

```
syms d1 d2 d4 d5 l1 l3 l4 mu mu0 CC PR lc
%syms NI(d2,l4,CC,PC)
d3 = d4 + 3E-3;
Acoil = 0.5 * l4 * (d2 - d3)
```

Acoil =

$$-\frac{l_4 \left(d_4 - d_2 + \frac{3}{1000} \right)}{2}$$

```
var3 = double(subs(Acoil,[d2,d4,l4],[26E-3,8E-3,25E-3]))
```

var3 = 1.8750e-04

```
NI = Acoil * CC * PR
```

NI =

$$-\frac{CC \, PR \, l_4 \left(d_4 - d_2 + \frac{3}{1000} \right)}{2}$$

```
var2 = double(subs(NI,[CC,PR,d2,d4,l4],[10E6,0.7,26E-3,8E-3,25E-3]))
```

var2 = 1.3125e+03

$$R_{vertical_in} = \frac{l_a - l_c}{\mu \cdot S_2} + \frac{l_c}{\mu_0 \cdot S_2}$$

```
l2 = l4 + 6E-3
```

l2 =

$$l_4 + \frac{3}{500}$$

```
la = 0.5 * (l1 + l3) + l2
```

la =

$$\frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}$$

```
lb = 0.5 * (0.5 * (d1 + d2) - d5)
```

lb =

$$\frac{d_1}{4} + \frac{d_2}{4} - \frac{d_5}{2}$$

```
S1 = 0.25 * (d1^2 - d2^2)
```

S1 =

$$\frac{d_1^2}{4} - \frac{d_2^2}{4}$$

```
S2 = 0.25 * pi * (d4^2 - d5^2)
```

$$S2 =$$

$$\frac{\pi (d_4^2 - d_5^2)}{4}$$

$$S3 = 0.5 * \pi * l1 * lb$$

$$S3 =$$

$$\frac{\pi l_1 \left(\frac{d_1}{4} + \frac{d_2}{4} - \frac{d_5}{2} \right)}{2}$$

$$S4 = 0.5 * \pi * l3 * lb$$

$$S4 =$$

$$\frac{\pi l_3 \left(\frac{d_1}{4} + \frac{d_2}{4} - \frac{d_5}{2} \right)}{2}$$

$$R_{vert_in} = (la - lc) / (\mu * S2) + lc / (\mu_0 * S2)$$

$$R_{vert_in} =$$

$$\frac{4 \left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 - lc + \frac{3}{500} \right)}{\mu \pi (d_4^2 - d_5^2)} + \frac{4 lc}{\mu_0 \pi (d_4^2 - d_5^2)}$$

$$R_{vertical_out} = \frac{la}{\mu \cdot S_1}$$

$$R_{vert_out} = la / (\mu * S1)$$

$$R_{vert_out} =$$

$$\frac{\frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}}{\mu \left(\frac{d_1^2}{4} - \frac{d_2^2}{4} \right)}$$

$$R_{horizontal_top} = R_{horizontal_bottom} = \frac{lb}{\mu \cdot S_3}$$

$$R_{hor_top} = lb / (\mu * S3)$$

$$R_{hor_top} =$$

$$\frac{2}{l_1 \mu \pi}$$

$$R_{hor_bot} = lb / (\mu * S4)$$

$$R_{hor_bot} =$$

$$\frac{2}{l_3 \mu \pi}$$

$$R_{total} = R_{vert_in} + R_{vert_out} + R_{hor_top} + R_{hor_bot}$$

$$R_{total} =$$

$$\frac{\frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}}{\mu \left(\frac{d_1^2}{4} - \frac{d_2^2}{4} \right)} + \frac{2}{l_1 \mu \pi} + \frac{2}{l_3 \mu \pi} + \frac{4 \left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 - l_c + \frac{3}{500} \right)}{\mu \pi \sigma_1} + \frac{4 l_c}{\mu_0 \pi \sigma_1}$$

