```
*HEADING
DISTORTION CONTROL EXAMPLE
3D SPHERICAL INDENTATION
Units - N, mm, sec
Also verifies the computation of Integrated Output.
SOF2 should match RF2 very closely.
*RESTART,TIMEMARKS=YES,WRITE,NUM=1
*NODE,NSET=ALLN
1,0.,300.
10,0.,0.
401,600.,300.
410,600.,0.
*NSET,NSET=N1
1,
*NSET,NSET=N10
10,
*NSET,NSET=N401
401,
*NSET,NSET=N410
410,
*NFILL,NSET=TOP2D
N1,N401,40,10
*NFILL,NSET=BOT2D
N10,N410,40,10
*NFILL,NSET=HEAD
TOP2D,BOT2D,9,1
*NCOPY, SHIFT, OLD SET=HEAD, NEW SET=TAIL,
CHANGE NUMBER=16400
0., 0., 600.
0., 0., -1., 0., 0., 1., 0.
*NFILL, NSET=NALL
HEAD, TAIL,   40,  410
*ELEMENT,TYPE=C3D8R
1,2,12,11,1,412,422,421,411
*ELGEN,ELSET=BLANK
1,40,10,1,9,1,40,40,410,360
*NCOPY, SHIFT, OLD SET=TOP2D, NEW SET=TOPLAST,
CHANGE NUMBER=16400
0., 0., 600.
0., 0., -1., 0., 0., 1., 0.
*NFILL, NSET=TOP
TOP2D, TOPLAST,   40,  410
*NCOPY, SHIFT, OLD SET=BOT2D, NEW SET=BOTLAST,
CHANGE NUMBER=16400
0., 0., 600.
0., 0., -1., 0., 0., 1., 0.
*NFILL, NSET=BOT
BOT2D, BOTLAST,   40,  410
*ELSET,ELSET=UPPER,GEN
1,40,1
361,400,1
721,760,1
1081,1120,1
1441,1480,1
1801,1840,1
2161,2200,1
2521,2560,1
2881,2920,1
3241,3280,1
3601,3640,1
3961,4000,1
4321,4360,1
4681,4720,1
5041,5080,1
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5401,5440,1
5761,5800,1
6121,6160,1
6481,6520,1
6841,6880,1
7201,7240,1
7561,7600,1
7921,7960,1
8281,8320,1
8641,8680,1
9001,9040,1
9361,9400,1
9721,9760,1
10081,10120,1
10441,10480,1
10801,10840,1
11161,11200,1
11521,11560,1
11881,11920,1
12241,12280,1
12601,12640,1
12961,13000,1
13321,13360,1
13681,13720,1
14041,14080,1
*ELSET,ELSET=QUART11,GEN
1,20,1
41,60,1
81,100,1
121,140,1
161,180,1
201,220,1
241,260,1
281,300,1
321,340,1
*ELCOPY,OLDSET=QUART11,NEWSET=QUART12,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART12,NEWSET=QUART13,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART13,NEWSET=QUART14,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART14,NEWSET=QUART15,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART15,NEWSET=QUART16,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART16,NEWSET=QUART17,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART17,NEWSET=QUART18,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART18,NEWSET=QUART19,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART19,NEWSET=QUART110,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART110,NEWSET=QUART111,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART111,NEWSET=QUART112,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART112,NEWSET=QUART113,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART113,NEWSET=QUART114,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART114,NEWSET=QUART115,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART115,NEWSET=QUART116,ELEMENT SHIFT=360,
SHIFT NODES=410
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*ELCOPY,OLDSET=QUART116,NEWSET=QUART117,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART117,NEWSET=QUART118,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART118,NEWSET=QUART119,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART119,NEWSET=QUART120,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELSET,ELSET=QUART1
QUART11,QUART12,QUART13,QUART14,QUART15,QUART16,QUART17,QUART18,
QUART19,QUART110,QUART111,QUART112,QUART113,QUART114,QUART115,QUART116,
QUART117,QUART118,QUART119,QUART120
*ELSET,ELSET=QUART21,GEN
21,40,1
61,80,1
101,120,1
141,160,1
181,200,1
221,240,1
261,280,1
301,320,1
341,360,1
*ELCOPY,OLDSET=QUART21,NEWSET=QUART22,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART22,NEWSET=QUART23,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART23,NEWSET=QUART24,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART24,NEWSET=QUART25,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART25,NEWSET=QUART26,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART26,NEWSET=QUART27,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART27,NEWSET=QUART28,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART28,NEWSET=QUART29,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART29,NEWSET=QUART210,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART210,NEWSET=QUART211,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART211,NEWSET=QUART212,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART212,NEWSET=QUART213,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART213,NEWSET=QUART214,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART214,NEWSET=QUART215,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART215,NEWSET=QUART216,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART216,NEWSET=QUART217,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART217,NEWSET=QUART218,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART218,NEWSET=QUART219,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART219,NEWSET=QUART220,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELSET,ELSET=QUART2
