$$C = \begin{bmatrix} l_1 & l_2 & l_3 \\ m_1 & m_2 & m_3 \\ s_1 & s_2 & s_3 \end{bmatrix} \quad ; \quad \begin{aligned} L &= (l_1 \ l_2 \ l_3) \\ M &= (m_1, m_2, m_3) \\ S &= (s_1, s_2, s_3) \end{aligned}$$

We define P as,

$$\vec{L} \cdot \vec{M} = \vec{M} \cdot \vec{S} = \vec{S} \cdot \vec{L} = 0.$$

$$P = \begin{bmatrix} \frac{l_1}{|L|^2} & \frac{m_1}{|M|^2} & \frac{s_1}{|S|^2} \\ \frac{l_2}{|L|^2} & \frac{m_2}{|M|^2} & \frac{s_2}{|S|^2} \\ \frac{l_3}{|L|^2} & \frac{m_3}{|M|^2} & \frac{s_3}{|S|^2} \end{bmatrix}$$

Since C is positive, P is also positive. We are just dividing by square of magnitude.

Now,

$$C \cdot P = \begin{bmatrix} \frac{1}{|L|^2} \cdot l_1^2 + l_2^2 + l_3^2 & 0 & 0 \\ 0 & \frac{1}{|M^2|}(m_1^2 + m_2^2 + m_3^2) & 0 \\ 0 & 0 & \frac{1}{|S|^2}(s_1^2 + s_2^2 + s_3^2) \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$\Rightarrow C \cdot P = I$

$\Rightarrow$ This proves P is valid set of primaries.