where

$$\sigma_1 = d_4^2 - d_5^2$$

$$\phi = NI / R_{total}$$

$$\phi =$$

$$- \frac{CC \cdot PR \cdot l_4 \left(d_4 - d_2 + \frac{3}{1000} \right)}{2 \left(\frac{\frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}}{\mu \left(\frac{d_1^2}{4} - \frac{d_2^2}{4} \right)} + \frac{2}{l_1 \mu \pi} + \frac{2}{l_3 \mu \pi} + \frac{4 \left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 - l_c + \frac{3}{500} \right)}{\mu \pi \sigma_1} + \frac{4 l_c}{\mu_0 \pi \sigma_1} \right)}$$

where

$$\sigma_1 = d_4^2 - d_5^2$$

$$\text{var4} = \text{double}(\text{subs}(\phi, [CC, PR, d1, d2, d4, d5, l1, l3, l4, lc, \mu, \mu_0], [10E6, 0.7, 30E-3, 26E-3, 8E-3, 0E-3, 20E-3, 1.25E-6, 4\pi \times 10^{-7}]))$$

$$\text{var4} = 1.3808e-04$$

$$F_{mag} = 0.5 * \phi^2 / (\mu_0 * S_2)$$

$$F_{mag} =$$

$$\frac{CC^2 \cdot PR^2 \cdot l_4^2 \left(d_4 - d_2 + \frac{3}{1000} \right)^2}{2 \mu_0 \pi \sigma_1 \left(\frac{\frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}}{\mu \left(\frac{d_1^2}{4} - \frac{d_2^2}{4} \right)} + \frac{2}{l_1 \mu \pi} + \frac{2}{l_3 \mu \pi} + \frac{4 \left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 - l_c + \frac{3}{500} \right)}{\mu \pi \sigma_1} + \frac{4 l_c}{\mu_0 \pi \sigma_1} \right)^2}$$

where

$$\sigma_1 = d_4^2 - d_5^2$$

ans = 150.9201

```
ans = 119.1669
```

```
phi_res = 1.3808e-04
```

S2_res = 5.0265e-05

ans = 150.9201

dMu

```
dFmag_dmu = diff(Fmag,mu)
```

$$dF_{mag_dmu} =$$

$$\frac{\text{CC}^2 \text{PR}^2 l_4^2 \left(d_4 - d_2 + \frac{3}{1000}\right)^2 \left(\frac{\sigma_4}{\mu^2 \sigma_3} + \frac{2}{l_1 \mu^2 \pi} + \frac{2}{l_3 \mu^2 \pi} + \frac{\sigma_2}{\mu^2 \pi \sigma_1}\right)}{\mu_0 \pi \sigma_1 \left(\frac{\sigma_4}{\mu \sigma_3} + \frac{2}{l_1 \mu \pi} + \frac{2}{l_3 \mu \pi} + \frac{\sigma_2}{\mu \pi \sigma_1} + \frac{4 \text{lc}}{\mu_0 \pi \sigma_1}\right)^3}$$

where

$$\sigma_1 = d_4^2 - d_5^2$$

$$\sigma_2 = 4 \left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 - 1c + \frac{3}{500} \right)$$

$$\sigma_3 = \frac{d_1^2}{4} - \frac{d_2^2}{4}$$

$$\sigma_4 = \frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}$$

dLc

```
dFmag_dlc = diff(Fmag,lc)
```

$$dF_{mag_dlc} =$$

$$\frac{CC^2 PR^2 l_4^2 \left(\frac{4}{\mu \pi \sigma_1} - \frac{4}{\mu_0 \pi \sigma_1} \right) \left(d_4 - d_2 + \frac{3}{1000} \right)^2}{\mu_0 \pi \sigma_1 \left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500} + \frac{2}{l_1 \mu \pi} + \frac{2}{l_3 \mu \pi} + \frac{4 \left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 - lc + \frac{3}{500} \right)}{\mu \pi \sigma_1} + \frac{4 lc}{\mu_0 \pi \sigma_1} \right)^3}$$

