Appendix F

Test Cases - Preload Analysis

This appendix contains:

Item	Description	Page
F-02	Table: Bolt shank average axial stress (S33)	F-02
F-03	Figure: Bolt axial stresses (s33) Time History Plots	F-03
F-08	Input Deck: Setpre01_A.inp	F-08
F-10	Command Proc: BBXY.COM	F-10
F-12	Journal File: BBXY.JNL	F-12

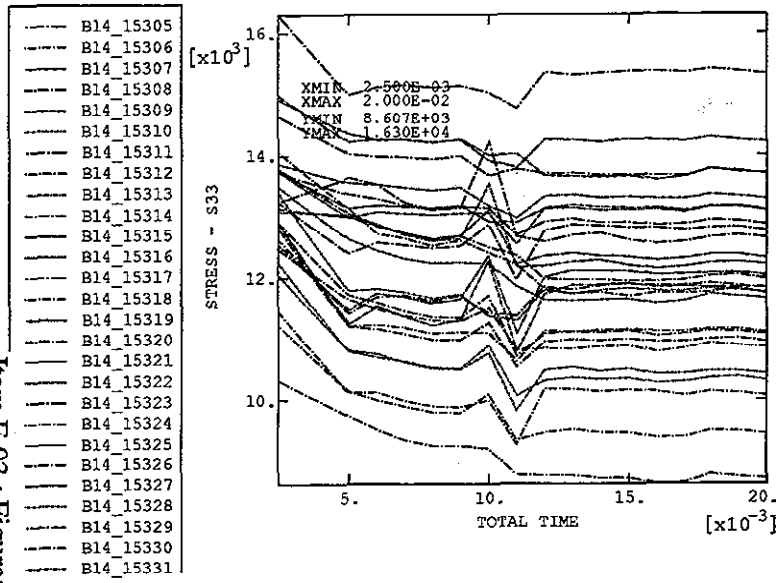
Bolt shank average axial stress S33

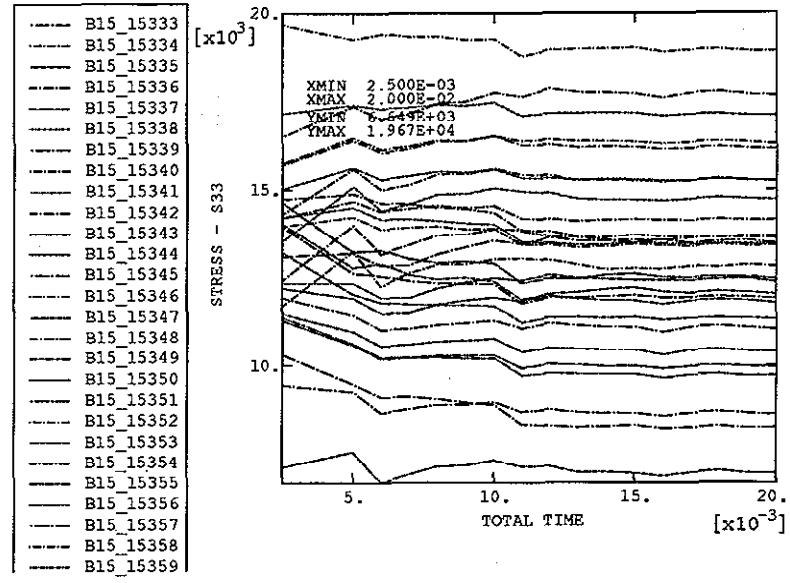
Time	B_14	B_15	B_16	B_17	B_34	B_35	B_36	B_37
0.002	13215.	13400.	13513.	13847.	223.	249.	41.	-236.
0.005	12324.	13452.	13390.	13068.	49416.	53712.	56426.	50916.
0.006	12289.	13078.	13592.	13400.	45118.	49256.	52412.	46562.
0.007	12203.	13117.	13205.	13387.	43201.	47420.	50596.	44919.
0.008	12121.	13222.	13277.	13277.	42258.	46384.	49574.	43928.
0.009	12150.	13233.	13337.	12902.	41621.	45872.	49014.	43513.
0.010	12282.	13294.	13213.	13372.	41184.	45259.	48524.	42918.
0.011	11695.	12988.	13365.	13392.	41102.	45248.	48343.	42970.
0.012	11978.	13051.	13450.	13012.	40809.	44817.	48109.	42805.
0.013	12002.	12988.	13413.	12968.	40525.	44715.	47875.	42581.
0.014	11993.	12988.	13414.	12917.	40543.	44645.	47810.	42556.
0.015	11995.	12998.	13409.	12946.	40463.	44576.	47722.	42455.
0.016	11947.	12934.	13416.	12940.	40481.	44573.	47714.	42579.
0.017	11957.	12971.	13423.	12931.	40350.	44468.	47666.	42427.
0.018	12020.	13004.	13399.	12925.	40287.	44374.	47538.	42305.
0.019	12012.	12974.	13414.	12934.	40363.	44367.	47610.	42378.
0.020	11967.	12947.	13421.	12934.	40332.	44378.	47572.	42364.

