

Example 8 – SPH impacts

(Courtesy of CEA and Samtech S.A.)

PRGL01:

```
METHODE SPH ** MATERIAU GELATINE POREUSE ** VZ = -600 M
Time: 0.00000E+00 Step: 0

MAX:+1.00E+01
----:+1.40E+08
----:+1.30E+08
----:+1.20E+08
----:+1.10E+08
----:+1.00E+08
----:+9.00E+07
----:+8.00E+07
----:+7.00E+07
----:+6.00E+07
----:+5.00E+07
----:+4.00E+07
----:+3.00E+07
----:+2.00E+07
----:+1.00E+07
MIN:+1.00E+01
Ecro 1 [N/A]
```

Absolute pressure in projectile

```
METHODE SPH ** MATERIAU GELATINE POREUSE ** VZ = -600 M
Time: 0.00000E+00 Step: 0

MAX:+0.00E+00
----:+3.48E-02
----:+3.40E-02
----:+3.35E-02
----:+3.30E-02
----:+3.25E-02
----:+3.20E-02
----:+3.15E-02
----:+3.10E-02
----:+3.05E-02
----:+3.00E-02
----:+2.95E-02
----:+2.90E-02
----:+2.85E-02
----:+2.80E-02
MIN:+0.00E+00
Ecro 3 [N/A]
```

Plastic strain in target

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Numerical Solutions

PRGL01

Simplified impact (10 particles only). Porous jelly material.

