

UPDATE ON CERTIFICATION TEST DEVELOPMENT

01/29/14

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Agenda

- Goal – reminder
- Test Documentation
- Drawings for UN
- Tests under development
 - Current Status
 - Issues
 - Plans
- Finishing dummies for Injury Criteria Development
 - VRTC dummies, BAST dummy



Goal - reminder

- Develop certification tests which can control dummy reproducibility
 - Must control setup of neck muscle substitutes and damper
 - Must detect critical differences between dummies found in vehicle seat R&R work
 - ▶ Spine bumper stiffness
 - ▶ Jacket stiffness
 - ▶ Pelvis stiffness



Test Documentation

- **Spine quasi-static setup** *(have corridors)*
 - Set springs and thorax/lumbar shape adjustment
 - Procedure in Mutual Resolution
- **Jacket only impact** *(have corridors)*
 - Control jacket stiffness
 - Procedure ready for comment in document (1/27/14)
- **Pelvis only impact, bottom** *(have corridors)*
 - Control pelvis stiffness
 - Procedure ready for comment in document (1/27/14)
- **Dummy certification without head restraint** *(reviewing corridors)*
 - Set damper, verify correct spring & shape adjustments
 - Procedure ready for comment in document (1/27/14)



Test Documentation

- **Test System Verification** (*have corridors*)
 - Make sure ETD is R&R and setup is functioning correctly
 - Procedure ready for comment in document (1/27/14)
- **Head Impact Pad Verification** (*corridors TBD*)
 - Make sure headrest pad is R&R
 - Procedures under development
- **Dummy certification with head rest** (*corridors TBD*)
 - Check complete system performance
 - Test & procedures under development



Test Documentation – Inspection Tests

- Pelvis shape verification (*corridors TBD*)
 - Make sure shrinkage is not too large
 - Test & procedures under development
- Bumper compression on spine (*corridors TBD*)
 - Check change in bumper stiffness
 - Test & procedures under development
- Pelvis quasi-static compression check (*corridors TBD*)
 - Check change in pelvis stiffness
 - Test & procedures under development



Test Documentation

- Generic procedure for UN MR
 - Draft 1/27/14 provided for review
 - ▶ Tried to make generic for regulation
 - ▶ Only necessary information
 - ▶ Not limit future improvements
 - Please review and comment
 - ▶ Procedures themselves
 - ▶ Appropriate level of information
- We will do update with comments to provide for inclusion into MR
 - Will leave thorough formatting for after put into MR



Drawings for UN

- Updates in Process
 - Engineer has marked up all drawings based on TEG comments and complete review
 - ▶ Entered into our ECO system & provided to CAD
 - Will provide samples for review next week
 - ▶ Please review:
 - › Formatting, especially assembly & BOM
 - › How weldments will be handled
 - Will provide update on timing next week