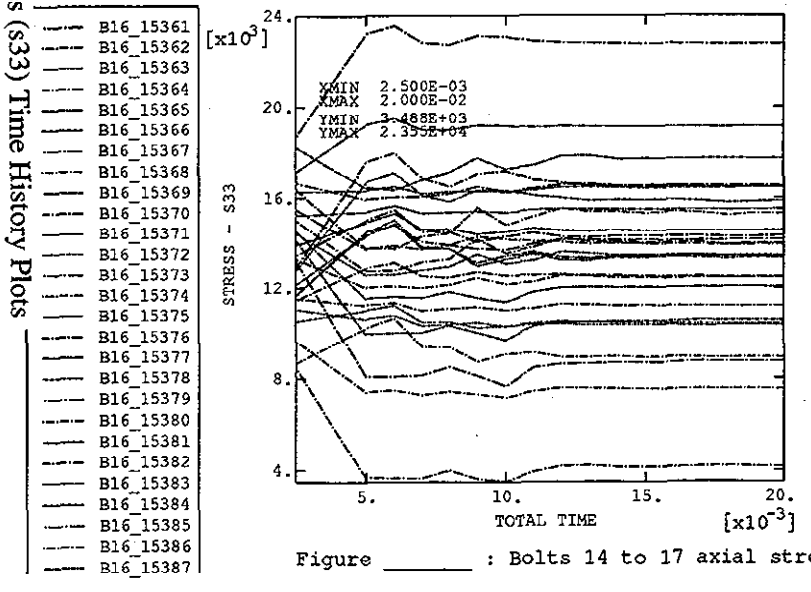
Time	B_41	B_42	B_43	B_44	B_48	B_49	B_50	B_51
0.002	257.	-299.	44.	-252.	307.	91.	604.	-338.
0.005	1179.	6236.	3026.	11960.	26647.	45759.	27337.	43576.
0.006	1192.	5949.	2536.	10592.	23563.	42787.	25254.	40254.
0.007	1260.	6008.	2629.	10334.	22319.	41572.	24432.	39148.
0.008	1169.	5649.	2367.	10340.	22021.	40927.	24287.	38360.
0.009	1016.	5657.	2774.	10621.	21895.	40623.	23991.	37884.
0.010	1122.	5473.	2184.	10267.	21638.	40477.	24100.	37394.
0.011	1170.	5773.	2084.	9992.	21402.	40463.	23970.	37337.
0.012	1192.	5632.	2334.	10059.	21391.	40262.	23957.	37253.
0.013	1131.	5700.	2357.	10075.	21363.	40171.	23848.	37134.
0.014	1177.	5705.	2255.	10198.	21378.	40245.	23866.	37044.
0.015	1091.	5566.	2390.	10088.	21372.	40148.	23838.	37016.
0.016	1082.	5545.	2319.	10155.	21347.	40199.	23904.	37110.
0.017	1171.	5668.	2350.	10084.	21313.	40146.	23899.	36990.
0.018	1113.	5544.	2389.	10107.	21264.	40058.	23839.	36881.
0.019	1106.	5602.	2358.	10140.	21300.	40131.	23793.	36971.
0.020	1093.	5559.	2339.	10117.	21294.	40102.	23830.	36952.

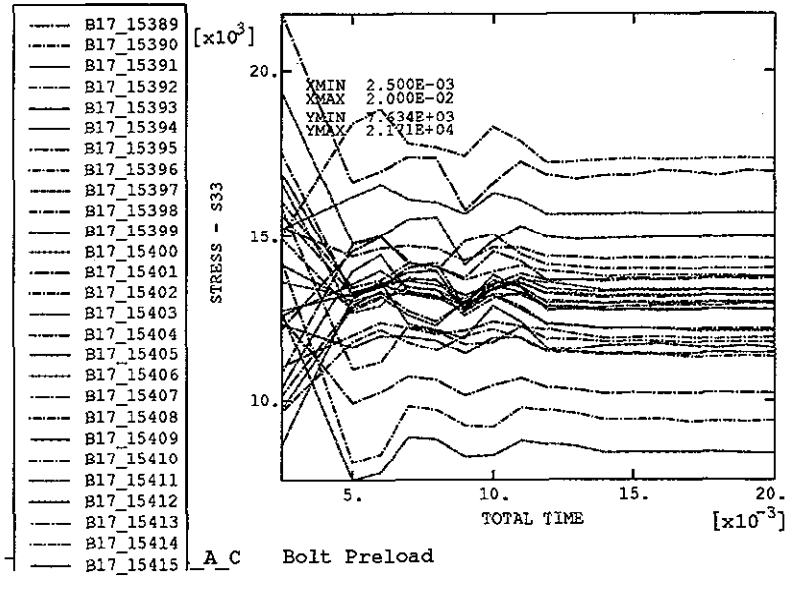
Time	B_55	B_56	B_57
0.002	-123.	475.	216.
0.005	34857.	36201.	28257.
0.006	32170.	32593.	26430.
0.007	31153.	31241.	25536.
0.008	30843.	30701.	25239.
0.009	30575.	30019.	24697.
0.010	30254.	30054.	24520.
0.011	30149.	29918.	24573.
0.012	29839.	29764.	24380.
0.013	29744.	29735.	24372.
0.014	29774.	29732.	24472.
0.015	29754.	29752.	24348.
0.016	29699.	29775.	24355.
0.017	29679.	29733.	24374.
0.018	29606.	29689.	24317.
0.019	29656.	29743.	24364.
0.020	29602.	29723.	24359.

