HSNV133 - Thermoplastic tension in large deformations VMIS_ISOT_PUIS

Summarized:

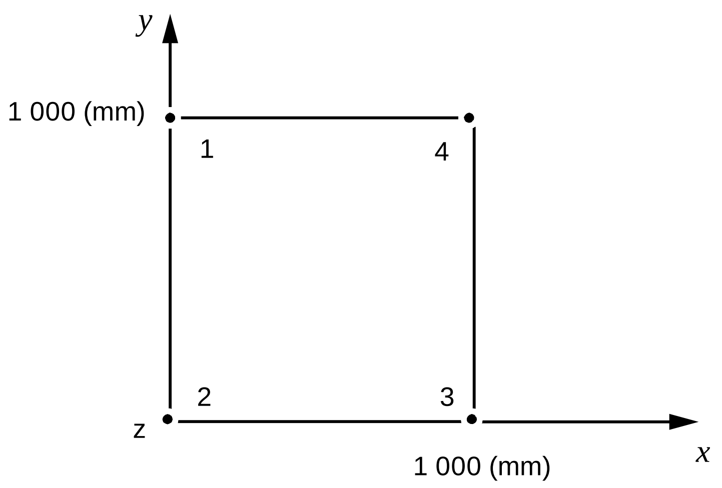
This quasi-static thermomechanical test consists in uniformly heating a bar of rectangular section (stress states and homogeneous strains) then to subject it to a tension.

In the same way, that in test HSNV121 [V7.22.121], one thus validates the kinematics of the large deformations in elastoplasticity (command STAT_NON_LINE, key word strain: "SIMO_MIEHE" or "PETIT_REAC") for a behavior model of the type Von Mises with definite isotropic hardening is by a point by point given curve of tension (VMIS_ISOT_TRAC); maybe by a model in power (VMIS_ISOT_PUIS).

The bar is modelled by a voluminal element (HEXA20, modelization A).

1 Problem of reference

1.1 Geometry



1.2 Properties of the material

the material obeys a constitutive law in plastic large deformations with isotropic hardening defined by a curve of tension (point by point or model in power).
Curve of tension is given in the logarithmic strain plane - rational stress.

$$\sigma=\frac{F}{S}=\frac{F}{S_o}\cdot\frac{l}{l_o}$$

$$R(p)=\sigma_y+\sigma_y\left(\frac{E}{a\,\sigma_y}p\right)^{1/n}$$

$\nu \quad =0.3$

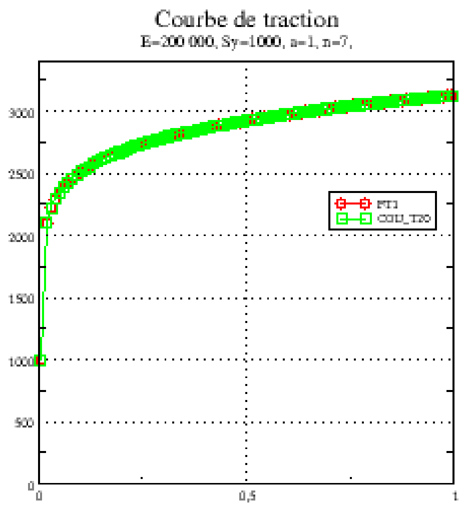
$\alpha \quad =10^{-4}K^{-1}$

$\sigma_y \quad =1000\,MPa$

$E \quad =200000\,MPa$

$n \quad =7$

$a \quad =1$

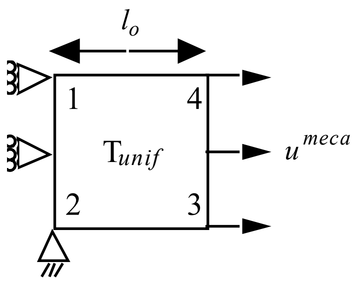


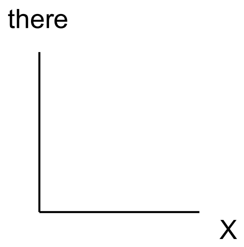
l_o and l are, respectively, the initial length and the current length of the useful part of the test-tube.

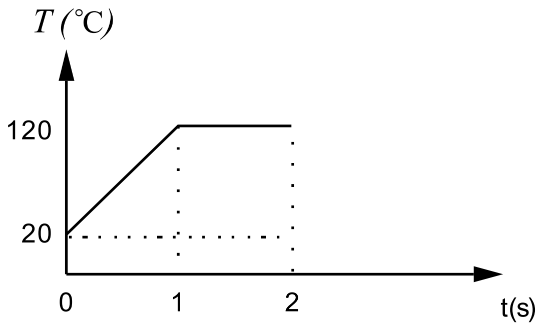
S_o and S are, respectively, surfaces initial and current. Between the temperatures $20\,°C$ and $120\,°C$, the characteristics are interpolated linearly.

