F0: Deformation gradient tenseur in the beginning of a time step
F1: Deformation gradient tenseur in the end of a time step

$$F0 = \dot{F}0 + (\dot{F}1 - \dot{F}0)\left(\frac{N_{increment} - 1}{N_{increment\_total}}\right)$$

F0: DFGRD0 en ABAQUS
F1: DFGRD1 en ABAQUS

$$F1 = \dot{F}0 + (\dot{F}1 - \dot{F}0)\left(\frac{N_{increment}}{N_{increment\_total}}\right)$$

$$\dot{F} = \frac{dF}{dt}$$

Where, N_increment is time step and N_increment _totale is the total number of time steps.
At the begining: N_increment _totale = N_increment =1
If the convergence wasn't reached, these values will change.

$$F^e = F0 * (F^p)^{-1} \Rightarrow F^e = \begin{pmatrix} -0.0004 & 0 & 0 \\ 0 & -0.0004 & 0 \\ 0 & 0 & 0.0012 \end{pmatrix}$$

$$\det(F^e) = 2e-13$$

$$E^{Green} = 0.5(F^{eT} F^e - I) \Rightarrow E^{Green} = \begin{pmatrix} -0.5 & 0 & 0 \\ 0 & -0.5 & 0 \\ 0 & 0 & 0.5 \end{pmatrix}$$

Second Piloa-Krichoff stress

$$S^{PK2} = \underline{\underline{C}} : E^{Green} \Rightarrow \underline{\underline{C}} = \begin{pmatrix} 136000 & 78000 & 68000 & 0 & 0 & 0 \\ 78000 & 136000 & 68000 & 0 & 0 & 0 \\ 68000 & 68000 & 163000 & 0 & 0 & 0 \\ 0 & 0 & 0 & 29000 & 0 & 0 \\ 0 & 0 & 0 & 0 & 29000 & 0 \\ 0 & 0 & 0 & 0 & 0 & 40000 \end{pmatrix} \text{(MPa)}$$

$$S^{PK2} = 10^5 \begin{pmatrix} -1.41 & 0 & 0 \\ 0 & -1.41 & 0 \\ 0 & 0 & -1.5 \end{pmatrix} \text{ (MPa)}$$

$$\sigma^{Cauchy} = \frac{1}{\det(F^e)} (F^e S^{PK2} F^{eT}) \Rightarrow \sigma^{Cauchy} = 10^{10} \begin{pmatrix} -0.15 & -0.06 & -0.08 \\ -0.06 & -0.12 & -0.37 \\ -0.08 & -0.37 & -2.3 \end{pmatrix} \text{ (MPa)}$$

Finally, we calculate the shear stress of each slip system using Cauchy stress and Schmid matrice $\underline{\underline{\mu}}$. Where, « ls » and « ns » are the direction and the normal of the slip system.

$$\underline{\underline{\mu}} = \frac{1}{2}(l_s \otimes n_s + n_s \otimes l_s) \qquad \underline{\underline{\mu}} = \begin{pmatrix} 0 & 0 & 0.5 \\ 0 & 0 & 0 \\ 0.5 & 0 & 0 \end{pmatrix}$$

$$\tau = \sigma^{Cauchy} : \underline{\underline{\mu}} \qquad \tau = -8.4e8 \text{ (MPa)}$$