The transformation for the correction term $\Delta H = H - H_2$ for $1/\rho = 0$:

$$
\begin{aligned}
\Delta H &= -\sqrt{p^2 - (p_x - a_c)^2 - (p_y - a_y)^2} + p - \frac{(p_x - a_x)^2}{2p} - \frac{(p_y - a_y)^2}{2p} \\
&= p - p_z - \frac{(p_x - a_x)^2}{2p} - \frac{(p_y - a_y)^2}{2p}, \\
a_x &= -\frac{B_z}{2} y, \\
a_y &= \frac{B_z}{2} x,
\end{aligned}
$$

is written as

$$
\begin{aligned}
x &= x_0 + \Delta x, \\
y &= y_0 + \Delta y, \\
p_x &= p_{x0} + \frac{B_z}{2} \Delta y, \\
p_y &= p_{y0} - \frac{B_z}{2} \Delta x,
\end{aligned}
$$

where

$$
\begin{aligned}
\Delta x &= \left(p_{x0} + \frac{B_z}{2} y_0\right) \sin w\ell - \left(p_{y0} - \frac{B_z}{2} x_0\right)(\cos w\ell - 1), \\
\Delta y &= \left(p_{x0} + \frac{B_z}{2} y_0\right)(\cos w\ell - 1) + \left(p_{y0} - \frac{B_z}{2} x_0\right) \sin w\ell, \\
w &= \frac{B_z(p - p_z)}{p p_z}.
\end{aligned}
$$

The longitudinal coordinate is transformed as:

$$
z = z_0 + \left(\frac{3}{2} - \frac{p}{p_z} - \frac{p_z^2}{2p^2} + \Delta v\right) \ell .
$$