The input file:

```
METHODE SPH ** MATERIAU GELATINE POREUSE ** VZ = -600 M/S UNITE M.K.S.
*-----
ECHO
*conv win
*-----Problem type
TRID NONLIN
*-----Dimensioning
DIME
PTIL 220 ZONE 2
BLOQ 50
BILL 10 CUBE 18
NPEF 1 NPTS 100
mpco 10 mtel 5
TERM
*-----Geometry
GEOM LIBRE POIN 58 BILLE 10 CUBE 18 TERM
1.00000E+00 1.00000E+00 9.50000E+00 1.00000E+00 1.00000E+00 1.00000E+00
8.50000E+00 1.00000E+00 1.00000E+00 7.50000E+00
1.00000E+00 1.00000E+00 6.50000E+00 1.00000E+00 1.00000E+00
5.50000E+00 1.00000E+00 1.00000E+00 4.50000E+00
1.00000E+00 1.00000E+00 3.50000E+00 1.00000E+00 1.00000E+00
2.50000E+00 1.00000E+00 1.00000E+00 1.50000E+00 2.00000E+00
1.00000E+00 1.00000E+00 5.00000E-01 2.00000E+00 2.00000E+00
-2.00000E-02 2.00000E+00 2.00000E+00 -5.10000E-01
2.00000E+00 2.00000E+00 -1.00000E+00 1.33333E+00 2.00000E+00
-2.00000E-02 0.00000E+00 2.00000E+00 -2.00000E-02
6.66667E-01 2.00000E+00 -2.00000E-02 1.33333E+00 2.00000E+00
-5.10000E-01 1.33333E+00 2.00000E+00 -1.00000E+00
0.00000E+00 2.00000E+00 -5.10000E-01 6.66667E-01 2.00000E+00
-5.10000E-01 0.00000E+00 2.00000E+00 -1.00000E+00
6.66667E-01 2.00000E+00 -1.00000E+00 2.00000E+00 1.33333E+00
-2.00000E-02 2.00000E+00 6.66667E-01 -2.00000E-02
-5.10000E-01 2.00000E+00 1.33333E+00 -1.00000E+00
2.00000E+00 6.66667E-01 -5.10000E-01 2.00000E+00 0.00000E+00
-5.10000E-01 2.00000E+00 6.66667E-01 6.66667E-01 1.00000E+00
2.00000E+00 0.00000E+00 -1.00000E+00 1.33333E+00 1.33333E+00
-2.00000E-02 0.00000E+00 1.33333E+00 -2.00000E-02
6.66667E-01 1.33333E+00 -2.00000E-02 1.33333E+00 1.33333E+00
-5.10000E-01 1.33333E+00 1.33333E+00 -1.00000E+00
0.00000E+00 1.33333E+00 -5.10000E-01 6.66667E-01 1.33333E+00
-5.10000E-01 0.00000E+00 1.33333E+00 -1.00000E+00
6.66667E-01 1.33333E+00 -1.00000E+00 1.33333E+00 6.66667E-01
-2.00000E-02 1.33333E+00 0.00000E+00 -2.00000E-02
0.00000E+00 0.00000E+00 -2.00000E-02 1.33333E+00 6.66667E-01
-5.10000E-01 1.33333E+00 0.00000E+00 -5.10000E-01
1.33333E+00 6.66667E-01 -1.00000E+00 1.33333E+00 0.00000E+00
-1.00000E+00 0.00000E+00 6.66667E-01 -5.10000E-01
6.66667E-01 6.66667E-01 -5.10000E-01 0.00000E+00 0.00000E+00
-5.10000E-01 0.00000E+00 6.66667E-01 -1.00000E+00
6.66667E-01 6.66667E-01 -1.00000E+00 6.66667E-01 0.00000E+00
-1.00000E+00 0.00000E+00 0.00000E+00 -1.00000E+00
6.66667E-01 0.00000E+00 -5.10000E-01
10 9 8 7 6 5 4 3 2 1
57 56 55 54 53 58 52 51

56 50 49 55 58 48 47 52
50 31 30 49 48 29 28 47
54 55 40 39 51 52 38 37
55 49 36 40 52 47 35 38
49 30 27 36 47 28 26 35
39 40 22 21 37 38 20 19
40 36 18 22 38 35 17 20
36 27 13 18 35 26 12 17
53 58 52 51 46 45 44 43
58 48 47 52 45 42 41 44
48 29 28 47 42 25 24 41
51 52 38 37 43 44 34 33
52 47 35 38 44 41 32 34
47 28 26 35 41 24 23 32
37 38 20 19 33 34 16 15
38 35 17 20 34 32 14 16
35 26 12 17 32 23 11 14
*-----Geometric Complements
COMPLEMENT
CBILLE RAYON 0.5 LINE 0.2 QUAD 8.
SPHY 1 STRUCT LECT 11 PAS 1 28 TERM BILLE LECT 1 PAS 1 10 TERM
*-----Material data
MATE VMIS ISOT RO 2800 YOUN 2.1E11 NU 0.3 ELAS 2.1E8
TRAC 2 2.1E8 0.001 2.31E9 10
PLAY
prgl rol 1060 ro2 1.03 gamm 1.4 csn1 1482.9
csn2 328 pin1 le5 pref le5 pmin 0. prop 0.9 cvt1 2.
cvt2 1.03
LECT 1 PAS 1 10 TERM
*-----Initial conditions
INIT VITESSE 3 -600. LECT 1 PAS 1 10 TERM
*-----Boundary conditions
LIAI BLOQ 1 LECT 1 PAS 1 10 TERM
HELM LECT 1 PAS 2 10 TERM
*-----Outputs
ECRIT depl VITE ECROU FEXT FREQ 1000
POIN LECT 1 PAS 1 10 TERM
HELM LECT 1 PAS 2 10 TERM
*-----Transient calculation
CALCUL TINI 0 PAS1 2.5E-8 NMAX 3000 TFIN 4.695E-2
*-----ANIMATION
CAME 1 EYE 5.31177E-01 -4.80553E+01 3.57776E+01
Q 8.85803E-01 4.35282E-01 -7.43757E-02 1.42656E-01
VIEW 7.57269E-03 7.92369E-01 -6.09995E-01
RIGH 9.48235E-01 1.87982E-01 2.55956E-01
UP -3.17480E-01 5.80357E-01 7.49929E-01
FOV 2.48819E+01
SCEN GEOM NAVI FREE
POIN SPHP
*ILINE HEUOU
!VECT SCCO SCAL USER PROG 5.D0 PAS 10.D0 55.D0 TERM !LENG 2.0
!TEXT VSQA
!iso fill fiel ecro 1 scal user prog 1.e7 pas 1.e7 1.4e8 term
!SUPP LECT 1 PAS 1 10 TERM
!text isca
!iso fill fiel ecro 3 scal user prog 2.8e-2 pas .05e-2 3.45e-2 term
```



```

SUPP LECT 11 PAS 1 28 TERM

text isca
colo pape
lima on

aler cam1 1 nfra 1
trac offa fich avi nocl nfto 127 fps 10 kfre 10 comp -1
rend

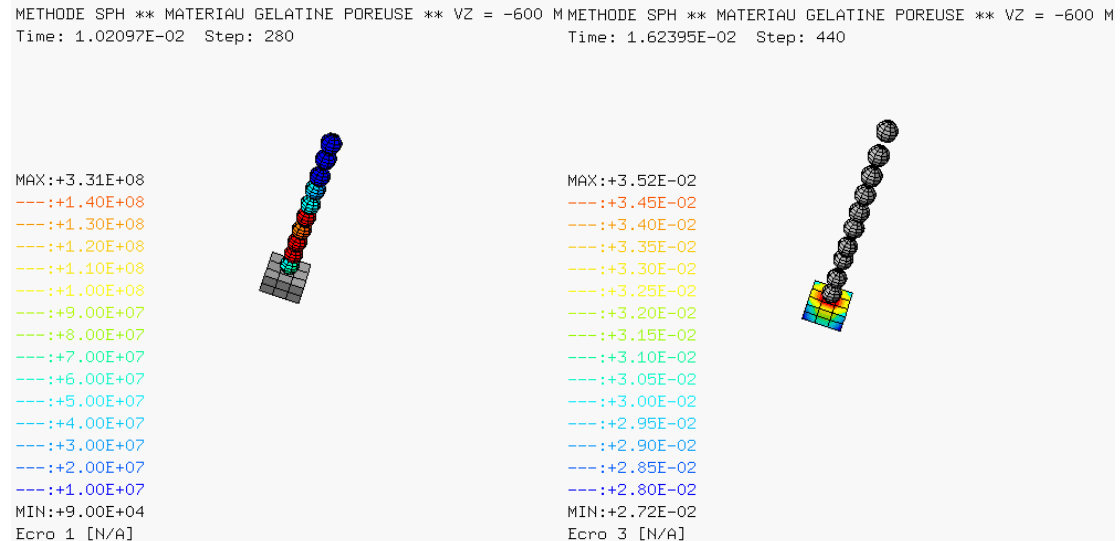
FREQ 10
GOTR LOOP 125 offa fich avi cont nocl

FREQ 5
GO
TRAC offa fich avi cont
rend

ENDPLAY
*****
QUAL ECRO comp 2 lect 5 term refer 883.94 toler 3E-3
*****
FIN