where

$$\sigma_1 = d_4^2 - d_5^2$$

dd1

```
dFmag_dd1 = diff(Fmag,d1)
```

dFmag_dd1 =

$$\frac{CC^2 PR^2 d_1 l_4^2 \left(d_4 - d_2 + \frac{3}{1000} \right)^2 \sigma_3}{2 \mu \mu_0 \pi \sigma_1 \sigma_2^2 \left(\frac{\sigma_3}{\mu \sigma_2} + \frac{2}{l_1 \mu \pi} + \frac{2}{l_3 \mu \pi} + \frac{4 \left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 - lc + \frac{3}{500} \right)}{\mu \pi \sigma_1} + \frac{4 lc}{\mu_0 \pi \sigma_1} \right)^3}$$

where

$$\sigma_1 = d_4^2 - d_5^2$$

$$\sigma_2 = \frac{d_1^2}{4} - \frac{d_2^2}{4}$$

$$\sigma_3 = \frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}$$

dd2

```
dFmag_dd2 = diff(Fmag,2)
```

dFmag_dd2 =

$$\frac{3 \text{CC}^2 \text{PR}^2 l_4^2 \sigma_1 \left(\frac{\sigma_5}{\mu^2 \sigma_4} + \frac{2}{l_1 \mu^2 \pi} + \frac{2}{l_3 \mu^2 \pi} + \frac{4 \sigma_6}{\mu^2 \pi \sigma_3} \right)^2}{\mu_0 \pi \sigma_3 \sigma_2^4} - \frac{\text{CC}^2 \text{PR}^2 l_4^2 \sigma_1 \left(\frac{2 \sigma_5}{\mu^3 \sigma_4} + \frac{4}{l_1 \mu^3 \pi} + \frac{4}{l_3 \mu^3 \pi} + \frac{8 \sigma_6}{\mu^3 \pi \sigma_3} \right)}{\mu_0 \pi \sigma_3 \sigma_2^3}$$

where

$$\sigma_1 = \left(d_4 - d_2 + \frac{3}{1000} \right)^2$$

$$\sigma_2 = \frac{\sigma_5}{\mu \sigma_4} + \frac{2}{l_1 \mu \pi} + \frac{2}{l_3 \mu \pi} + \frac{4 \sigma_6}{\mu \pi \sigma_3} + \frac{4 \text{lc}}{\mu_0 \pi \sigma_3}$$

$$\sigma_3 = d_4^2 - d_5^2$$

$$\sigma_4 = \frac{d_1^2}{4} - \frac{d_2^2}{4}$$

$$\sigma_5 = \frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}$$

$$\sigma_6 = \frac{l_1}{2} + \frac{l_3}{2} + l_4 - \text{lc} + \frac{3}{500}$$

dd4

```
dFmag_dd4 = diff(Fmag,d4)
```

```
dFmag_dd4 =
```

$$\frac{CC^2 PR^2 l_4^2 \left(2 d_4 - 2 d_2 + \frac{3}{500}\right)}{2 \mu_0 \pi \sigma_3 \sigma_2^2} - \frac{CC^2 PR^2 d_4 l_4^2 \sigma_1}{\mu_0 \pi \sigma_3^2 \sigma_2^2} + \frac{CC^2 PR^2 l_4^2 \left(\frac{8 d_4 \sigma_4}{\mu \pi \sigma_3^2} + \frac{8 d_4 lc}{\mu_0 \pi \sigma_3^2}\right) \sigma_1}{\mu_0 \pi \sigma_3 \sigma_2^3}$$

where

$$\sigma_1 = \left(d_4 - d_2 + \frac{3}{1000}\right)^2$$

$$\sigma_2 = \frac{\frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}}{\mu \left(\frac{d_1^2}{4} - \frac{d_2^2}{4}\right)} + \frac{2}{l_1 \mu \pi} + \frac{2}{l_3 \mu \pi} + \frac{4 \sigma_4}{\mu \pi \sigma_3} + \frac{4 lc}{\mu_0 \pi \sigma_3}$$