Tests Under Development

- Current Status
- Issues
- Plans



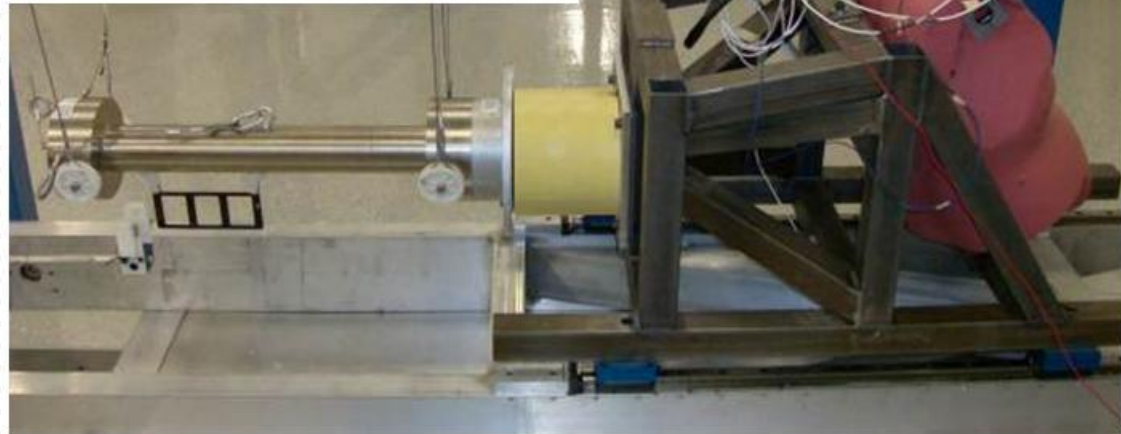
Test Dev. – Current Status

- Dummy certification without head restraint
 - Finalize corridors
 - Discuss rotation measurement methods for procedure
 - ▶ Currently pots
 - ▶ Allow other methods in UN procedure?



Tests Under Development

Dummy certification without head restraint



Dummy certification without head restraint

- Overlay data from R&R dummies plus one dummy changed to stiff bumpers (all bumpers in dummy)
 - Pre & post R&R from Huron, some data from HIS Heidelberg, some data from BAST
 - Stiff dummy data different color
- Existing corridors shown
- Time history envelopes calculated
 - +/- 2 std dev of R&R dummies
 - +/- 10% of peak of R&R dummies