```

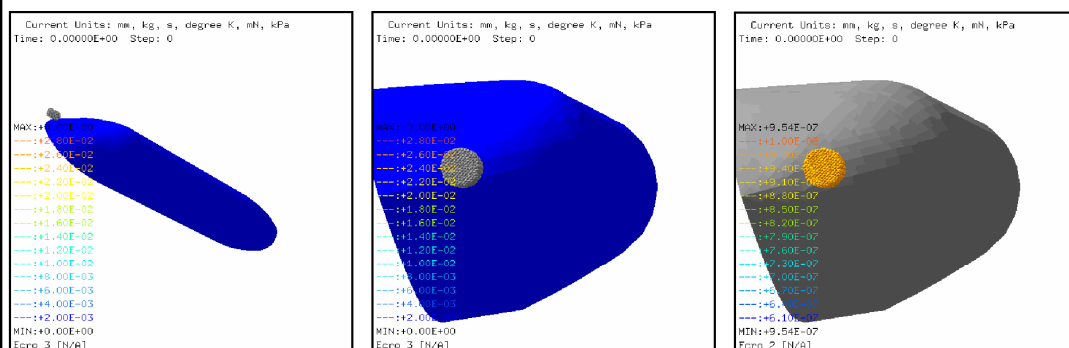
Some hardening quantity in the projectile and in the target:



