Fierz transformation

$$\Lambda_{32}^{(i)} \otimes \Lambda_{14}^{(i)} = \sum_{j=1}^{5} \lambda_{ij}\ \Lambda_{12}^{(j)} \otimes \Lambda_{34}^{(j)}$$

where $\Lambda_i = (1, \gamma_\mu, \sigma_{\mu\nu}/\sqrt{2}, \gamma_\mu\gamma_5, \gamma_5)$ and $\sigma_{\mu\nu} = \frac{i}{2}[\gamma_\mu, \gamma_\nu]$.

$$\lambda_{ij} = \frac{1}{4} \begin{pmatrix} +1 & +1 & +1 & -1 & +1 \\ +4 & -2 & 0 & -2 & -4 \\ +6 & 0 & -2 & 0 & +6 \\ -4 & -2 & 0 & -2 & +4 \\ +1 & -1 & +1 & +1 & +1 \end{pmatrix},$$

Using this relation it is easy to show that

$$(\gamma_\mu\gamma_L)_{32} \otimes (\gamma_\mu\gamma_L)_{14} = -(\gamma_\mu\gamma_L)_{12} \otimes (\gamma_\mu\gamma_L)_{34}$$

and that

$$(\gamma_\mu\gamma_R)_{32} \otimes (\gamma_\mu\gamma_L)_{14} = 2(\gamma_R)_{12} \otimes (\gamma_L)_{34}$$