$$\sigma_3 = d_4^2 - d_5^2$$

$$\sigma_4 = \frac{l_1}{2} + \frac{l_3}{2} + l_4 - lc + \frac{3}{500}$$

dd5

$$dFmag_dd5 = \text{diff}(Fmag, d5)$$

$$dFmag_dd5 =$$

$$\frac{CC^2 PR^2 d_5 l_4^2 \sigma_1}{\mu_0 \pi \sigma_3^2 \sigma_2^2} - \frac{CC^2 PR^2 l_4^2 \left(\frac{8 d_5 \sigma_4}{\mu \pi \sigma_3^2} + \frac{8 d_5 lc}{\mu_0 \pi \sigma_3^2}\right) \sigma_1}{\mu_0 \pi \sigma_3 \sigma_2^3}$$

where

$$\sigma_1 = \left(d_4 - d_2 + \frac{3}{1000}\right)^2$$

$$\sigma_2 = \frac{\frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}}{\mu \left(\frac{d_1^2}{4} - \frac{d_2^2}{4}\right)} + \frac{2}{l_1 \mu \pi} + \frac{2}{l_3 \mu \pi} + \frac{4 \sigma_4}{\mu \pi \sigma_3} + \frac{4 lc}{\mu_0 \pi \sigma_3}$$

$$\sigma_3 = d_4^2 - d_5^2$$

$$\sigma_4 = \frac{l_1}{2} + \frac{l_3}{2} + l_4 - lc + \frac{3}{500}$$

dl1

```
dFmag_dl1 = diff(Fmag,l1)
```

dFmag_dl1 =

$$-\frac{CC^2 PR^2 l_4^2 \left(d_4 - d_2 + \frac{3}{1000}\right)^2 \left(\frac{1}{2\mu\sigma_2} + \frac{2}{\mu\pi\sigma_1} - \frac{2}{l_1^2\mu\pi}\right)}{\mu_0\pi\sigma_1 \left(\frac{\frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}}{\mu\sigma_2} + \frac{2}{l_1\mu\pi} + \frac{2}{l_3\mu\pi} + \frac{4\left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 - lc + \frac{3}{500}\right)}{\mu\pi\sigma_1} + \frac{4lc}{\mu_0\pi\sigma_1}\right)^3}$$

where

$$\sigma_1 = d_4^2 - d_5^2$$

$$\sigma_2 = \frac{d_1^2}{4} - \frac{d_2^2}{4}$$

dl3

```
dFmag_dl3 = diff(Fmag,l3)
```

dFmag_dl3 =

$$-\frac{CC^2 PR^2 l_4^2 \left(d_4 - d_2 + \frac{3}{1000}\right)^2 \left(\frac{1}{2\mu\sigma_2} + \frac{2}{\mu\pi\sigma_1} - \frac{2}{l_3^2\mu\pi}\right)}{\mu_0\pi\sigma_1 \left(\frac{\frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}}{\mu\sigma_2} + \frac{2}{l_1\mu\pi} + \frac{2}{l_3\mu\pi} + \frac{4\left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 - lc + \frac{3}{500}\right)}{\mu\pi\sigma_1} + \frac{4lc}{\mu_0\pi\sigma_1}\right)^3}$$

where

$$\sigma_1 = d_4^2 - d_5^2$$

$$\sigma_2 = \frac{d_1^2}{4} - \frac{d_2^2}{4}$$

dl4

```
dFmag_dl4 = diff(Fmag,l4)
```

dFmag_dl4 =

$$\frac{CC^2 PR^2 l_4 \left(d_4 - d_2 + \frac{3}{1000}\right)^2}{\mu_0 \pi \sigma_2 \sigma_1^2} - \frac{CC^2 PR^2 l_4^2 \left(\frac{1}{\mu \left(\frac{d_1^2}{4} - \frac{d_2^2}{4}\right)} + \frac{4}{\mu \pi \sigma_2}\right) \left(d_4 - d_2 + \frac{3}{1000}\right)^2}{\mu_0 \pi \sigma_2 \sigma_1^3}$$

