2, Y_2, are yoke coordinates for Y = 0.5

Equating and solving for O, DR (within tolerances)
O = 0.023", DR = 0.0115"

Another means of creating a curve through these two points is to offset the center in the X-direction (Figure 3). Rewriting the equations,

at 30° $:(R-DR)^2 = (X_1 - O)^2 + (Y_1)^2$

at Y = 0.5 $:(R-DR)^2 = (X_2 - O + I)^2 + (Y_2)^2$

solving, O = 0.050", and DR = 0.042"

The Y offset method provides the required clearance without removing an excessive amount of collar material. Some X, Y coordinates for this geometry, all in inches.

Y	Xcollar	Xyoke	(α)
.5"	2.129"	2.123"	13.25°
.6	2.102	2.097	15.97
.7	2.070	2.066	18.72
.8	2.032	2.029	21.52
.9	1.989	1.987	24.37
1.0	1.939	1.938	27.29
1.1	1.883	1.883	30.29

A 0.0115" clearance exists on the radius at the collar/yoke interface on the vertical symmetry plane.

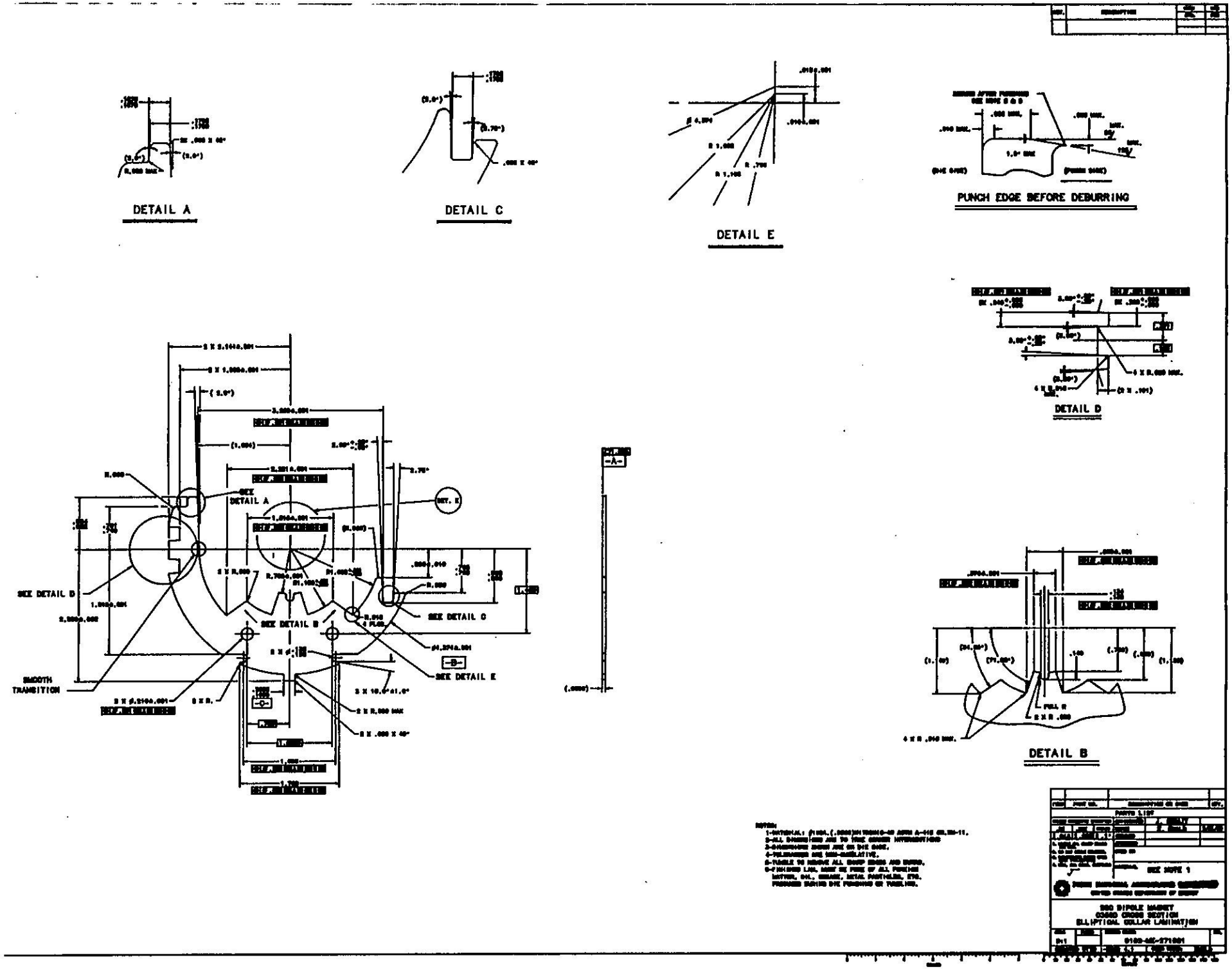


Figure 1. Ovalized Collar Preliminary Design

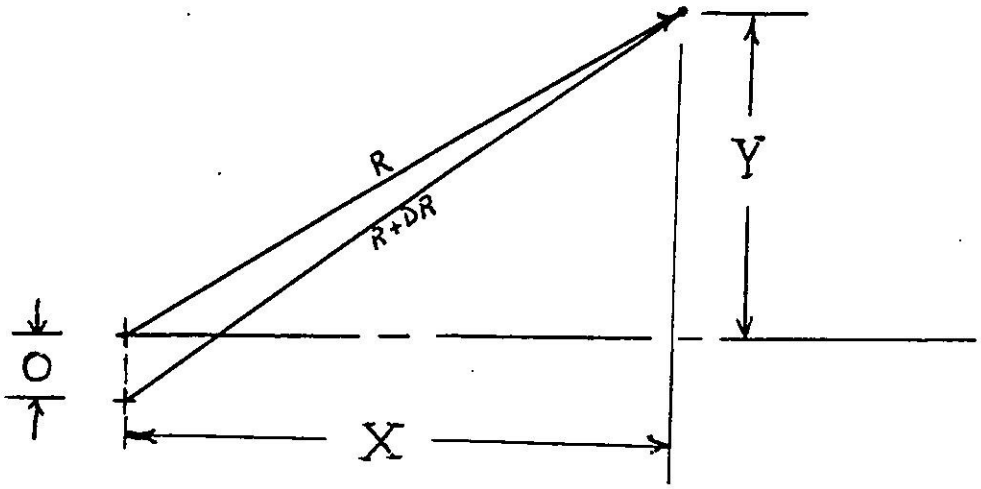


Figure 2. Vertical Center Offset

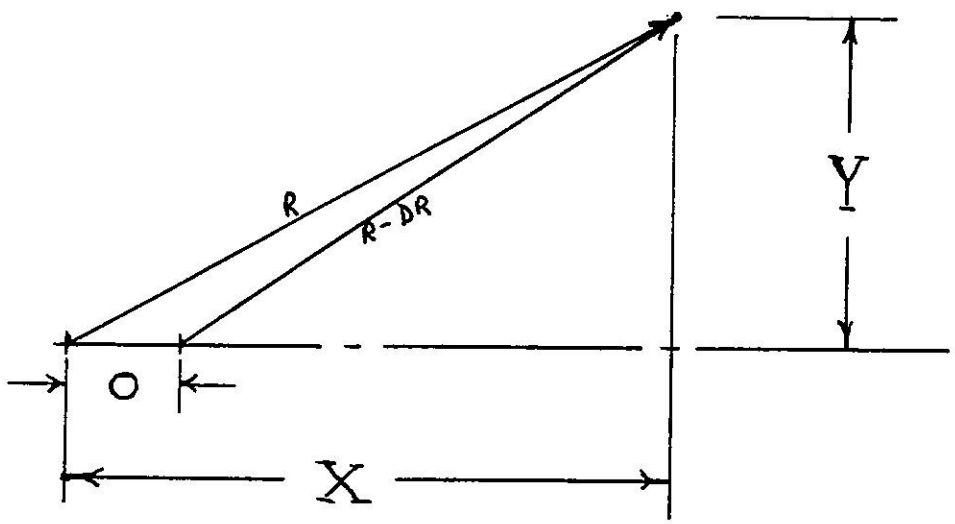
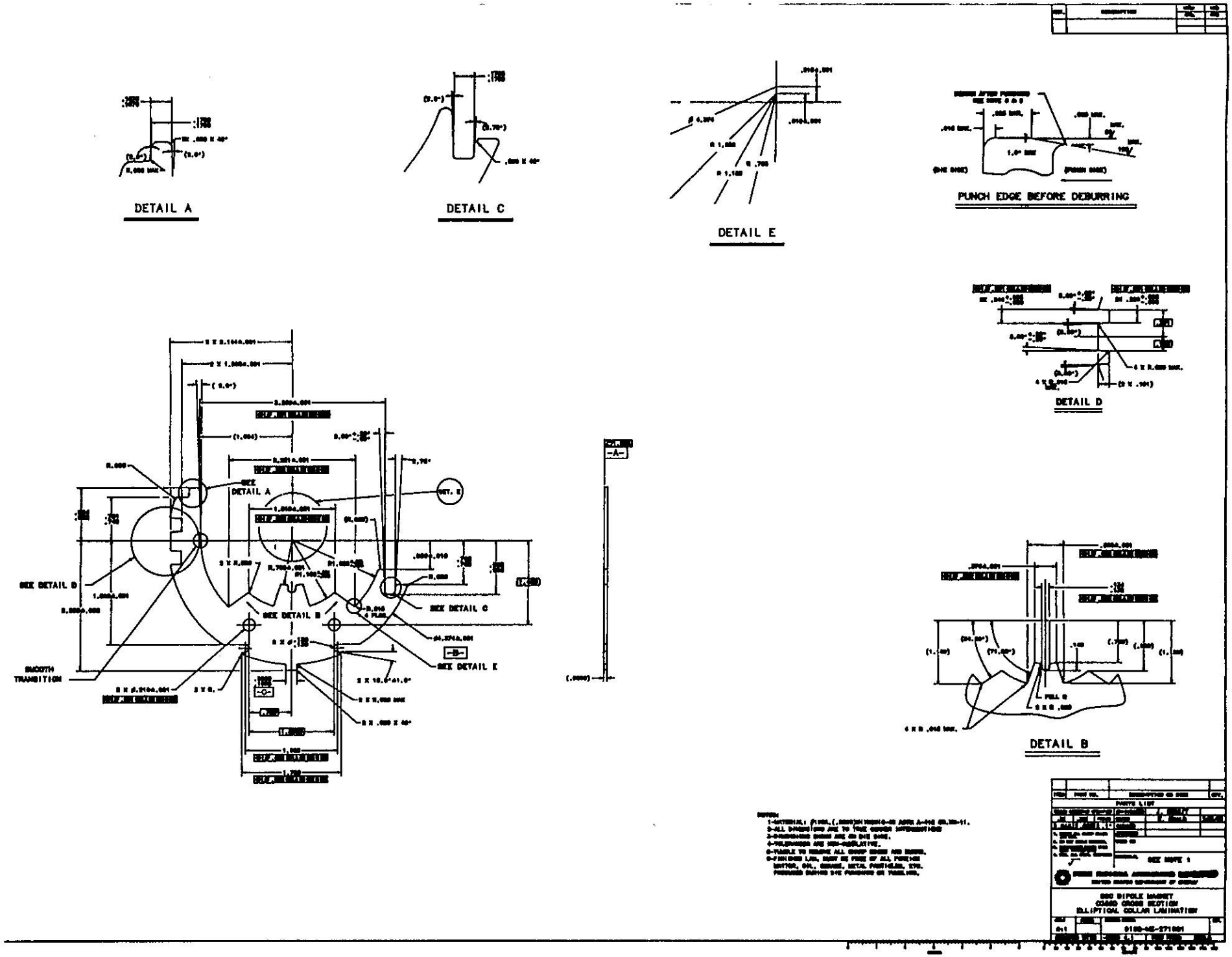