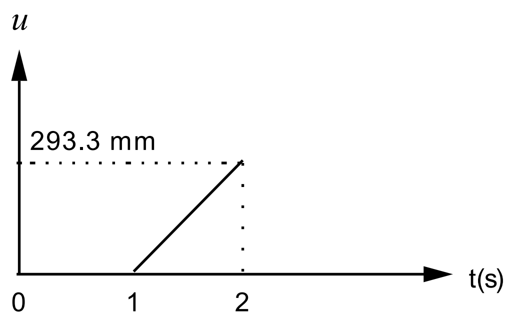
1.3 Boundary conditions and loadings

the bar, initial length l_o , blocked in the direction Ox on the face [1,2] is subjected to a uniform temperature T and a mechanical displacement of tension u^{meca} on the face [3, 4]. The sequences of loading are the following ones:









Reference temperature: $T_{réf}=20°C$.

Note:

> *Mechanical displacement is measured from the configuration deformed by the thermal loading ($t=1s$). To have total displacement, it is thus necessary to add the thermal displacement obtained at time $t=1s$.*

2 Reference solution

2.1 Results of reference

One will adopt like results of reference displacements, the stress of Cauchy σ and the cumulated plastic strain p obtained with behavior `VMIS_ISOT_TRAC` (validated in addition with `DEFORMATION=' SIMO_MIEHE'`).

One will compare the solutions obtained with time $t=2\ s$ ($\Delta T=100°C$, tension u)

2.2 Uncertainty on the Very

weak solution since it is about intercomparison between two behaviors formally identical. However, the discretization of the model of hardening in power leads to an uncertainty.

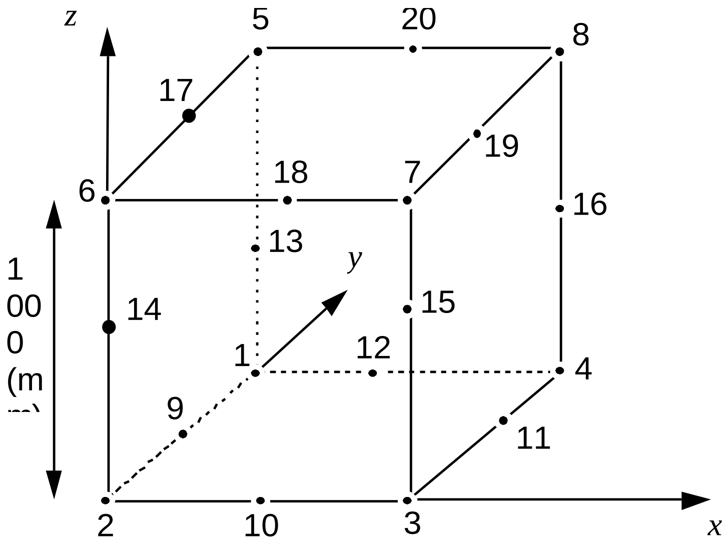
2.3 Bibliographical references

1. V. CANO, E. LORENTZ: Introduction into *the Code_Aster* of an elastoplastic model of behavior in large deformations with isotropic hardening - internal Note EDF DER HI - 74/98/006/0

3 Modelization A

3.1 Characteristic of the voluminal

modelization Modelization: 1 mesh `HEXA20`
1 nets `QUAD8`



Boundary conditions:

N2: $U_x = U_y = U_z = 0$ $N9, N13, N14, N5, N17$: $U_x = 0$

N1: $U_x = U_z = 0$

N6: $U_x = U_y = 0$

Charge: Displacement imposed on the face $[3\,4\,8\,7\,11\,16\,19\,15]$ + assignment of the same temperature on all the nodes. The nombre total of increments is of 21 (1 increment enters $t=0\text{s}$ and 1s , 20 increments enters $t=1\text{s}$ and 2s).

Convergence is carried out if the residue is lower or equal to `RESI_GLOB_RELA= 10-6`.

3.2 Characteristics of the mesh

Many nodes: 20

Number of meshes: 2

1 `HEXA20`
1 `QUAD8`

3.3 Quantities tested and results

Identification	Reference `VMIS_ISOT_TRAC`	*Aster* `VMIS_ISOT_PUIS`	% difference
$t=2$ Displacement DX ($N8$)	303.06	303.06	< 10-4
$t=2$ Displacement DY ($N8$)	– 108.82	– 108.82	< 10-4
$t=2$ Displacement DZ ($N8$)	– 108.82	– 108.82	< 10-4
$t=2$ Stresses $SIGXX$ ($PG1$)	2651.633	2651.694	0.002
$t=2$ Variable p $VARI$ ($PG1$)	0.24556	0.24558	0.009

4 Summary of the results

inter-validation of behaviors VMIS_ISOT_TRAC and VMIS_ISOT_PUIS realized here watch that the curves of isotropic hardening can be modelled in these two ways in *Code_Aster,* that it is into small or large deformations, via the model "SIMO_MIEHE".