Item F-02 : Table: Bolt shank average axial stress (S33)



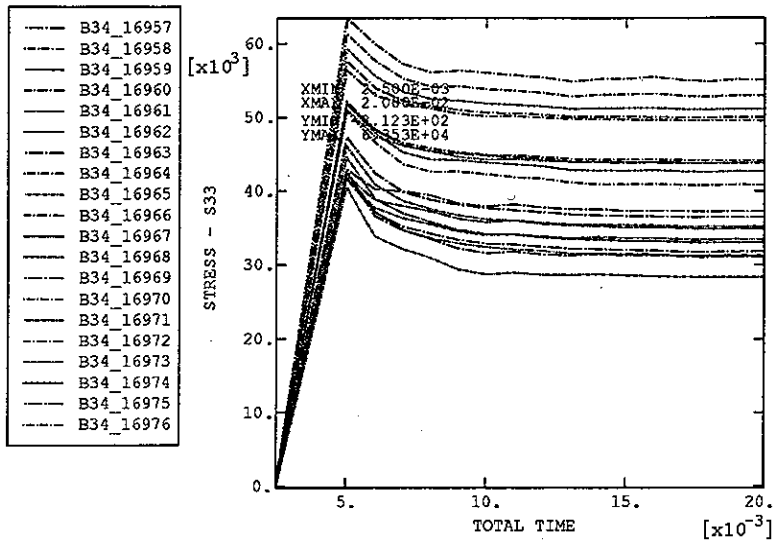


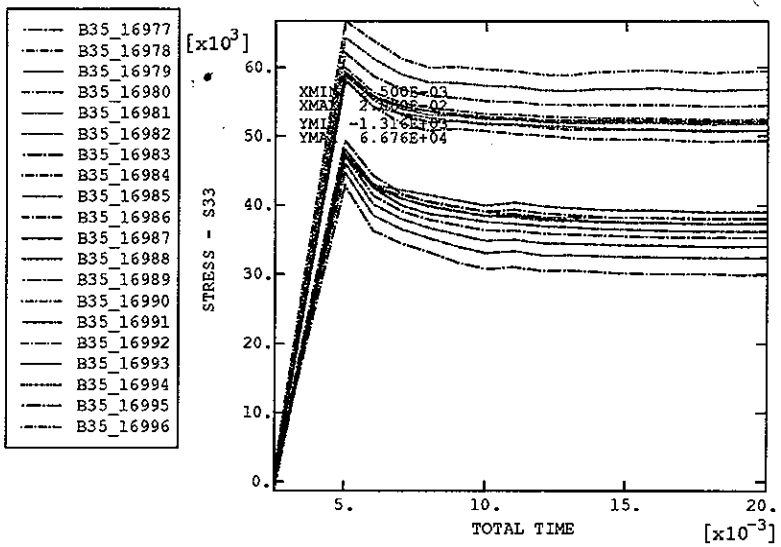


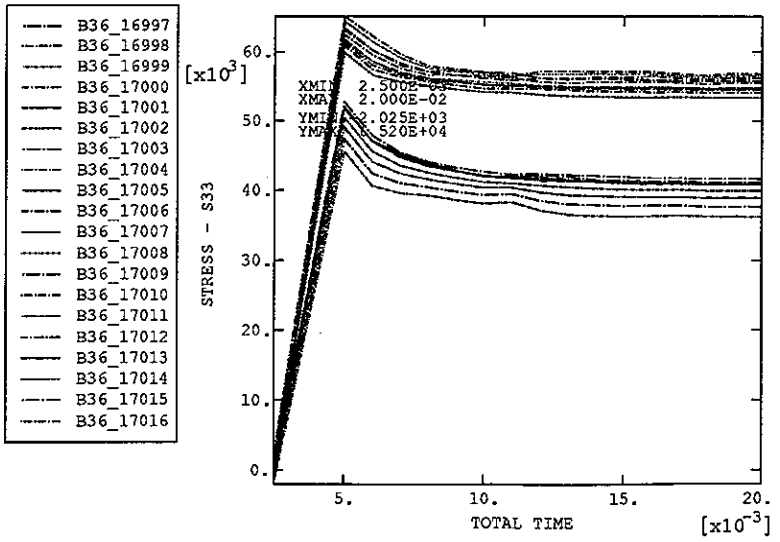


Item F-03 : Figure: Bolt axial stresses (s33) Time History Plots

Figure _____ : Bolts 14 to 17 axial stress time histories _A_C Bolt Preload







