6.3 Example C: Thermomechanical Load Problem

Sample Input File For A Thermomechanical Load Problem

The following example is used to explain how to impose thermal residual stresses due to manufacturing into mechanical analysis.

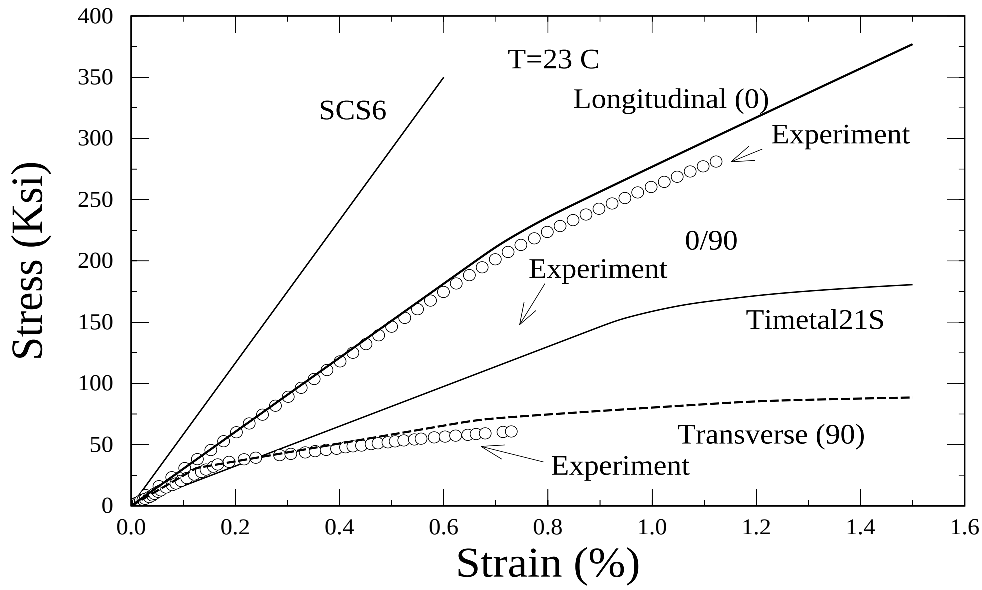
Problem Summary:

Load Type:	Thermomechanical
Load Component:	33-direction (transverse to fiber)
Load History:	Cyclic
Load Control:	Strain
Load History Data:	Cool-down from 900 ^{o}C to 23 ^{o}C then hold temperature constant during mechanical loading $\dot{T} = 1.52x10^{-2}$ ^{o}C/sec $\dot{\varepsilon} = 1.666x10^{-4}$ /sec, $\varepsilon_{max} = 0.015$, $\varepsilon_{min} = 0.$ $\Delta t_{thermal} = 100.$ sec, $\Delta t_{mech} = 0.1$ sec
Micromechanics model:	Double Periodicity
Fiber Packing Arrangement:	Rectangular Pack at 33% fiber volume ratio
Integration Algorithm:	Forward Euler
Constituent Material Model:	GVIPS - isotropic form
Constituents:	Fiber: SCS-6 (properties input manually) Matrix: TIMETAL21S
Debonding:	First implementation of debond model

☞ **Note: This example demonstrates how one would included the effects of residual stresses on the composite behavior. Also, although strain control is prescribe, during a pure cool down MAC/GMC allows Poisson’s strains to be incurred.**

```
test of residual stress idp=11 23C apply transverse loading
*PRINT
 NPL=0 %
*LOAD
 LCON=3 LOP=3 LSS=1 %
#  LCON=3 LOP=1 LSS=1 %
*MECH
 NPTW=3 TI=0.,57600.,57690. LO=0.,0.,0.015 %
#  NPTW=3 TI=0.,57600.,57750. LO=0.,0.,0.015 %
*THERM
 NPTT=3 TI=0.,57600.,57690. TE=900.,23.,23. %
#  NPTT=3 TI=0.,57600.,57750. TE=900.,23.,23. %
*MODEL
 MOD=1 %
*SOLVER
 NTF=1 NPTS=3 TIM=0.,57600.,57690. STP=100.,0.1 %
#  NTF=1 NPTS=3 TIM=0.,57600.,57750. STP=100.,0.1 %
*FIBER
 NFIBS=1
# Use GVIPS but make it elastic k=1E20, so it represents SCS-6 fiber
 NF=1 MF=4 NDPT=1 MAT=U IFM=1 &
 EL=58.E3, 0.32, 3.5E-06 &
 VI=0.8E-9,1.E20,0.1E-5,0.,0.85E-4,0.05,1.,1.,1.,3.3,1.8,1.35,1.,0.01 %
*MATRIX
 NMATX=1
 NM=1 MM=4 NDPT=2 MAT=A %
*MRVE
 IDP=11 VF=0.33 RAD=0.07 R=1.1111 %
*DEBOND
 NII=2
 DBCH=1 NBI=1 NGI=1 FACE=2 RN=0.1 BDN=14. TI=57600.
 DBCH=1 NBI=1 NGI=2 FACE=2 RN=0.1 BDN=14. TI=57600. %
*CURVE
 NP=2 %
*MACRO
 NT=2
 NC=1 X=3 Y=9 NAM=apdxc-t
 NC=2 X=1 Y=7 NAM=apdxc-l
*END
```

The following figure was obtained from the x-y plot data file produced by the present example.



☞ **Note:** In order to produce the longitudinal response curve one must change the direction of loading (LOP=1 instead of 3) and the mechanical strain rate imposed, so as to agree with the imposed experimental history by commenting and uncommenting the appropriate lines under *LOAD, *MECH, *THERM, and *SOLVER.

☞ **Note:** It is recommended that a new user construct a **MAC/GMC** input file using the data given in this Example and then check to see if the same resulting plot can be obtained.