where

$$\sigma_1 = \frac{\frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}}{\mu \left(\frac{d_1^2}{4} - \frac{d_2^2}{4}\right)} + \frac{2}{l_1 \mu \pi} + \frac{2}{l_3 \mu \pi} + \frac{4 \left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 - lc + \frac{3}{500}\right)}{\mu \pi \sigma_2} + \frac{4 lc}{\mu_0 \pi \sigma_2}$$

$$\sigma_2 = d_4^2 - d_5^2$$

dCC

$$dFmag_dCC = \text{diff}(Fmag, CC)$$

$$dFmag_dCC =$$

$$\frac{CC PR^2 l_4^2 \left(d_4 - d_2 + \frac{3}{1000}\right)^2}{\mu_0 \pi \sigma_1 \left(\frac{\frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500}}{\mu \left(\frac{d_1^2}{4} - \frac{d_2^2}{4}\right)} + \frac{2}{l_1 \mu \pi} + \frac{2}{l_3 \mu \pi} + \frac{4 \left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 - lc + \frac{3}{500}\right)}{\mu \pi \sigma_1} + \frac{4 lc}{\mu_0 \pi \sigma_1}\right)^2}$$

where

$$\sigma_1 = d_4^2 - d_5^2$$

dPR

$$dFmag_dPR = \text{diff}(Fmag, PR)$$

$$dFmag_dPR =$$

$$\frac{CC^2 PR l_4^2 \left(d_4 - d_2 + \frac{3}{1000} \right)^2}{\mu_0 \pi \sigma_1 \left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 + \frac{3}{500} + \frac{2}{l_1 \mu \pi} + \frac{2}{l_3 \mu \pi} + \frac{4 \left(\frac{l_1}{2} + \frac{l_3}{2} + l_4 - lc + \frac{3}{500} \right)}{\mu \pi \sigma_1} + \frac{4 lc}{\mu_0 \pi \sigma_1} \right)^2}$$

where

$$\sigma_1 = d_4^2 - d_5^2$$

```
density6061 = 2700;
density430F = 7800;
densityCopper = 8960;
W_copper = PR * 0.25 * l4 * (d2^2 - d3^2) * densityCopper
```

W_copper =

$$-2240 PR l_4 \left(\left(d_4 + \frac{3}{1000} \right)^2 - d_2^2 \right)$$

```
double(subs(W_copper,[PR,d2,d4,l4],[0.7,27E-3,8E-3,25E-3]))
```

ans = 0.0238

```
W_coilformer = 0.25 * (d2^2 * (l2 - l4) + d3^2 * l4 - d4^2 * l2) * density6061
```

W_coilformer =

$$\frac{81 d_2^2}{20} - 675 d_4^2 \left(l_4 + \frac{3}{500} \right) + 675 l_4 \left(d_4 + \frac{3}{1000} \right)^2$$

```
W_shell = 0.25 * (d1^2 - d2^2) * l2 * density430F
```

W_shell =

$$7800 \left(\frac{d_1^2}{4} - \frac{d_2^2}{4} \right) \left(l_4 + \frac{3}{500} \right)$$

```
W_magtop = 0.25 * ((d1^2 - d5^2) * l1 + (d4^2 - d5^2) * l2 * 0.5) * density430F
```

W_magtop =

$$1950 l_1 (d_1^2 - d_5^2) + 975 (d_4^2 - d_5^2) \left(l_4 + \frac{3}{500} \right)$$

```
W_magbot = 0.25 * (d1^2 - d5^2) * l3 * density430F
```