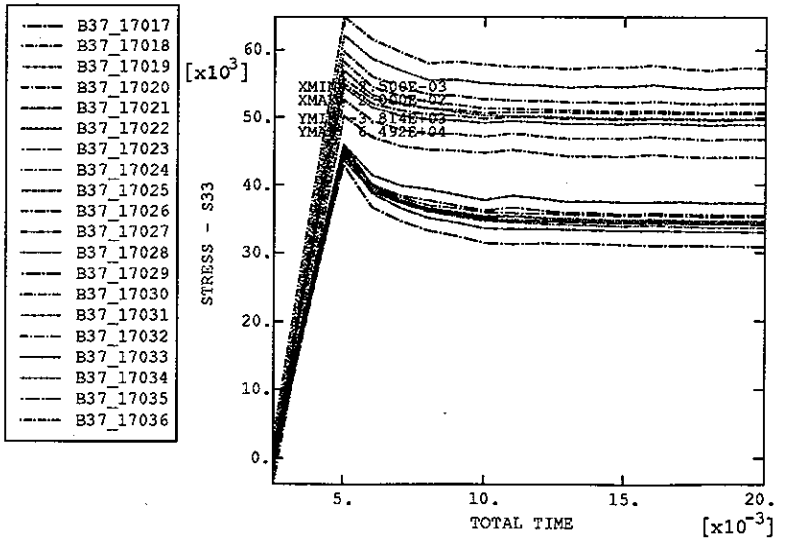
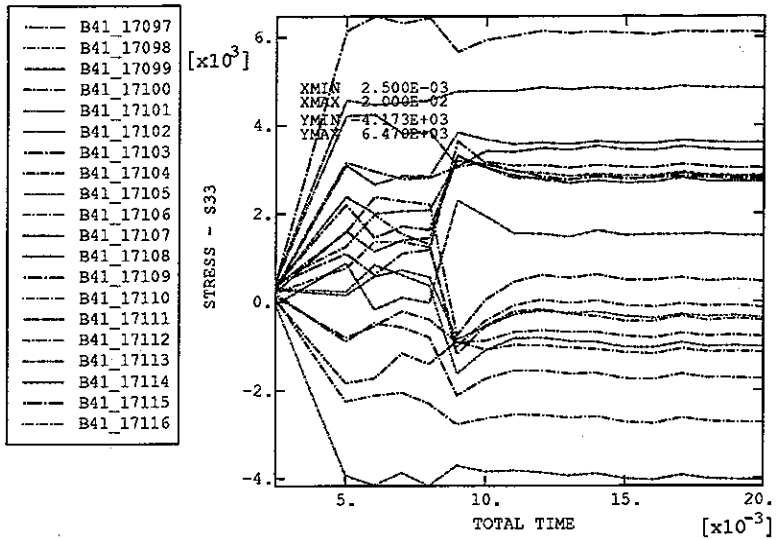
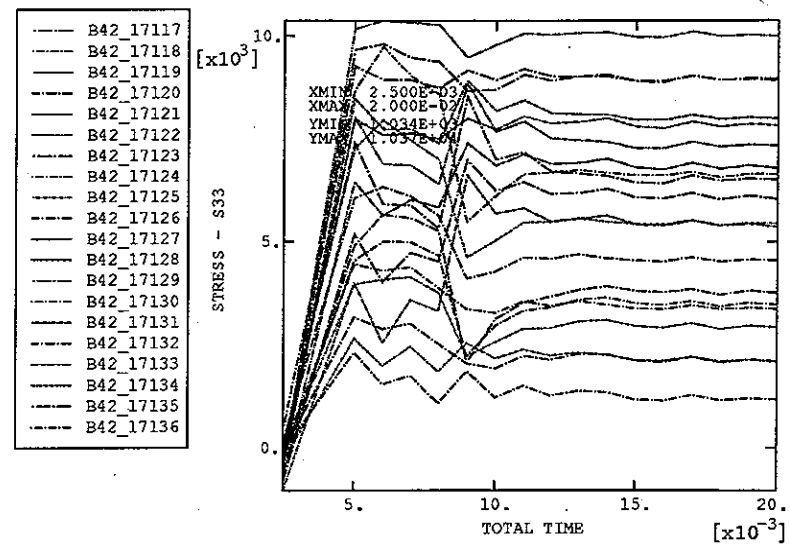
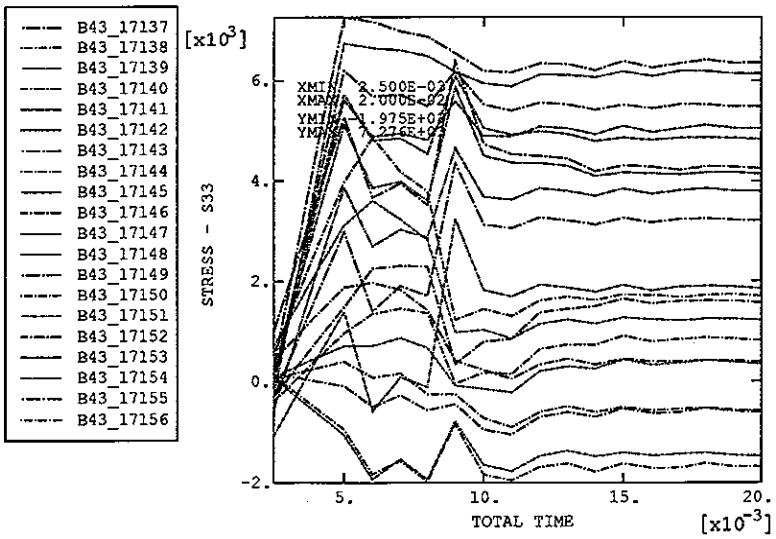


Figure _____ : Bolts 34 to 37 axial stress time histories - run SETPRE01_A_C Bolt Preload