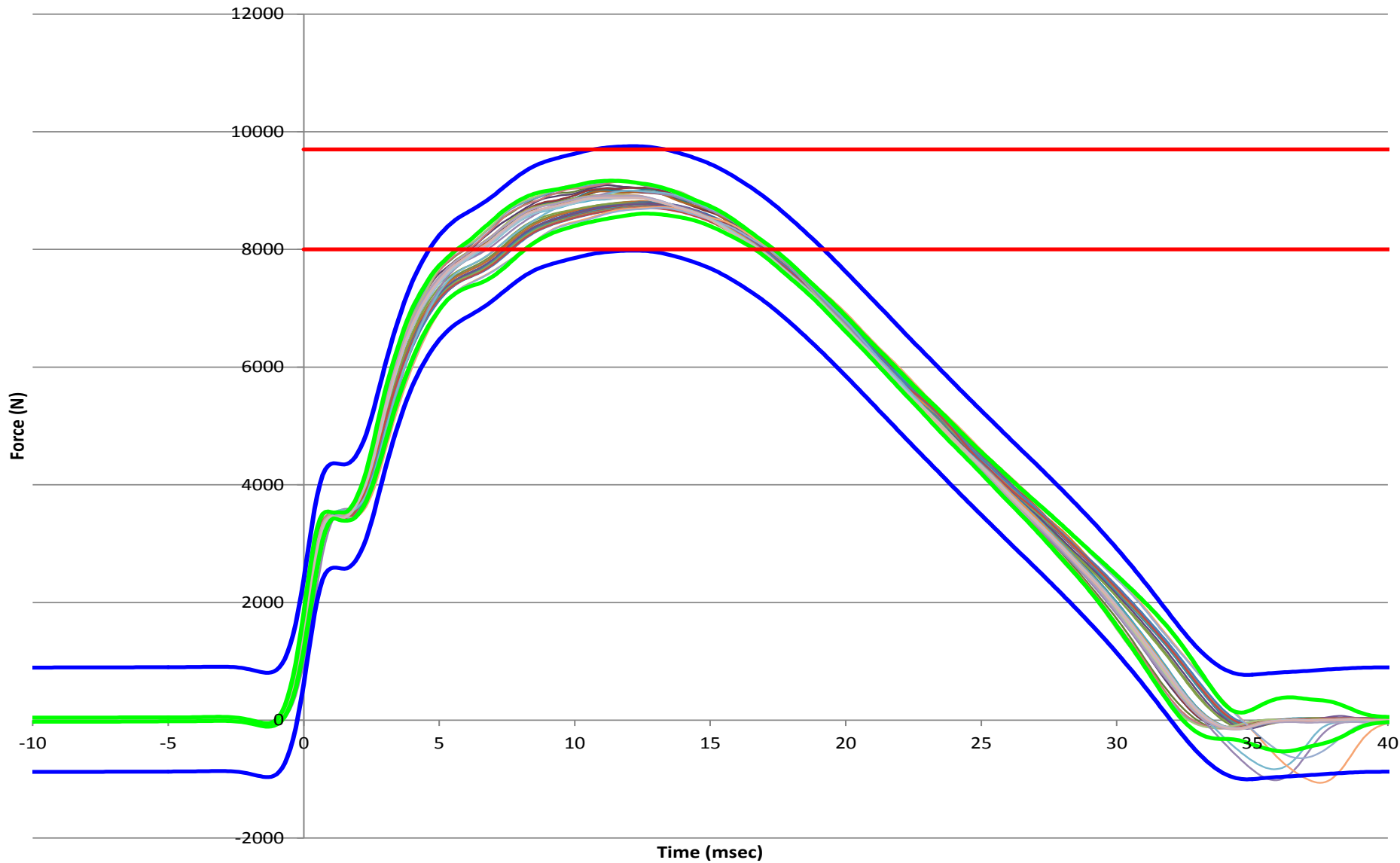


Dummy certification without head restraint

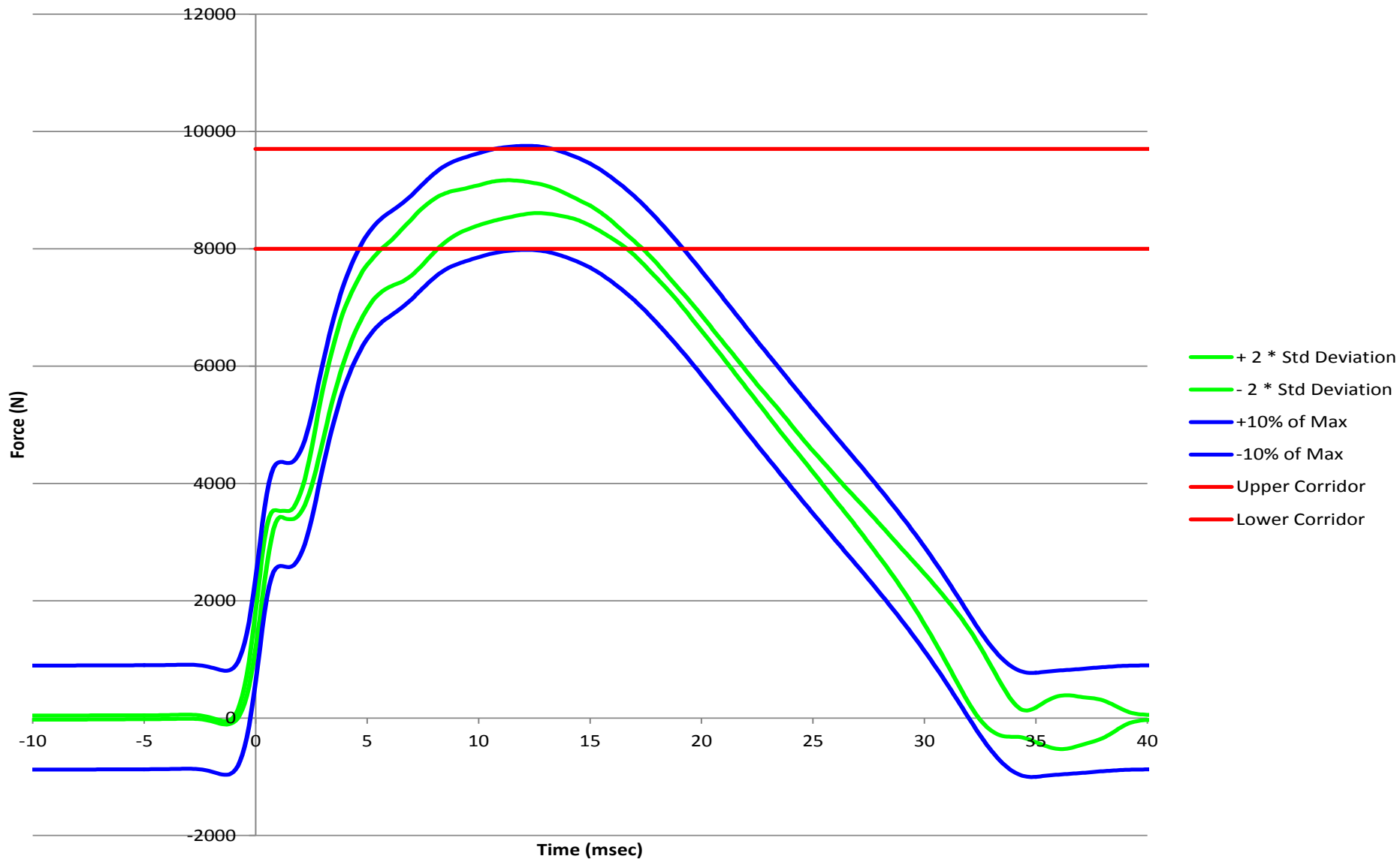
- Questions
 - Are current corridors adequate?
 - Should we use some type of time-history corridors?
 - Can we drop some corridors?
 - Do you want to review data and discuss next week?