W_magbot =

$$7800 l_3 \left(\frac{d_1^2}{4} - \frac{d_5^2}{4} \right)$$

$$W_{\text{magpintle}} = 0.25 * (d_4^2 - d_5^2) * 12 * 0.5 * \text{density430F}$$

$$W_{\text{magpintle}} =$$

$$3900 \left(\frac{d_4^2}{4} - \frac{d_5^2}{4} \right) \left(l_4 + \frac{3}{500} \right)$$

$$\text{Weight} = W_{\text{copper}} + W_{\text{coilformer}} + W_{\text{shell}} + W_{\text{magtop}} + W_{\text{magbot}} + W_{\text{magpintle}}$$

$$\text{Weight} =$$

$$1950 l_1 (d_1^2 - d_5^2) + 7800 l_3 \left(\frac{d_1^2}{4} - \frac{d_5^2}{4} \right) + 975 (d_4^2 - d_5^2) \left(l_4 + \frac{3}{500} \right) + \frac{81 d_2^2}{20} + 7800 \left(\frac{d_1^2}{4} - \frac{d_2^2}{4} \right) \left(l_4 + \frac{3}{500} \right)$$

where

$$\sigma_1 = \left(d_4 + \frac{3}{1000} \right)^2$$

$$\text{double}(\text{subs}(\text{Weight}, [\text{PR}, d_1, d_2, d_4, d_5, l_1, l_3, l_4], [0.8, 30\text{E-}3, 27\text{E-}3, 8\text{E-}3, 0\text{E-}3, 3\text{E-}3, 3\text{E-}3, 25\text{E-}3]))$$

$$\text{ans} = 0.0556$$

dPR

$$d\text{Weight}_{\text{dcop}} = \text{diff}(\text{Weight}, \text{PR})$$

$$d\text{Weight}_{\text{dcop}} =$$

$$-2240 l_4 \left(\left(d_4 + \frac{3}{1000} \right)^2 - d_2^2 \right)$$

dd1

$$d\text{Weight}_{\text{dd1}} = \text{diff}(\text{Weight}, d_1)$$

$$d\text{Weight}_{\text{dd1}} =$$

$$3900 d_1 l_1 + 3900 d_1 l_3 + 3900 d_1 \left(l_4 + \frac{3}{500} \right)$$

dd2

$$d\text{Weight}_{\text{dd2}} = \text{diff}(\text{Weight}, d_2)$$

$$d\text{Weight}_{\text{dd2}} =$$

$$\frac{81 d_2}{10} - 3900 d_2 \left(l_4 + \frac{3}{500} \right) + 4480 \text{PR} d_2 l_4$$

dd4

$$d\text{Weight}_{\text{dd4}} = \text{diff}(\text{Weight}, d_4)$$

$$d\text{Weight}_{\text{dd4}} =$$

$$2550 d_4 \left(l_4 + \frac{3}{500} \right) + 675 l_4 \left(2 d_4 + \frac{3}{500} \right) - 2240 \text{ PR } l_4 \left(2 d_4 + \frac{3}{500} \right)$$

dd5

$$\text{dWeight_dd1} = \text{diff}(\text{Weight}, d5)$$

$$\text{dWeight_dd1} =$$

$$-3900 d_5 l_1 - 3900 d_5 l_3 - 3900 d_5 \left(l_4 + \frac{3}{500} \right)$$

dl1

$$\text{dWeight_dl1} = \text{diff}(\text{Weight}, l1)$$

$$\text{dWeight_dl1} = 1950 d_1^2 - 1950 d_5^2$$

dl3

$$\text{dWeight_dl3} = \text{diff}(\text{Weight}, l3)$$

$$\text{dWeight_dl3} = 1950 d_1^2 - 1950 d_5^2$$

dl4

$$\text{dWeight_dl4} = \text{diff}(\text{Weight}, l4)$$

$$\text{dWeight_dl4} =$$

$$675 \left(d_4 + \frac{3}{1000} \right)^2 - 2240 \text{ PR} \left(\left(d_4 + \frac{3}{1000} \right)^2 - d_2^2 \right) + 1950 d_1^2 - 1950 d_2^2 + 1275 d_4^2 - 1950 d_5^2$$