P-8A Electromechanical characteristics matrix

Stiffness coefficient matrix

$$\begin{bmatrix} C_{11}^{E} & C_{12}^{E} & C_{13}^{E} & 0 & 0 & 0 \\ C_{12}^{E} & C_{11}^{E} & C_{13}^{E} & 0 & 0 & 0 \\ C_{13}^{E} & C_{13}^{E} & C_{33}^{E} & 0 & 0 & 0 \\ 0 & 0 & 0 & C_{44}^{E} & 0 & 0 \\ 0 & 0 & 0 & 0 & C_{55}^{E} & 0 \\ 0 & 0 & 0 & 0 & 0 & C_{66}^{E} \end{bmatrix} = \begin{bmatrix} 17.4 & 10.4 & 9.9 & 0 & 0 & 0 \\ 10.4 & 17.4 & 9.9 & 0 & 0 & 0 \\ 9.9 & 9.9 & 13.3 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2.9 & 0 & 0 \\ 0 & 0 & 0 & 0 & 2.9 & 0 \\ 0 & 0 & 0 & 0 & 0 & 3.5 \end{bmatrix}^{E} 10^{10} N/m^{2}$$

$$\begin{bmatrix} C_{11}^{D} & C_{12}^{D} & C_{13}^{D} & 0 & 0 & 0 \\ C_{12}^{D} & C_{11}^{D} & C_{13}^{D} & 0 & 0 & 0 \\ C_{13}^{D} & C_{13}^{D} & C_{33}^{D} & 0 & 0 & 0 \\ 0 & 0 & 0 & C_{44}^{D} & 0 & 0 \\ 0 & 0 & 0 & 0 & C_{55}^{D} & 0 \\ 0 & 0 & 0 & 0 & 0 & C_{66}^{D} \end{bmatrix} = \begin{bmatrix} 17.7 & 10.6 & 9.1 & 0 & 0 & 0 \\ 10.6 & 17.7 & 9.1 & 0 & 0 & 0 \\ 9.1 & 9.1 & 17.4 & 0 & 0 & 0 \\ 0 & 0 & 0 & 4.7 & 0 & 0 \\ 0 & 0 & 0 & 0 & 4.7 & 0 \\ 0 & 0 & 0 & 0 & 0 & 3.5 \end{bmatrix}^{D} 10^{10} N/m^{2}$$

Elastic Flexibility Coefficient Matrix

$$\begin{bmatrix} S_{11}^{E} & S_{12}^{E} & S_{13}^{E} & 0 & 0 & 0 \\ S_{12}^{E} & S_{11}^{E} & S_{13}^{E} & 0 & 0 & 0 \\ S_{13}^{E} & S_{13}^{E} & S_{33}^{E} & 0 & 0 & 0 \\ 0 & 0 & 0 & S_{44}^{E} & 0 & 0 \\ 0 & 0 & 0 & 0 & S_{55}^{E} & 0 \\ 0 & 0 & 0 & 0 & 0 & S_{66}^{E} \end{bmatrix} = \begin{bmatrix} 10.9 & -3.3 & -5.7 & 0 & 0 & 0 \\ -3.3 & 10.9 & -5.7 & 0 & 0 & 0 \\ -5.7 & -5.7 & 15.9 & 0 & 0 & 0 \\ 0 & 0 & 0 & 34.7 & 0 & 0 \\ 0 & 0 & 0 & 0 & 34.7 & 0 \\ 0 & 0 & 0 & 0 & 0 & 28.4 \end{bmatrix}^{E} 10^{-12} m^{2}/N$$

$$\begin{bmatrix} S_{11}^{D} & S_{12}^{D} & S_{13}^{D} & 0 & 0 & 0 \\ S_{12}^{D} & S_{11}^{D} & S_{13}^{D} & 0 & 0 & 0 \\ S_{13}^{D} & S_{13}^{D} & S_{33}^{D} & 0 & 0 & 0 \\ 0 & 0 & 0 & S_{44}^{D} & 0 & 0 \\ 0 & 0 & 0 & 0 & S_{55}^{D} & 0 \\ 0 & 0 & 0 & 0 & 0 & S_{66}^{D} \end{bmatrix} = \begin{bmatrix} 9.8 & -4.4 & -3 & 0 & 0 & 0 \\ -4.4 & 9.8 & -3 & 0 & 0 & 0 \\ -3 & -3 & 9.3 & 0 & 0 & 0 \\ 0 & 0 & 0 & 21.3 & 0 & 0 \\ 0 & 0 & 0 & 0 & 21.3 & 0 \\ 0 & 0 & 0 & 0 & 0 & 28.4 \end{bmatrix}^{D} 10^{-12} m^{2}/N$$

Piezoelectric constant matrix

$$\begin{bmatrix} 0 & 0 & 0 & 0 & d_{15} & 0 \\ 0 & 0 & 0 & d_{24} & 0 & 0 \\ d_{31} & d_{31} & d_{33} & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 & 400 & 0 \\ 0 & 0 & 0 & 400 & 0 & 0 \\ -110 & -110 & 240 & 0 & 0 & 0 \end{bmatrix} \quad 10^{12} C/N$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 & g_{15} & 0 \\ 0 & 0 & 0 & g_{24} & 0 & 0 \\ g_{31} & g_{31} & g_{33} & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 & 33.4 & 0 \\ 0 & 0 & 0 & 33.4 & 0 & 0 \\ -11 & -11 & 26.5 & 0 & 0 & 0 \end{bmatrix} \quad 10^{-3} Vm/N$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 & e_{15} & 0 \\ 0 & 0 & 0 & e_{24} & 0 & 0 \\ e_{31} & e_{31} & e_{33} & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 & 11.6 & 0 \\ 0 & 0 & 0 & 11.6 & 0 & 0 \\ -3.5 & -3.5 & 13.1 & 0 & 0 & 0 \end{bmatrix} \quad C/m^2$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 & h_{15} & 0 \\ 0 & 0 & 0 & h_{24} & 0 & 0 \\ h_{31} & h_{31} & h_{33} & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 & 15.7 & 0 \\ 0 & 0 & 0 & 15.7 & 0 & 0 \\ -6.5 & -6.5 & 24 & 0 & 0 & 0 \end{bmatrix} \quad 10^{8} V/m$$

Clamped dielectric constant Matrix

$$\begin{bmatrix} \varepsilon_{11}{}^{S}/\varepsilon_0 & 0 & 0 \\ 0 & \varepsilon_{11}{}^{S}/\varepsilon_0 & 0 \\ 0 & 0 & \varepsilon_{33}{}^{S}/\varepsilon_0 \end{bmatrix} = \begin{bmatrix} 830 & 0 & 0 \\ 0 & 830 & 0 \\ 0 & 0 & 610 \end{bmatrix}^{S}$$

Free dielectric constant matrix

$$\begin{bmatrix} \varepsilon_{11}{}^{T}/\varepsilon_0 & 0 & 0 \\ 0 & \varepsilon_{11}{}^{T}/\varepsilon_0 & 0 \\ 0 & 0 & \varepsilon_{33}{}^{T}/\varepsilon_0 \end{bmatrix} = \begin{bmatrix} 1360 & 0 & 0 \\ 0 & 1360 & 0 \\ 0 & 0 & 1050 \end{bmatrix}^{T}$$