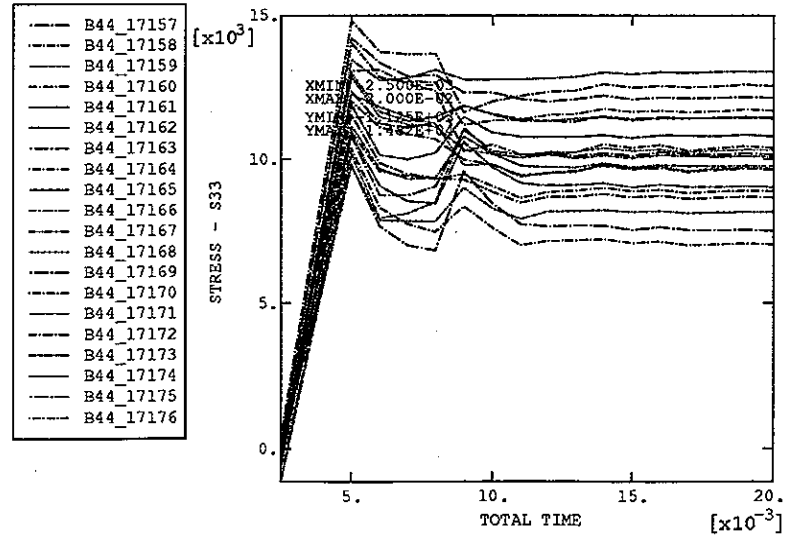
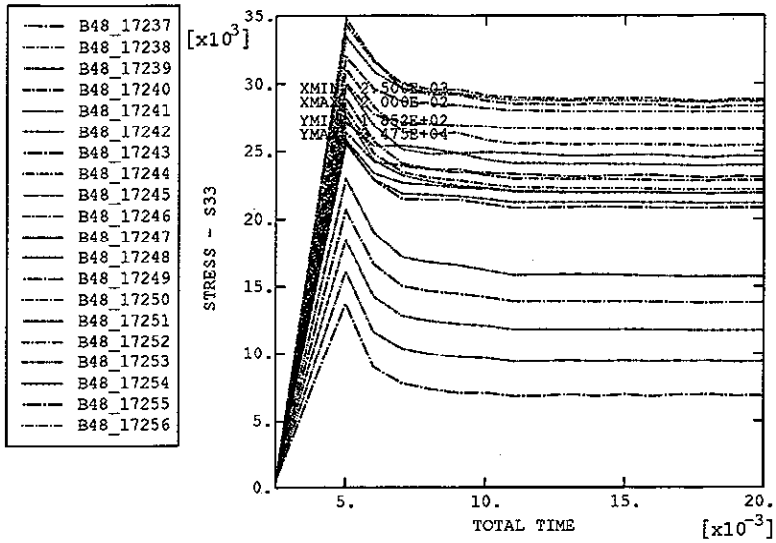
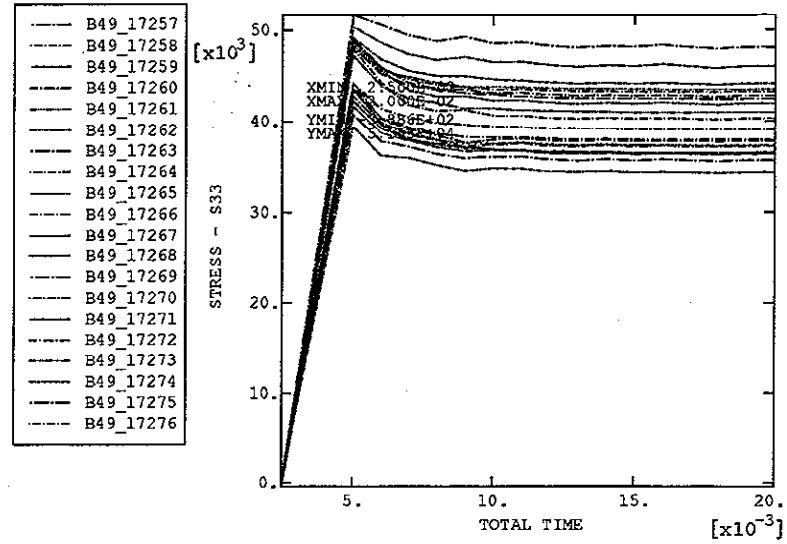
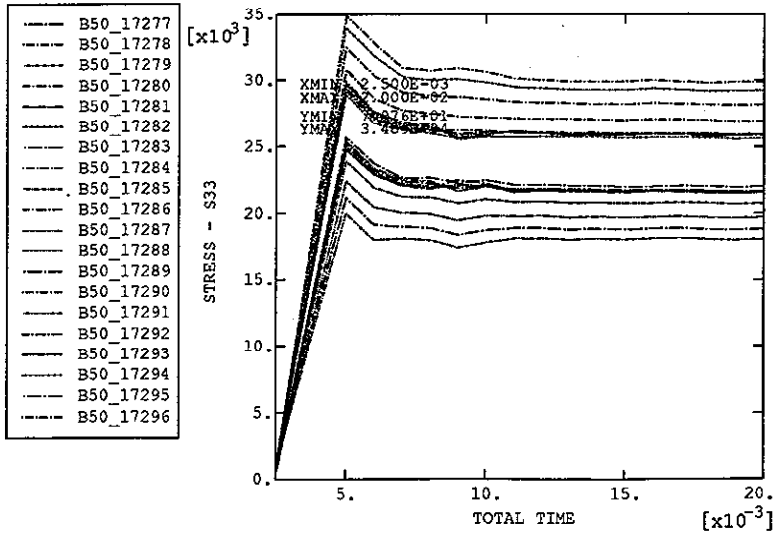


Figure _____ : Bolts 41 to 44 axial stress time histories - run SETPRE01_A_C Bolt Preload