Example 8 – SPH impacts

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ROMA01:



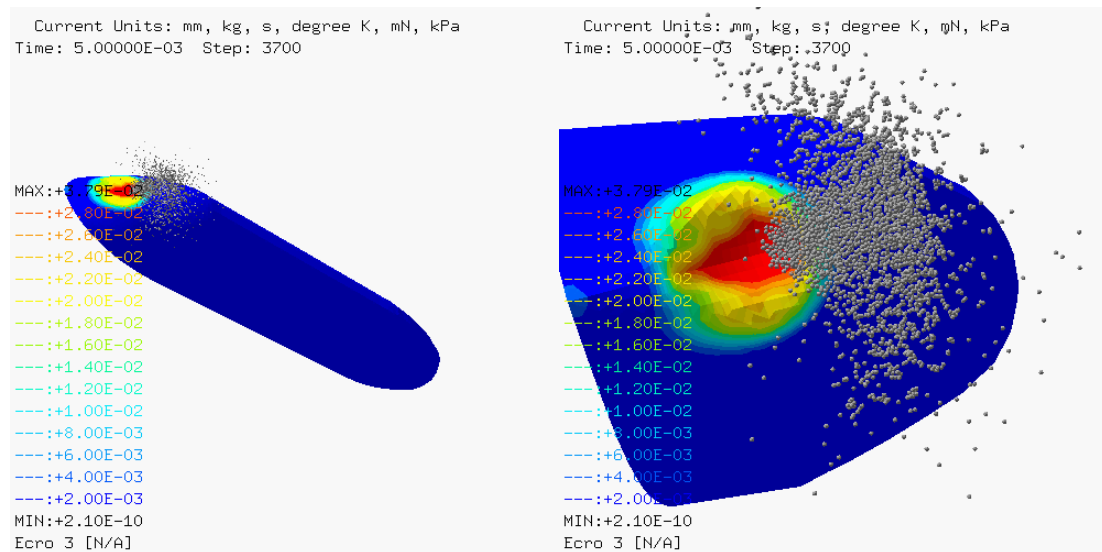
Plastic strain in
structure

Plastic strain in
structure (zoom)