QUART21,QUART22,QUART23,QUART24,QUART25,QUART26,QUART27,QUART28,
QUART29,QUART210,QUART211,QUART212,QUART213,QUART214,QUART215,QUART216,
QUART217,QUART218,QUART219,QUART220
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*ELCOPY,OLDSET=QUART120,NEWSET=QUART121,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART121,NEWSET=QUART122,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART122,NEWSET=QUART123,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART123,NEWSET=QUART124,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART124,NEWSET=QUART125,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART125,NEWSET=QUART126,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART126,NEWSET=QUART127,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART127,NEWSET=QUART128,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART128,NEWSET=QUART129,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART129,NEWSET=QUART130,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART130,NEWSET=QUART131,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART131,NEWSET=QUART132,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART132,NEWSET=QUART133,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART133,NEWSET=QUART134,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART134,NEWSET=QUART135,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART135,NEWSET=QUART136,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART136,NEWSET=QUART137,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART137,NEWSET=QUART138,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART138,NEWSET=QUART139,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART139,NEWSET=QUART140,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELSET,ELSET=QUART3
QUART121,QUART122,QUART123,QUART124,QUART125,QUART126,QUART127,QUART128,
QUART129,QUART130,QUART131,QUART132,QUART133,QUART134,QUART135,QUART136,
QUART137,QUART138,QUART139,QUART140
**
*ELCOPY,OLDSET=QUART220,NEWSET=QUART221,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART221,NEWSET=QUART222,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART222,NEWSET=QUART223,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART223,NEWSET=QUART224,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART224,NEWSET=QUART225,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART225,NEWSET=QUART226,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART226,NEWSET=QUART227,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART227,NEWSET=QUART228,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART228,NEWSET=QUART229,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART229,NEWSET=QUART230,ELEMENT SHIFT=360,
SHIFT NODES=410
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*ELCOPY,OLDSET=QUART230,NEWSET=QUART231,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART231,NEWSET=QUART232,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART232,NEWSET=QUART233,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART233,NEWSET=QUART234,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART234,NEWSET=QUART235,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART235,NEWSET=QUART236,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART236,NEWSET=QUART237,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART237,NEWSET=QUART238,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART238,NEWSET=QUART239,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELCOPY,OLDSET=QUART239,NEWSET=QUART240,ELEMENT SHIFT=360,
SHIFT NODES=410
*ELSET,ELSET=QUART4
QUART221,QUART222,QUART223,QUART224,QUART225,QUART226,QUART227,QUART228,
QUART229,QUART230,QUART231,QUART232,QUART233,QUART234,QUART235,QUART236,
QUART237,QUART238,QUART239,QUART240
*NODE,NSET=NOUT
100000,300.,410.,300.