Figure 3. Horizontal Center Offset



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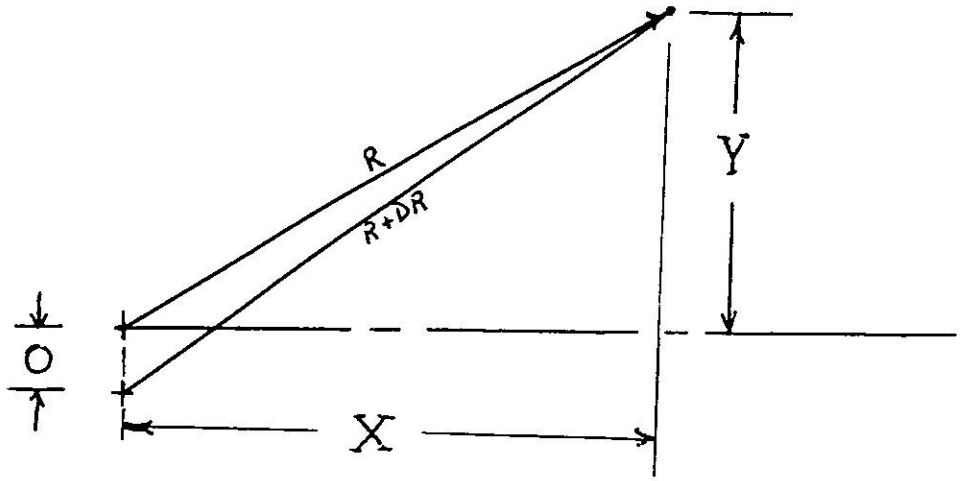
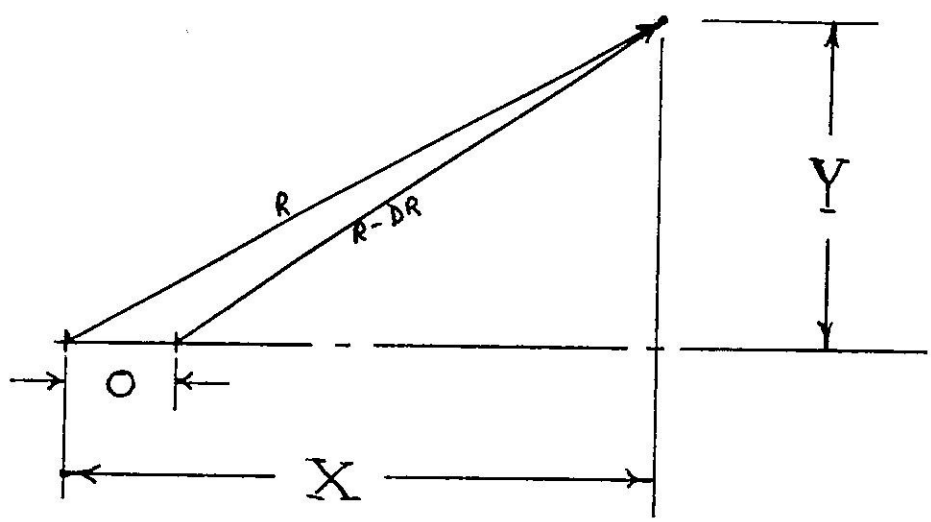


Figure 2. Vertical Center Offset



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