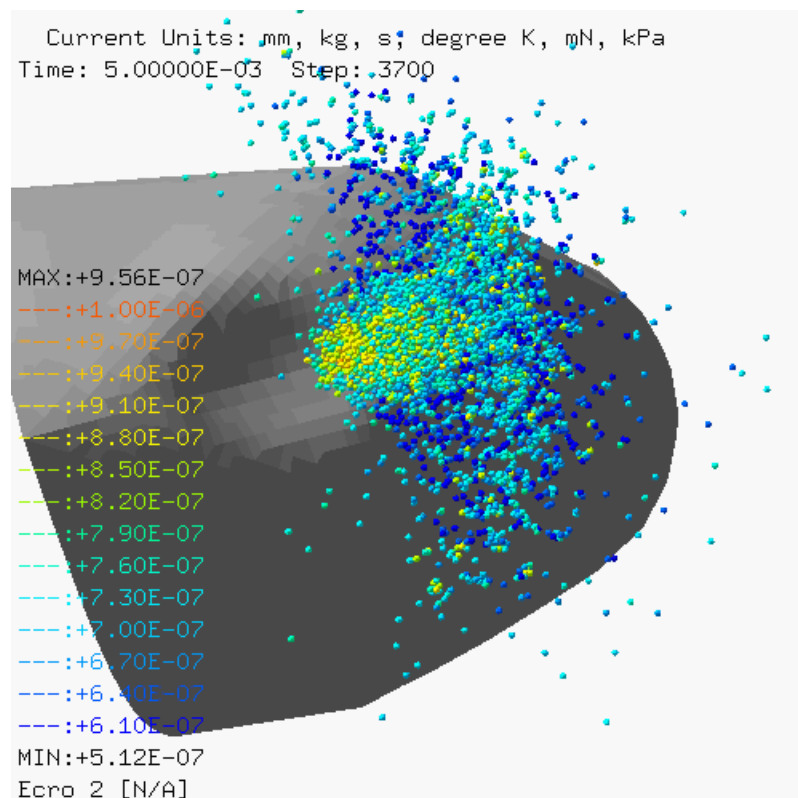
Density in
projectile

ROMA01

Final plastic streen in the target (full and zoom views):



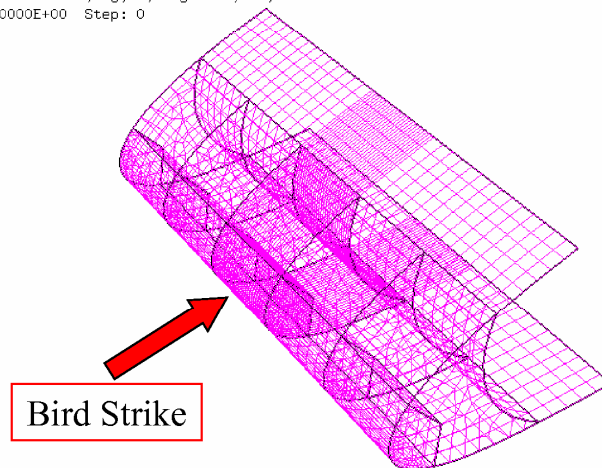
Final density in the projectile:



Example 8 – SPH impacts (2)

SONA01:

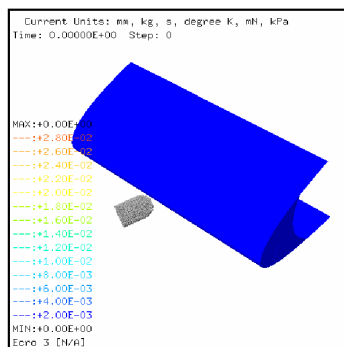
Current Units: mm, kg, s, degree K, mN, kPa
Time: 0.00000E+00 Step: 0



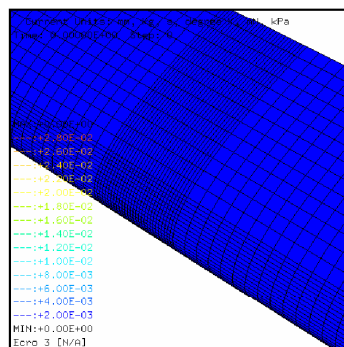
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Example 8 – SPH impacts (3)

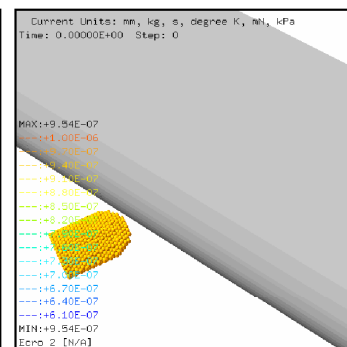
SONA01:



