MFRON01 – Test of the interface *Code_Aster*-MFront for laws élasto-visco-plastics

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
ε_{xx}	0.0960649	0,1%
ε_{xy}	0.1438997	0,1%
σ_{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

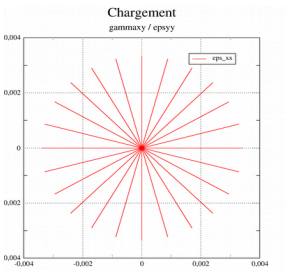
One compares the solution obtained with the Mfront behavior and that obtained with behavior VISC_CIN1_CHAB

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
ε_{xx}	0.0960649	0,1%
ε_{xy}	0.1438997	0,1%
σ_{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: $E = 200\,GPa$, $\nu = 0{,}3$, $E_T = 50\,GPa$

5.2 Sizes tested and results

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

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

p	$t=66.666$	0
	$t=80$	3.0000 10^{-4}
	$t=90$	5.2500 10^{-4}
σ_{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 $SIGXX$ ($PG1$)	1500.55	1494.80	0.1 %
$t=2$ Variable p $VARI$ ($PG1$)	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.