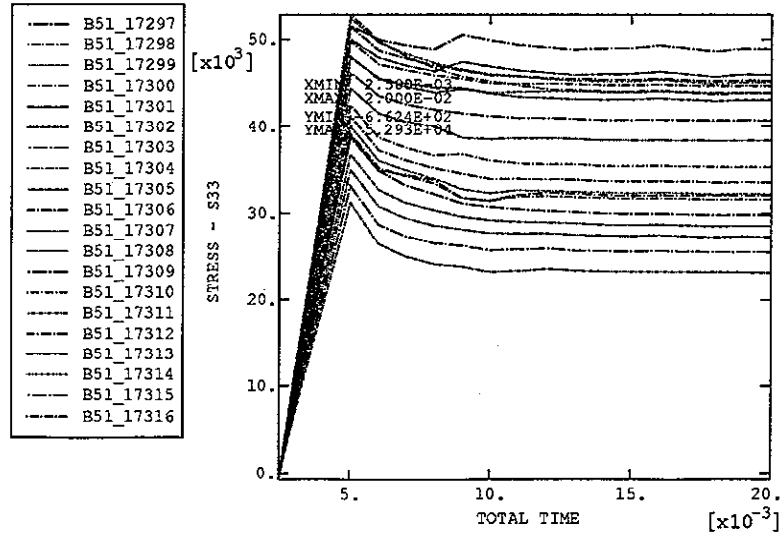
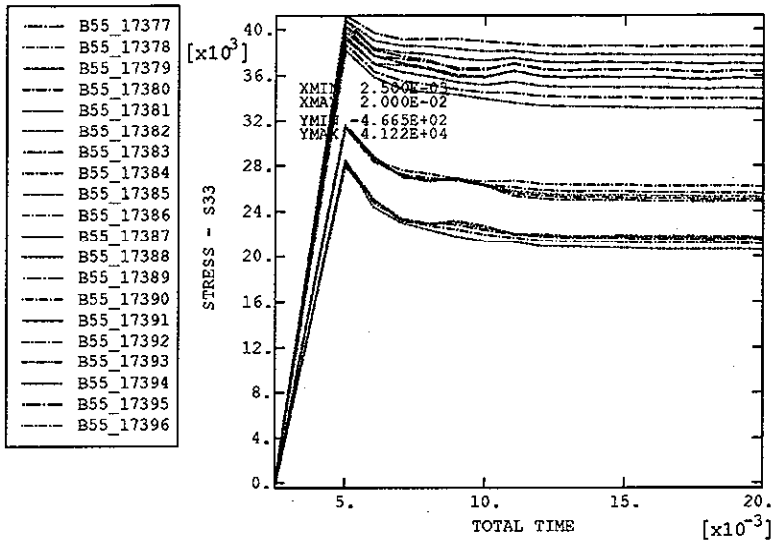
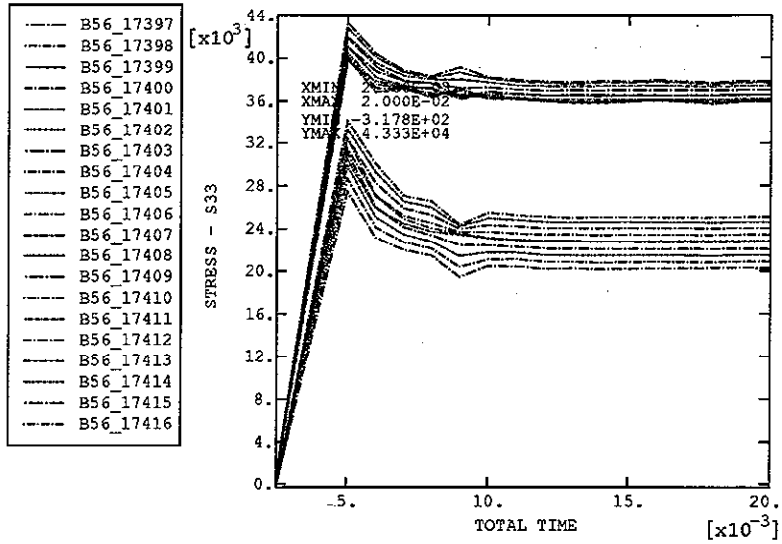


Figure _____ : Bolts 48 to 51 axial stress time histories - run SETPRE01_A_C Bolt Preload





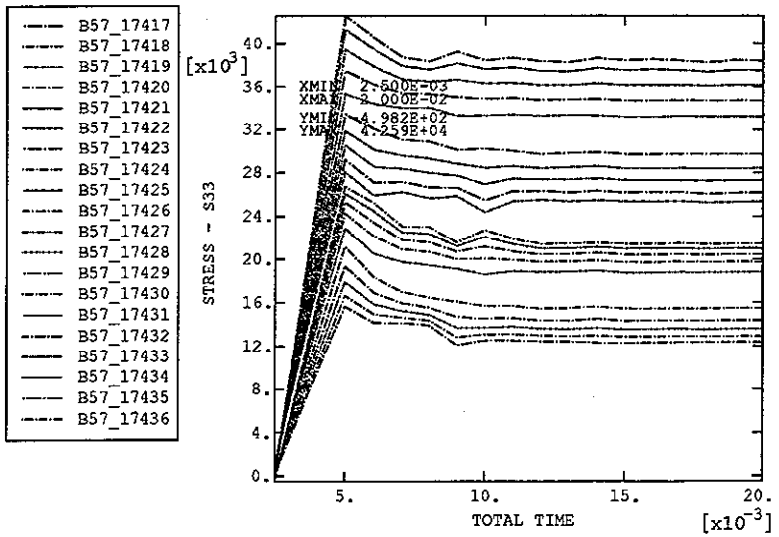


Figure _____ : Bolts 55 to 57 axial stress time histories - run SETPRE01_A_C

F-8

STRESS::BASKIN

JOB 594

SETPRE01_A.INP;1

File: _6DRB5:[BASKIN.TEST.CUT.PRELOAD]SETPRE01_A.INP;1
Last Modified: 3-NOV-1997 12:09
Owner UIC: [G42,BASKIN]