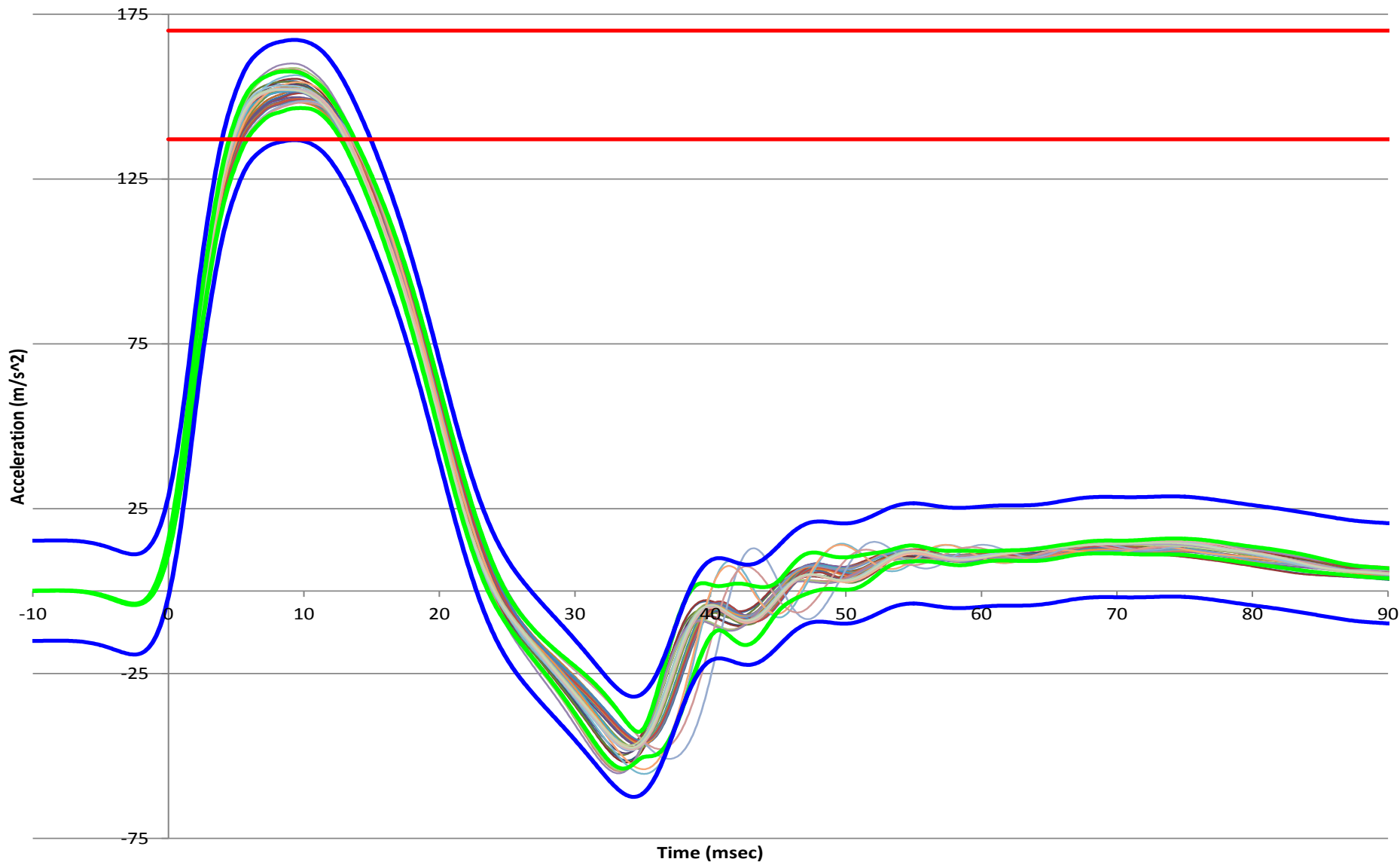
GR&R Dummies Pendulum Force



