Example: Modified Johnson-Cook model

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Before working out this example, a walk through the VUHARD_V2 and VUSDFLD_V2 examples is strongly recommended.

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In this example, we want to develop the MJC model:

Yield strength

$$\sigma_y = (\sigma_0 + R) \cdot \left(1 + \frac{\dot{p}}{\dot{p}_0}\right)^C \cdot \left(1 - \left(\frac{T - T_r}{T_m - Tr}\right)^m\right)$$

Isotropic hardening:

$$R = \sum_{i=1}^{3} Q_i \left(1 - \exp\left(-\frac{\theta_i}{Q_i} p\right)\right)$$

Visco-plasticity

Thermo-plasticity

Failure model

Cockcroft-Latham criterion:

$$D = \int_0^{p_f} \frac{\langle \sigma_1 \rangle}{W_c} \dot{p} \leq D_c$$

Critical temperature:

$$T \leq T_c \quad \text{with} \quad T_c = s_f \cdot T_m$$

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To implement this model, we can use the VUHARD_V2.f and the VUSDFLD_V2.f subroutines.

We can only link one subroutine (fortran file) to ABAQUS

Include here the additional subroutines

MJC_example > VUHARD_MJC.f > ...

```
1       include 'VUSDFLD_MJC.f'
2     !$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
3     !$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
4     !     Subroutine VUHARD
5     !$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
6     !$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
7           SUBROUTINE VUHARD(NBLOCK,JELEM,KINTPT,KLAYER,KSECPT,
```

```
!-----------------------------------------------------------------
!     Check for fracture according to Cockcroft-Latham
!-----------------------------------------------------------------
      do i=1,nblock
         if(damage(i).ge.DCRIT)then
            statusCL(i) = 0.0
         else
            statusCL(i) = 1.0
         endif
      enddo
!-----------------------------------------------------------------
!     Check for fracture according maximum temperature criterion
!-----------------------------------------------------------------
      do i=1,nblock
         if(temp(i).ge.Tc*sTf)then
            statusTC(i) = 0.0
         else
            statusTC(i) = 1.0
         endif
      enddo
!-----------------------------------------------------------------
```

VUSDFLD

To handle two fracture criteria:

```
!-----------------------------------------------------------------
!     Check for fracture over the two fracture models
!-----------------------------------------------------------------
      do i=1,nblock
         stateNew(i,3) = min(statusTC(i),statusCL(i))
      enddo
!-----------------------------------------------------------------
```

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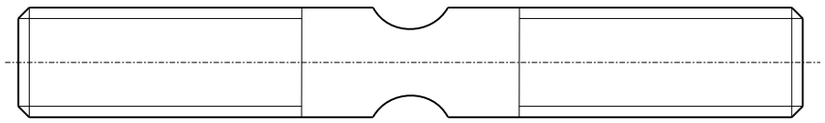
Notched specimen:



2D axisymmetric elements