Length:	7 blocks
Longest record:	80 bytes
Priority:	100
Submit queue:	SYS$PRINT
Submitted:	10-NOV-1997 12:00
Printer queue:	SYS$PRINT
Printer device:	POSTMO::

```
*HEADING
BRUCE A BOLER DIVIDER PLATE MODEL - SKIN FIX
**
**
** *PREPRINT, MODEL=NO, HISTORY=NO, ECHO=NO
**
*INCLUDE, input= MODEL.NODE
*INCLUDE, input= MODEL.NSET
**
*NCOPY,CHANGE NUMBER=33000,OLD SET=NREF,SHIFT
0,0,-0.158

*INCLUDE, input= MODEL.NODE_XSYMM
**
**
*INCLUDE, input= MODEL.ELEM
*INCLUDE, input= MODEL.ELSET_SUM
*INCLUDE, input= MODEL.ELSET
**
*INCLUDE, input= MODEL.MATERIAL_A
**
*INCLUDE, input= MODEL.STRESS
**
*INCLUDE,INPUT= MODEL.ELSET2
**
*AMPLITUDE, NAME=RAMP1, TIME=TOTAL TIME
0.0,0.0,20.0E-3,0.0,80.0E-3,300.0
**
*BOUNDARY
NFIXED, ENCASTRE
NSYMY, YSYMM
CPSYM, YSYMM
SKSYM, YSYMM
XSYMM, XSYMM
**
*INITIAL CONDITIONS,TYPE=TEMPERATURE
ALLN,70.0
** ----------------------------------
*INCLUDE,INPUT=MODEL.NSET_BOLTS
** ----------------------------------
*NODE,NSET=N_CONTAC
*INCLUDE, input=MODEL.ADDITIONAL
*STEP
LOAD RAMP
*DYNAMIC, EXPLICIT
 ,5.0E-3
**
*INCLUDE, input=MODEL.CSURF_MOD
*INCLUDE, input=MODEL.CPAIR
*INCLUDE, input=MODEL.CPAIR_TIED
*INCLUDE, input=MODEL.CINTER
**
*DLOAD,AMP=RAMP1
C1EF2,P2,1.0
C2EF2,P2,1.0
**
*TEMPERATURE
N_ECB14,70.0
N_ECB15,70.0
N_ECB16,70.0
N_ECB17,70.0
N_ECB34,-2000.0
N_ECB35,-2000.0
N_ECB36,-2000.0
```



```
N_ECB37,-2000.0
N_ECB41,-2000.0
N_ECB42,-2000.0
N_ECB43,-2000.0
N_ECB44,-2000.0
N_ECB48,-2000.0
N_ECB49,-2000.0
N_ECB50,-2000.0
N_ECB51,-2000.0
N_ECB55,-2000.0
N_ECB56,-2000.0
N_ECB57,-2000.0
**
*MONITOR, NODE=15873, DOF=3, FREQ=1
**
*RESTART, WRITE, NUM=2
**
*HISTORY OUTPUT, TIME INTERVAL=0.001
*EL HISTORY,ELSET=ECBU
S33
PEEQ,
*NODE HISTORY,NSET=BREF
U,V,A
*NODE HISTORY,NSET=NFIXED
RF
*ENERGY HISTORY
 ALLKE,ALLIE, ALLPD,ALLSE, ALLVD,ALLKL,ALLFD,ALLAE,ALLWK,ETOTAL
*END STEP
** ----------------------------------
*STEP
LOAD RAMP
*DYNAMIC, EXPLICIT
 ,5.0E-3
**
*DLOAD,AMP=RAMP1
C1EF2,P2,1.0
C2EF2,P2,1.0
**
*TEMPERATURE
N_ECB14,70.0
N_ECB15,70.0
N_ECB16,70.0
N_ECB17,70.0
N_ECB34,-2000.0
N_ECB35,-2000.0
N_ECB36,-2000.0
N_ECB37,-2000.0
N_ECB41,-2000.0
N_ECB42,-2000.0
N_ECB43,-2000.0
N_ECB44,-2000.0
N_ECB48,-2000.0
N_ECB49,-2000.0
N_ECB50,-2000.0
N_ECB51,-2000.0
N_ECB55,-2000.0
N_ECB56,-2000.0
N_ECB57,-2000.0
**
*MONITOR, NODE=15873, DOF=3, FREQ=1
**
*RESTART, WRITE, NUM=5
**
*END STEP
```



```
** ----------------------------------
*STEP
LOAD RAMP
*DYNAMIC, EXPLICIT
 ,5.0E-3
**
*TEMPERATURE
N_ECB14,70.0
N_ECB15,70.0
N_ECB16,70.0
N_ECB17,70.0
N_ECB34,-2000.0
N_ECB35,-2000.0
N_ECB36,-2000.0
N_ECB37,-2000.0
N_ECB41,-2000.0
N_ECB42,-2000.0
N_ECB43,-2000.0
N_ECB44,-2000.0
N_ECB48,-2000.0
N_ECB49,-2000.0
N_ECB50,-2000.0
N_ECB51,-2000.0
N_ECB55,-2000.0
N_ECB56,-2000.0
N_ECB57,-2000.0
**
*MONITOR, NODE=15873, DOF=3, FREQ=1
**
*RESTART, WRITE, NUM=5
**
*END STEP
** ----------------------------------
*STEP
LOAD RAMP
*DYNAMIC, EXPLICIT
 ,5.0E-3
**
*TEMPERATURE
N_ECB14,70.0
N_ECB15,70.0
N_ECB16,70.0
N_ECB17,70.0
N_ECB34,-2000.0
N_ECB35,-2000.0
N_ECB36,-2000.0
N_ECB37,-2000.0
N_ECB41,-2000.0
N_ECB42,-2000.0
N_ECB43,-2000.0
N_ECB44,-2000.0
N_ECB48,-2000.0
N_ECB49,-2000.0
N_ECB50,-2000.0
N_ECB51,-2000.0
N_ECB55,-2000.0
N_ECB56,-2000.0
N_ECB57,-2000.0
**
*MONITOR, NODE=15873, DOF=3, FREQ=1
**
*RESTART, WRITE, NUM=5
**
*END STEP
```



```
** ----------------------------------
```

STRESS::BASKIN

JOB 595

BBXY.COM;11

File: _6DRB5:[BASKIN.TEST.CUT.PRELOAD]BBXY.COM;11
Last Modified: 5-NOV-1997 08:40
Owner UIC: [G42,BASKIN]