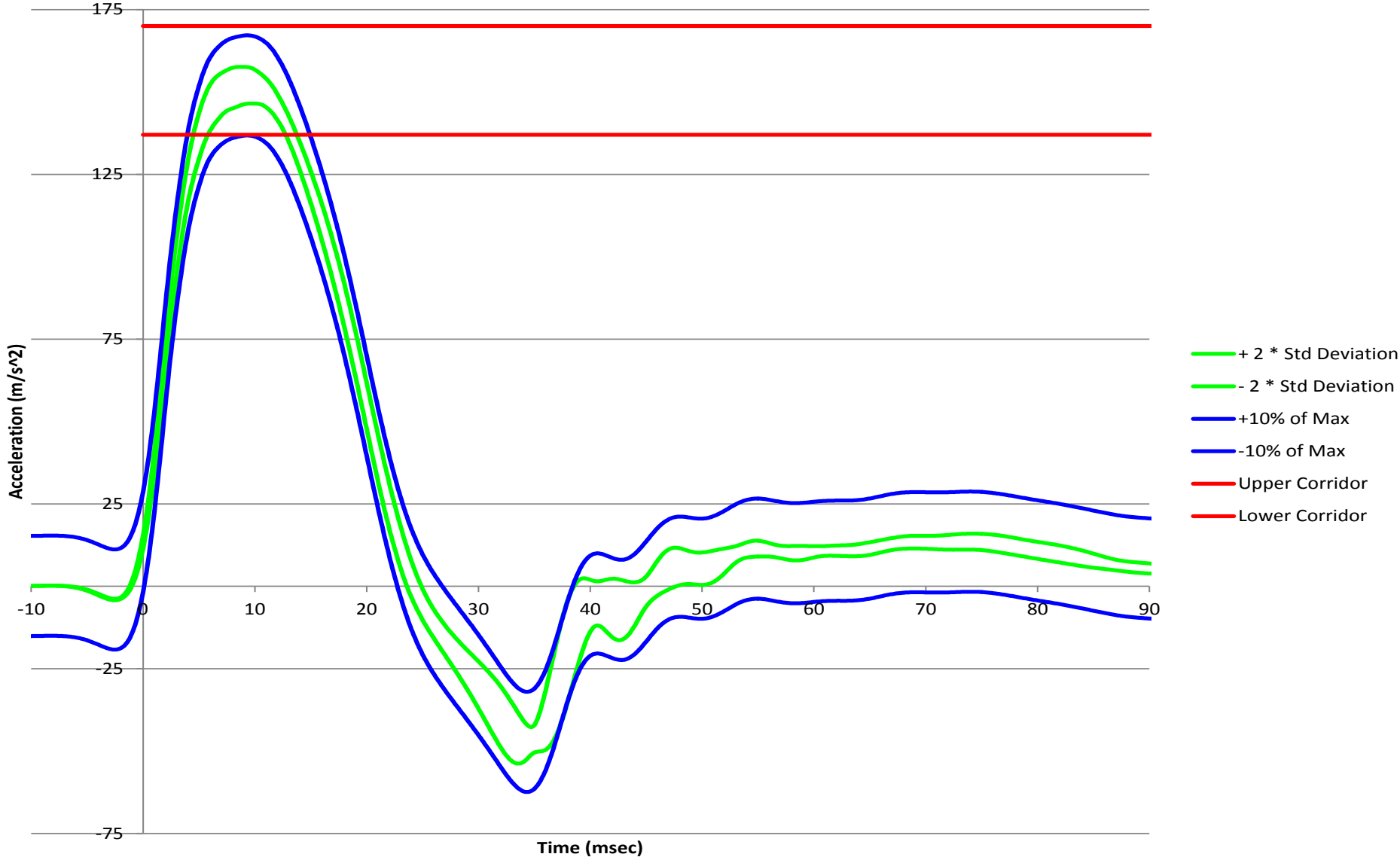
GR&R Dummies Pendulum Force



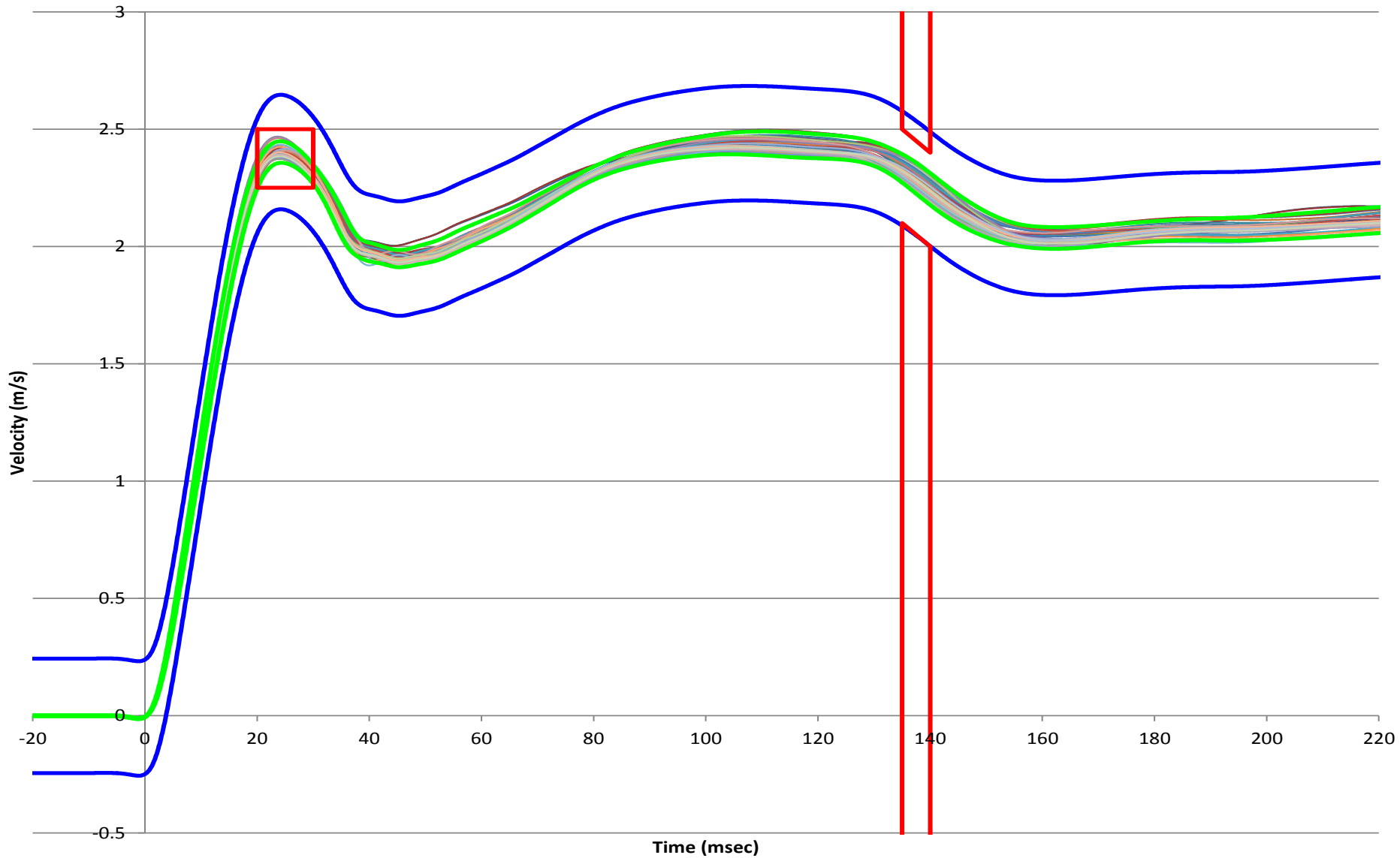
