

## SSNA113 – Notched sample in viscoplasticity

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### Summary:

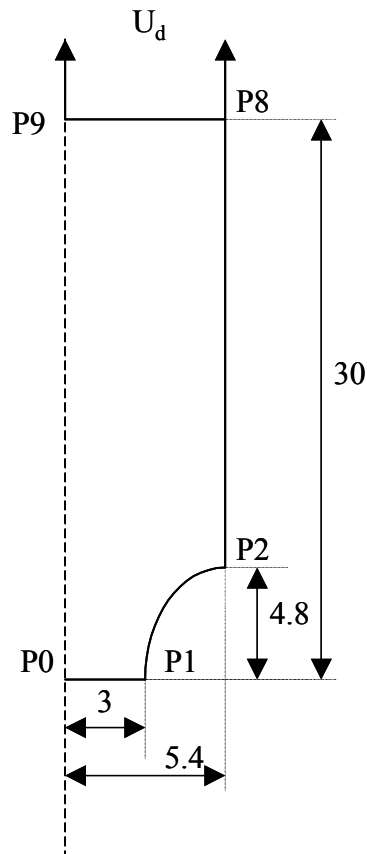
This test models a notched sample into axisymmetric. The law of behavior used is the law `VISC_ISOT_TRAC`. Two loading rates are simulated:

- slow:  $T=1000s$  That is to say  $\dot{\epsilon}=10^{-3}s^{-1}$
- rapid:  $T=0.001s$  That is to say  $\dot{\epsilon}=10^{-3}s^{-1}$

The results (effort resulting and contraction from the ligament) are compared with the calculations carried out with the model of viscous Rousselier (`ROUSS_VISC`) degenerated so that the evolution of porosity is negligible.

## 1 Problem of reference

### 1.1 Geometry



The test-tube is axisymmetric, and only half of the test-tube is represented. Dimensions are given in millimetres.

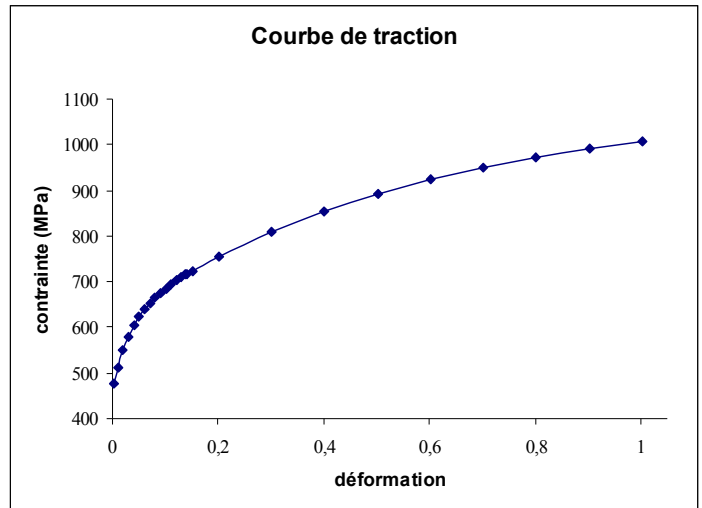
## 1.2 Properties of material

Isotropic elasticity

Young modulus:  $E = 215000 \text{ MPa}$

Traction diagram

Poisson's ratio:  $\nu = 0.3$



Coefficient for viscous law  $VISC\_SINH$

$\sigma_0 = 6176 \text{ MPa}$

$\varepsilon_0 = 3.31131121483 \cdot 10^{13}$

$m = 6.76$

Coefficients of the model of Rousselier used to obtain the reference solution

$f_0 = 5 \cdot 10^{-9}$

$D = 0.0001$

$\sigma_1 = 1575 \text{ MPa}$

## 1.3 Boundary conditions and loadings

Because of symmetry, vertical displacements are blocked for the side  $P0P1$  that is to say  $DY = 0$ .

The side  $P8P9$  is subjected to an imposed displacement  $U_d = 1 \text{ mm}$ .

The loading is imposed using 500 pas de time in  $T = 1000\text{s}$  for the slow case and  $T = 0.001\text{s}$  for the fast case.

## 2 Reference solution

### 2.1 Results of reference

The reference solution is obtained by carrying out same calculation with the model of Rousselier in viscous version ( $BEHAVIOR = 'ROUSS\_VISC'$ ,  $DEFORMATION = 'PETIT\_REAC'$ ) whose parameters were selected in order to return the effect of negligible porosity.

One compares the contraction of the ligament, i.e. following displacement  $x$  node  $P1$  as well as the resulting effort ( $REAC\_NODA$ ) on the face  $P8P9$ . One is interested in 3 values of displacement  $U_d$ : 0.05mm, 0.5mm and 1mm.

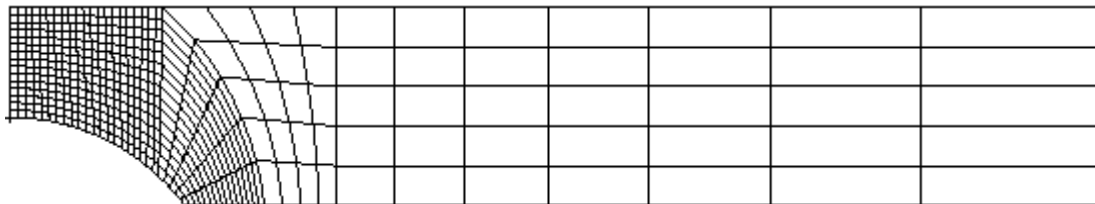
## 3 Modeling A

### 3.1 Characteristics of modeling

- Modeling `AXIS_SI`

### 3.2 Characteristics of the grid

The grid is obtained by `GIBI`.



Many nodes: 1440  
Many meshes: 445 QUAD8

### 3.3 Sizes tested and results

#### Fast speed

Displacement	Identification	Reference	% tolerance
$U=0.05\text{ mm}$	REAC_NODA on P8P9	$3.43132 \cdot 10^3$	-0.12
	$U_y$ in PI	$-8.0411 \cdot 10^{-3}$	0.67
$U=0.5\text{ mm}$	REAC_NODA on P8P9	$3.93495 \cdot 10^3$	-0.22
	$U_y$ in PI	$-4.06758 \cdot 10^{-1}$	-0.03
$U=1\text{ mm}$	REAC_NODA on P8P9	$3.17328 \cdot 10^3$	-0.28
	$U_y$ in PI	$-8.89457 \cdot 10^{-1}$	-0.03

#### Slow speed

Displacement	Identification	Reference	% tolerance
$U=0.05\text{ mm}$	REAC_NODA on P8P9	$2.86423 \cdot 10^3$	-0.12
	$U_y$ in PI	$-1.52635 \cdot 10^{-2}$	0.24
$U=0.5\text{ mm}$	REAC_NODA on P8P9	$3.36223 \cdot 10^3$	-0.19
	$U_y$ in PI	$-4.19637 \cdot 10^{-1}$	-0.03
$U=1\text{ mm}$	REAC_NODA on P8P9	$2.73903 \cdot 10^3$	-0.26
	$U_y$ in PI	$-9.14404 \cdot 10^{-1}$	-0.04

## 4 Summary of the results

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One obtains a good agreement of the results between the 2 models with lower deviations than 1% .

At the total level, one notes that to the maximum 4 iterations are necessary to obtain convergence. On the level of the integration of the law of behavior, less than 10 iterations are necessary to obtain an accuracy of  $10^{-9}$ .