Length:	3 blocks
Longest record:	76 bytes
Priority:	100
Submit queue:	SYS$PRINT
Submitted:	10-NOV-1997 12:00
Printer queue:	SYS$PRINT
Printer device:	POSTMO::

F-11

```
_$6$DRB5:[BASKIN.TEST.CUT.PRELOAD]BBXY.COM;11    5-NOV-1997 08:40     Page 1

$! type @sspp:submit bbxy////converted_restart_file_runid,sel_file_run_id
$!
$  set def d42f:[baskin.test.cut.preload]
$  if f$mode().eqs."BATCH"
$  then
$       set veri
$       if p1.eqs."" then exit
$       @d42:[mlleta]pr.com
$  else
$    if p1.eqs."" then inq p1 "Enter .RES converted restart file run ID "
$    if p2.eqs."" then inq p2 "Enter .SEL file run ID ? (CR) for fast plot "
$    if p3.eqs."" then inq p3 "Print the plots ?  (Yes) "
$    p3=f$ext(0,1,p3)
$    if p2.eqs."" then p2="_"
$    if p3.eqs."" then p3="_"
$    @sspp:submit bbxy.com/7///'p1','p2','p3'
$    exit
$  endif
$!
$  comments="Bolt Preload"
$  open/write lfn 'p1'_bbxy.edt
$  write lfn "s/run_id/ ''p1'/w
$  write lfn "s/comments/''comments'/w
$  if p2.eqs."_" then write lfn "s/sel,file=/** sel,file=/w
$  if p2.nes."_" then write lfn "s/sel,file=/sel,file=''p2'/w
$  write lfn "exit
$  close lfn
$!
$  ed/comm='p1'_bbxy/out='p1'_bbxy.jnl bbxy.jnl
$!
$  abqp post j='p1'_bbxy rest='p1' inp='p1'_bbxy.jnl dev=terminal
$!
$  if(f$sea("''p1'_bbxy.ps").nes."") then del 'p1'_bbxy.ps;*
$  abqp plot j='p1'_bbxy dev=cps
b
n
n
y
L
4

n
$  if p3.nes."N" then 'prtaps' 'p1'_bbxy.ps
$  del 'p1'_bbxy.edt;
$  def/u for001 'p1'.bpe
$  def/u for002 'p1'.s33sum
$  run roads33


$  'prt' 'p1'.s33sum
$exit
```

F-12

STRESS::BASKIN

JOB 596

BBXY.JNL;12

File: _6DRB5:[BASKIN.TEST.CUT.PRELOAD]BBXY.JNL;12
Last Modified: 4–NOV–1997 09:58
Owner UIC: [G42,BASKIN]

Length:	6 blocks
Longest record:	78 bytes
Priority:	100
Submit queue:	SYS$PRINT
Submitted:	10–NOV–1997 12:00
Printer queue:	SYS$PRINT
Printer device:	POSTMO::

```
set,xy print file=run_id.BPE
set,xy report=(0.38,0.75)
graph legend,ori=(0.01,0.98)
sel,file=
set,har=run_id_bbxy.mpl
** graph axes,ymax=  0.1200
read curve,var=s33,ele=ecb14u,name=b14
disp
b14

print curve
b14

read curve,var=s33,ele=ecb15u,name=b15
disp
b15

print curve
b15

read curve,var=s33,ele=ecb16u,name=b16
disp
b16

print curve
b16

tit,ori=(.35,.01),siz=.02
Figure _____ : Bolts 14 to 17 axial stress time histories - run run_id
read curve,var=s33,ele=ecb17u,name=b17
disp
b17

print curve
b17

tit,ori=(.35,.01),siz=.02
comments
read curve,var=s33,ele=ecb34u,name=b34
disp
b34

print curve
b34

read curve,var=s33,ele=ecb35u,name=b35
disp
b35

print curve
b35

read curve,var=s33,ele=ecb36u,name=b36
disp
b36

tit,ori=(.35,.01),siz=.02
Figure _____ : Bolts 34 to 37 axial stress time histories - run run_id
print curve
b36

read curve,var=s33,ele=ecb37u,name=b37
disp
b37
```



```
print curve
b37

tit,ori=(.35,.01),siz=.02
comments
read curve,var=s33,ele=ecb41u,name=b41
disp
b41

print curve
b41

read curve,var=s33,ele=ecb42u,name=b42
disp
b42

print curve
b42

read curve,var=s33,ele=ecb43u,name=b43
disp
b43

print curve
b43

tit,ori=(.35,.01),siz=.02
Figure _____ : Bolts 41 to 44 axial stress time histories - run run_id
read curve,var=s33,ele=ecb44u,name=b44
disp
b44

print curve
b44

tit,ori=(.35,.01),siz=.02
comments
read curve,var=s33,ele=ecb48u,name=b48
disp
b48

print curve
b48

read curve,var=s33,ele=ecb49u,name=b49
disp
b49

print curve
b49

read curve,var=s33,ele=ecb50u,name=b50
disp
b50

print curve
b50

tit,ori=(.35,.01),siz=.02
Figure _____ : Bolts 48 to 51 axial stress time histories - run run_id
read curve,var=s33,ele=ecb51u,name=b51
disp
b51
```



```
print curve
b51

tit,ori=(.35,.01),siz=.02
comments
read curve,var=s33,ele=ecb55u,name=b55
disp
b55

print curve
b55

read curve,var=s33,ele=ecb56u,name=b56
disp
b56

print curve
b56

read curve,var=s33,ele=ecb57u,name=b57
disp
b57

print curve
b57

tit,ori=(.35,.01),siz=.02
Figure _____ : Bolts 55 to 57 axial stress time histories - run run_id

end
```