GR&R Dummies Sled Acceleration



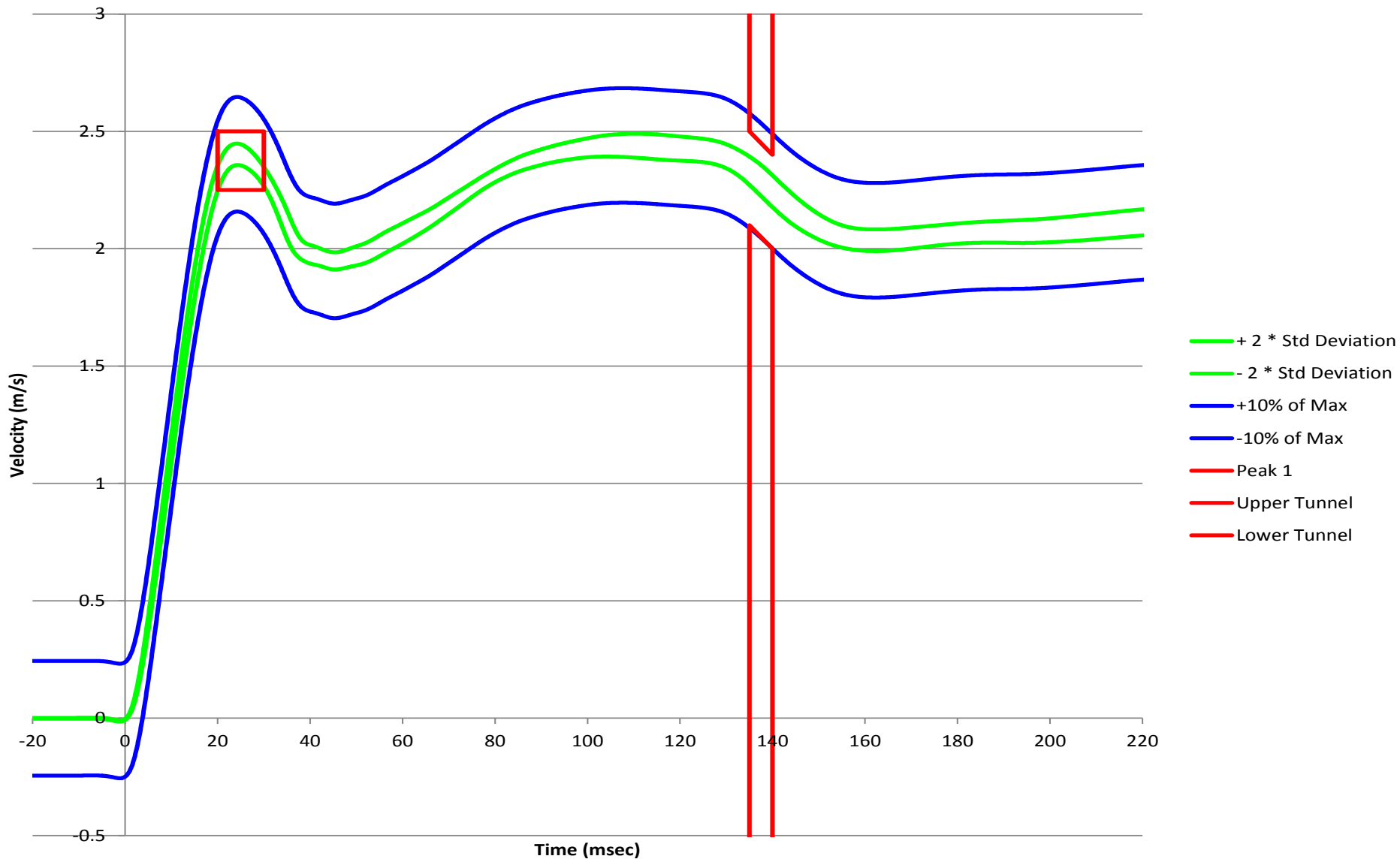
GR&R Dummies