*ELEMENT,TYPE=MASS,ELSET=PMASS
100000,100000
*MASS,ELSET=PMASS
0.2,
*SOLID SECTION,ELSET=BLANK,MATERIAL=FOAM,CONTROLS=SECT
*SECTION CONTROLS,HOURGLASS=ENHANCED,
KINEMATICS=ORTHOGONAL,NAME=SECT, DISTORTION CONTROL
*MATERIAL,NAME=FOAM
*ELASTIC
 7.5E3, 0.0
*CRUSHABLE FOAM,HARDENING=ISOTROPIC
 1.0, 0.0
*CRUSHABLE FOAM HARDENING
 0.2000E3, 0.0000
 0.2577E3, 0.0094
 0.2760E3, 0.0258
 0.3053E3, 0.0452
 0.3267E3, 0.0655
 0.3623E3, 0.1084
 0.3891E3, 0.1540
 0.4250E3, 0.2405
 0.4568E3, 0.3812
 0.4738E3, 0.4600
 0.5170E3, 0.6391
 0.5862E3, 0.8570
 0.6503E3, 0.9857
 0.7470E3, 1.1324
 0.9820E3, 1.2965
 1.4702E3, 1.4808
 2.7262E3, 1.6609
 5.3911E3, 1.9000
*DENSITY
 60.E-9,
*BOUNDARY
BOT,1,3,
100000,1,
100000,3,
100000,4,6,
*AMPLITUDE,NAME=RAMPP,TIME=TOTAL TIME,
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DEFINITION=SMOOTH STEP
0.0,0.0,0.06,-285.,
*ELSET,ELSET=SMALL,GEN
6495,6505,1
6855,6865,1
7215,7225,1
*NSET,NSET=SMALL
7571,7581,7591,7981,7991,8001,8391,8401,
8411,
*SURFACE,TYPE=ELEMENT,NAME=TARGET
UPPER,S5
*SURFACE,TYPE=CUTTING SURFACE,NAME=MID_CUT
585.0, 150., 600.0, 0., 1., 0.

*SURFACE,TYPE=CUTTING SURFACE,NAME=BOT_CUT
600.0, 15.0, 600.0, 0., -1., 0.

*SURFACE,TYPE=CUTTING SURFACE,NAME=ANGLE_CUT
585.0, 150., 600.0, -.08, 1., -0.16

*SURFACE,TYPE=REVOLUTION,NAME=PUNCH
300., 400., 300.,300.,600., 300.
START,100.,80.
LINE, 100.,0.
CIRCL,0.,-100.,0.,0.
*RIGID BODY,REF NODE=100000,
ANALYTICAL SURFACE =PUNCH
*STEP
*DYNAMIC,EXPLICIT
,0.06
*BOUNDARY,AMPLITUDE=RAMPP
100000,2,2,1.
*SURFACE INTERACTION,NAME=IMP_TARG
*CONTACT PAIR,INTERACTION=IMP_TARG
PUNCH,TARGET
*FILE OUTPUT,NUMBER INTERVAL=1, TIMEMARKS=YES
*EL FILE, ELSET=SMALL
 LE,
*NODE FILE, NSET=NOUT
 U,RF
*ENERGY FILE
*****
*NSET, NSET=QA_TEST_REFN
NOUT,
*ELSET, ELSET=QA_TEST
SMALL,
*NSET, NSET=QA_TEST
SMALL,
*OUTPUT, FIELD, TIME MARKS=YES, NUMBER INTERVAL=1
*ELEMENT OUTPUT, ELSET=QA_TEST
PEEQ,
*NODE OUTPUT, NSET=QA_TEST
U,
*NODE OUTPUT, NSET=QA_TEST_REFN
RF,
*OUTPUT, HIST, FREQ=9999
*ENERGY OUTPUT, VAR=PRESELECT
*NODE OUTPUT, NSET=QA_TEST_REFN
RF,
*INTEGRATED OUTPUT, SURFACE=TARGET
SOF,SOM
*INTEGRATED OUTPUT, SURFACE=BOT_CUT
SOF,SOM
*INTEGRATED OUTPUT, SURFACE=MID_CUT
SOF,SOM
```

```
*INTEGRATED OUTPUT, SURFACE=ANGLE_CUT
SOF,SOM
******
*** output for figures
*OUTPUT, FIELD, TIME MARKS=YES, NUMBER INTERVAL=1
*ELEMENT OUTPUT
PEEQ,
*NODE OUTPUT
U,
*END STEP
```