Plastic strain in
structure



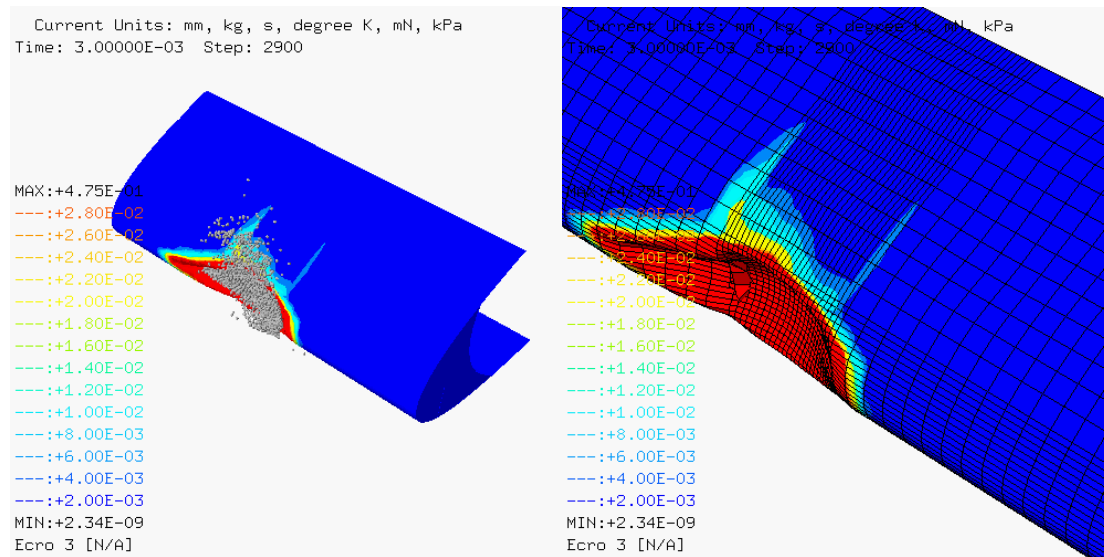
Plastic strain in
structure (zoom)



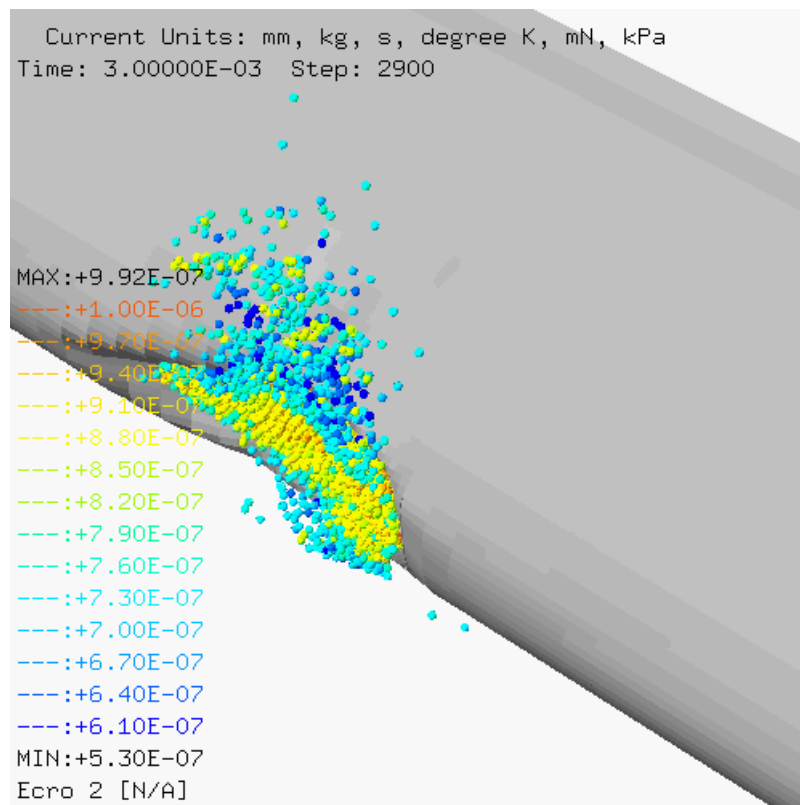
Density in the
projectile

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Final plastic strain in the target (full view and zoom):



Final density in the projectile:



Final plastic strain in target internals (backfaces only):

