Matrixes of DL-60HD

Stiffness Matrix

$$\begin{pmatrix} C_{11} & C_{12} & C_{13} & 0 & 0 & 0 \\ C_{12} & C_{11} & C_{13} & 0 & 0 & 0 \\ C_{13} & C_{13} & C_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & C_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & C_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & C_{66} \end{pmatrix}^{E} = \begin{pmatrix} 15.8 & 10.8 & 11.1 & 0 & 0 & 0 \\ 10.8 & 15.8 & 11.1 & 0 & 0 & 0 \\ 11.1 & 11.1 & 14.0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 3.3 & 0 & 0 \\ 0 & 0 & 0 & 0 & 3.3 & 0 \\ 0 & 0 & 0 & 0 & 0 & 2.5 \end{pmatrix}^{E} 10^{10}\, N/m^2$$

$$\begin{pmatrix} C_{11} & C_{12} & C_{13} & 0 & 0 & 0 \\ C_{12} & C_{11} & C_{13} & 0 & 0 & 0 \\ C_{13} & C_{13} & C_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & C_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & C_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & C_{66} \end{pmatrix}^{D} = \begin{pmatrix} 18.4 & 13.4 & 10.7 & 0 & 0 & 0 \\ 13.4 & 18.4 & 10.7 & 0 & 0 & 0 \\ 10.7 & 10.7 & 17.7 & 0 & 0 & 0 \\ 0 & 0 & 0 & 7.6 & 0 & 0 \\ 0 & 0 & 0 & 0 & 7.6 & 0 \\ 0 & 0 & 0 & 0 & 0 & 2.5 \end{pmatrix}^{D} 10^{10}\, N/m^2$$

Elastic Matrix

$$\begin{pmatrix} S_{11} & S_{12} & S_{13} & 0 & 0 & 0 \\ S_{12} & S_{11} & S_{13} & 0 & 0 & 0 \\ S_{13} & S_{13} & S_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & S_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & S_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & S_{66} \end{pmatrix}^{E} = \begin{pmatrix} 15.6 & -4.5 & -8.8 & 0 & 0 & 0 \\ -4.5 & 15.6 & -8.8 & 0 & 0 & 0 \\ -8.8 & -8.8 & 21.1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 30.1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 30.1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 40.2 \end{pmatrix}^{E} 10^{-12}\, m^2/N$$

$$\begin{pmatrix} S_{11} & S_{12} & S_{13} & 0 & 0 & 0 \\ S_{12} & S_{11} & S_{13} & 0 & 0 & 0 \\ S_{13} & S_{13} & S_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & S_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & S_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & S_{66} \end{pmatrix}^{D} = \begin{pmatrix} 12.7 & -7.4 & -3.2 & 0 & 0 & 0 \\ -7.4 & 12.7 & -3.2 & 0 & 0 & 0 \\ -3.2 & -3.2 & 9.5 & 0 & 0 & 0 \\ 0 & 0 & 0 & 13.2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 13.2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 40.2 \end{pmatrix}^{D} 10^{-12}\, m^2/N$$

Matrix of Clamp Dielectric Constant

$$\begin{pmatrix} \varepsilon_{11} & 0 & 0 \\ 0 & \varepsilon_{11} & 0 \\ 0 & 0 & \varepsilon_{33} \end{pmatrix}^{S} = \begin{pmatrix} 2010 & 0 & 0 \\ 0 & 2010 & 0 \\ 0 & 0 & 1900 \end{pmatrix}^{S}$$

Matrix of Free Dielectric Constant

$$\begin{pmatrix} \varepsilon_{11} & 0 & 0 \\ 0 & \varepsilon_{11} & 0 \\ 0 & 0 & \varepsilon_{33} \end{pmatrix}^{T} = \begin{pmatrix} 4600 & 0 & 0 \\ 0 & 4600 & 0 \\ 0 & 0 & 5500 \end{pmatrix}^{T}$$

Piezoelectric Constant Matrixes

$$\begin{pmatrix} 0 & 0 & 0 & 0 & d_{15} & 0 \\ 0 & 0 & 0 & d_{24} & 0 & 0 \\ d_{31} & d_{31} & d_{33} & 0 & 0 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 & 0 & 830 & 0 \\ 0 & 0 & 0 & 830 & 0 & 0 \\ -365 & -365 & 750 & 0 & 0 & 0 \end{pmatrix} 10^{-12} C/N$$

$$\begin{pmatrix} 0 & 0 & 0 & 0 & g_{15} & 0 \\ 0 & 0 & 0 & g_{24} & 0 & 0 \\ g_{31} & g_{31} & g_{33} & 0 & 0 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 & 0 & 20.4 & 0 \\ 0 & 0 & 0 & 20.4 & 0 & 0 \\ -7.5 & -7.5 & 15.4 & 0 & 0 & 0 \end{pmatrix} 10^{-3} Vm/N$$

$$\begin{pmatrix} 0 & 0 & 0 & 0 & e_{15} & 0 \\ 0 & 0 & 0 & e_{24} & 0 & 0 \\ e_{31} & e_{31} & e_{33} & 0 & 0 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 & 0 & 27.4 & 0 \\ 0 & 0 & 0 & 27.4 & 0 & 0 \\ -13.8 & -13.8 & 24.0 & 0 & 0 & 0 \end{pmatrix} C/m^{2}$$

$$\begin{pmatrix} 0 & 0 & 0 & 0 & h_{15} & 0 \\ 0 & 0 & 0 & h_{24} & 0 & 0 \\ h_{31} & h_{31} & h_{33} & 0 & 0 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 & 0 & 15.5 & 0 \\ 0 & 0 & 0 & 15.5 & 0 & 0 \\ -7.4 & -7.4 & 11.2 & 0 & 0 & 0 \end{pmatrix} 10^{8} V/m$$