

## MFRON01 – Test of the interface Code\_Aster-MFront for laws élasto-visco-plastics

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### Summary:

This test validates laws of elastoplastic behavior and viscoplastic standard (used in particular for metals: plasticity of Von Mises, Chaboche,...) defined using *MFront* by comparison with similar behaviors of *Code\_Aster* .

Each modeling validates a law of behavior, generally by comparison with the results of the equivalent law of *Code\_Aster* .

## 1 Modeling A

### 1.1 Characteristics of modeling

- Behavior tested: Chaboche.mfront. Elastoplastic law of Chaboche with two variable kinematics, comparable to VMIS\_CIN2\_CHAB [cf R5.03.04].
- Modeling and data similar to those of test SSNV101A.

### 1.2 Sizes tested and results

The reference solution is that obtained by behavior VMIS\_CIN2\_CHAB

Identification (t=1.435)	Reference	Tolerance
$\epsilon_{xx}$	0.0960649	0,1%
$\epsilon_{xy}$	0.1438997	0,1%
$\sigma_{xx}$	143.50	0,1%
$p$	0.190153	0,1%

## 2 Modeling B

### 2.1 Characteristics of modeling

- Behavior tested: ViscoChaboche.mfront. Law élasto-visco-plastic of Chaboche with two variable kinematics, comparable to VISC\_CIN2\_CHAB [cf R5.03.04].
- Modeling and data similar to those of test HSNV125A.

### 2.2 Sizes tested and results

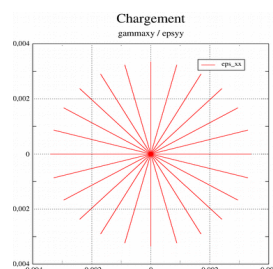
One compares the solution obtained with the Mfront behavior and that obtained with behavior VISC\_CIN1\_CHAB

Constraint ( MPa )	Moment (S)	Reference (difference)	Absolute tolerance
SIXX	Maximum change	0	0.0002
SIXY	Maximum change	0	0.0002

## 3 Modeling C

### 3.1 Characteristics of modeling

- Behavior tested: ViscoMemoNrad.mfront. Law elastoplastic of Chaboche with effects of memory and nonradiality, comparable to VISC\_MEMO\_NRAD [cf R5.03.04].
- Test of traction-torsion, "star" loading. Modeling and data similar to those of test SSND115A.



## 3.2 Sizes tested and results

The reference solution is that obtained by behavior VISC\_MEMO\_NRAD

Extreme values	Reference	Tolerance
$\max(\sigma_{xx})$	413.85873	0,1%
$\min(\sigma_{xx})$	-415.03392	0,1%
$\max(\sigma_{xy})$	244.14796	0,1%
$\min(\sigma_{xy})$	-243.38215	0,1%

## 4 Modeling D

### 4.1 Characteristics of modeling

- Behavior tested: Chaboche.mfront. Elastoplastic law of Chaboche with two variable kinematics, comparable to VMIS\_CIN2\_CHAB, in plane constraints
- Modeling similar to that of test SSNV101B.

### 4.2 Sizes tested and results

The reference solution is that obtained by behavior VMIS\_CIN2\_CHAB

Identification (t=1.435)	Reference	Tolerance
$\epsilon_{xx}$	0.0960649	0,1%
$\epsilon_{xy}$	0.1438997	0,1%
$\sigma_{xx}$	143.50	0,1%
$p$	0.190153	0,1%

## 5 Modeling G

### 5.1 Characteristics of modeling

- Behavior tested: PlasticityTH.mfront (which imports Plasticity\_Sy.mfront). Elastoplastic law of Von Mises, comparable to VMIS\_ISOT\_LINE, with effect of the temperature.
- Modeling similar to that of test HSNV100J. The elastic limit varies according to the temperature in the following way:  $\sigma_y = 400.0 - 4.0 T$  ;
- the other properties material are constant:  $E = 200 \text{ GPa}$  ,  $\nu = 0,3$  ,  $E_T = 50 \text{ GPa}$

### 5.2 Sizes tested and results

The reference solution is analytical (cf [V7.22.100]):

Variables	Moments ( $s$ )	Reference
$\epsilon_{xx}$	$t = 66.666$	$8.6666 \cdot 10^{-4}$
	$t = 80$	$1.1000 \cdot 10^{-3}$
	$t = 90$	$1.2750 \cdot 10^{-3}$

$p$	$t=66.666$	0
	$t=80$	$3.0000 \cdot 10^{-4}$
	$t=90$	$5.2500 \cdot 10^{-4}$
$\sigma_{yy}$ (MPa)	$t=66.666$	- 133,333
	$t=80$	- 100.
	$t=90$	- 75,000

## 6 Modeling H

### 6.1 Characteristics of modeling

- Behavior tested: ImplicitSimoMieheElastoPlasticity.mfront and Plasticity.mfront.

Elastoplastic law of using Von Mises in great deformations is the formulation of Simo and Miehe, comparable to VMIS\_ISOT\_LINE, with DEFORMATION=' SIMO\_MIEHE' (cf [R5.03.21]), that is to say DEFORMATION=' GDEF\_LOG' (cf [R5.03.24]).

- Modeling and data similar to those of test SSNP159A.

### 6.2 Sizes tested and results

The reference solution is that obtained by behavior VMIS\_ISOT\_LINE and SIMO\_MIEHE.

Identification	Reference Aster		Tolerance
	SIMO_MIEHE	GDEF_LOG	Mfront/Aster
$t=2$ Displacement $DX$ ( $N8$ )	290	290	0.1 %
$t=2$ Constraints $SIGXX$ ( $PGI$ )	1500.55	1494.80	0.1 %
$t=2$ Variable $P$ $VARI$ ( $PGI$ )	0.25	0.2475	0.1 %

## 7 Modeling J

### 7.1 Characteristics of modeling

- Behavior tested: Chaboche. Modeling DKT.
- Modeling is equivalent to that of the test ssnl501b

### 7.2 Sizes tested and results

The reference solution is analytical.

Identification	Moments	Type of reference	Reference	Tolerance (%)
ETA_PILOTAGE	5	'ANALYTICAL'	1.0	15.
ETA_PILOTAGE	15	'ANALYTICAL'	1.0	15.

## 8 Summary of the results

The results are satisfactory and validate the interface enters Code\_Aster and MFRONT in small and great deformations, for behaviors élasto-visco-plastics of metals.

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