

Matrixes of DL-53HD

Stiffness Matrix

$$\begin{pmatrix} C_{11} & C_{12} & C_{13} & 0 & 0 & 0 \\ C_{12} & C_{11} & C_{13} & 0 & 0 & 0 \\ C_{13} & C_{13} & C_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & C_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & C_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & C_{66} \end{pmatrix}^E = \begin{pmatrix} 16.9 & 11.8 & 10.9 & 0 & 0 & 0 \\ 11.8 & 16.9 & 10.9 & 0 & 0 & 0 \\ 10.9 & 10.9 & 12.3 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2.7 & 0 & 0 \\ 0 & 0 & 0 & 0 & 2.7 & 0 \\ 0 & 0 & 0 & 0 & 0 & 2.5 \end{pmatrix}^E 10^{10} N/m^2$$

$$\begin{pmatrix} C_{11} & C_{12} & C_{13} & 0 & 0 & 0 \\ C_{12} & C_{11} & C_{13} & 0 & 0 & 0 \\ C_{13} & C_{13} & C_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & C_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & C_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & C_{66} \end{pmatrix}^D = \begin{pmatrix} 18.5 & 13.4 & 9.7 & 0 & 0 & 0 \\ 13.4 & 18.5 & 9.7 & 0 & 0 & 0 \\ 9.7 & 9.7 & 14.8 & 0 & 0 & 0 \\ 0 & 0 & 0 & 6.2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 6.2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 2.6 \end{pmatrix}^D 10^{10} N/m^2$$

Elastic Matrix

$$\begin{pmatrix} S_{11} & S_{12} & S_{13} & 0 & 0 & 0 \\ S_{12} & S_{11} & S_{13} & 0 & 0 & 0 \\ S_{13} & S_{13} & S_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & S_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & S_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & S_{66} \end{pmatrix}^E = \begin{pmatrix} 15.1 & -4.5 & -9.4 & 0 & 0 & 0 \\ -4.5 & 15.1 & -9.4 & 0 & 0 & 0 \\ -9.4 & -9.4 & 24.8 & 0 & 0 & 0 \\ 0 & 0 & 0 & 37.1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 37.1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 39.2 \end{pmatrix}^E 10^{-12} m^2/N$$

$$\begin{pmatrix} S_{11} & S_{12} & S_{13} & 0 & 0 & 0 \\ S_{12} & S_{11} & S_{13} & 0 & 0 & 0 \\ S_{13} & S_{13} & S_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & S_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & S_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & S_{66} \end{pmatrix}^D = \begin{pmatrix} 12.4 & -7.2 & -3.4 & 0 & 0 & 0 \\ -7.2 & 12.4 & -3.4 & 0 & 0 & 0 \\ -3.4 & -3.4 & 11.2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 16.2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 16.2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 39.2 \end{pmatrix}^D 10^{-12} m^2/N$$

Matrix of Clamp Dielectric Constant

$$\begin{pmatrix} \epsilon_{11} & 0 & 0 \\ 0 & \epsilon_{11} & 0 \\ 0 & 0 & \epsilon_{33} \end{pmatrix}^s = \begin{pmatrix} 1550 & 0 & 0 \\ 0 & 1550 & 0 \\ 0 & 0 & 1390 \end{pmatrix}^s$$

Matrix of Free Dielectric Constant

$$\begin{pmatrix} \epsilon_{11} & 0 & 0 \\ 0 & \epsilon_{11} & 0 \\ 0 & 0 & \epsilon_{33} \end{pmatrix}^T = \begin{pmatrix} 3550 & 0 & 0 \\ 0 & 3550 & 0 \\ 0 & 0 & 3850 \end{pmatrix}^T$$

Piezoelectric Constant Matrixes

$$\begin{pmatrix} 0 & 0 & 0 & 0 & d_{15} & 0 \\ 0 & 0 & 0 & d_{24} & 0 & 0 \\ d_{31} & d_{31} & d_{33} & 0 & 0 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 & 0 & 810 & 0 \\ 0 & 0 & 0 & 810 & 0 & 0 \\ -300 & -300 & 680 & 0 & 0 & 0 \end{pmatrix} 10^{-12} C/N$$

$$\begin{pmatrix} 0 & 0 & 0 & 0 & g_{15} & 0 \\ 0 & 0 & 0 & g_{24} & 0 & 0 \\ g_{31} & g_{31} & g_{33} & 0 & 0 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 & 0 & 25.8 & 0 \\ 0 & 0 & 0 & 25.8 & 0 & 0 \\ -8.8 & -8.8 & 19.9 & 0 & 0 & 0 \end{pmatrix} 10^{-3} Vm/N$$

$$\begin{pmatrix} 0 & 0 & 0 & 0 & e_{15} & 0 \\ 0 & 0 & 0 & e_{24} & 0 & 0 \\ e_{31} & e_{31} & e_{33} & 0 & 0 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 & 0 & 21.9 & 0 \\ 0 & 0 & 0 & 21.9 & 0 & 0 \\ -12.0 & -12.0 & 18.2 & 0 & 0 & 0 \end{pmatrix} C/m^2$$

$$\begin{pmatrix} 0 & 0 & 0 & 0 & h_{15} & 0 \\ 0 & 0 & 0 & h_{24} & 0 & 0 \\ h_{31} & h_{31} & h_{33} & 0 & 0 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 & 0 & 16.0 & 0 \\ 0 & 0 & 0 & 16.0 & 0 & 0 \\ -8.8 & -8.8 & 12.4 & 0 & 0 & 0 \end{pmatrix} 10^8 V/m$$