Sled Acceleration



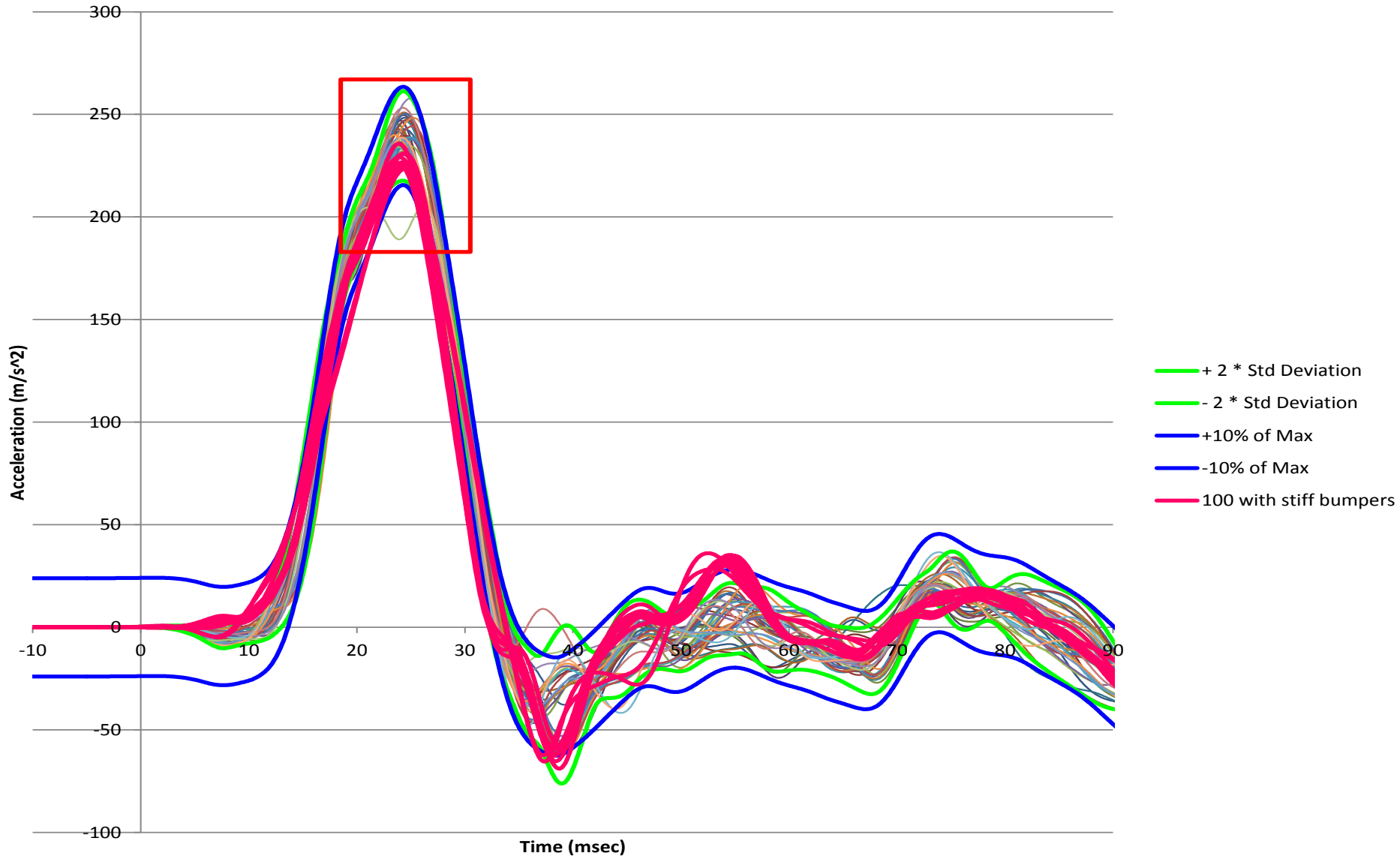
GR&R Dummies Sled Velocity



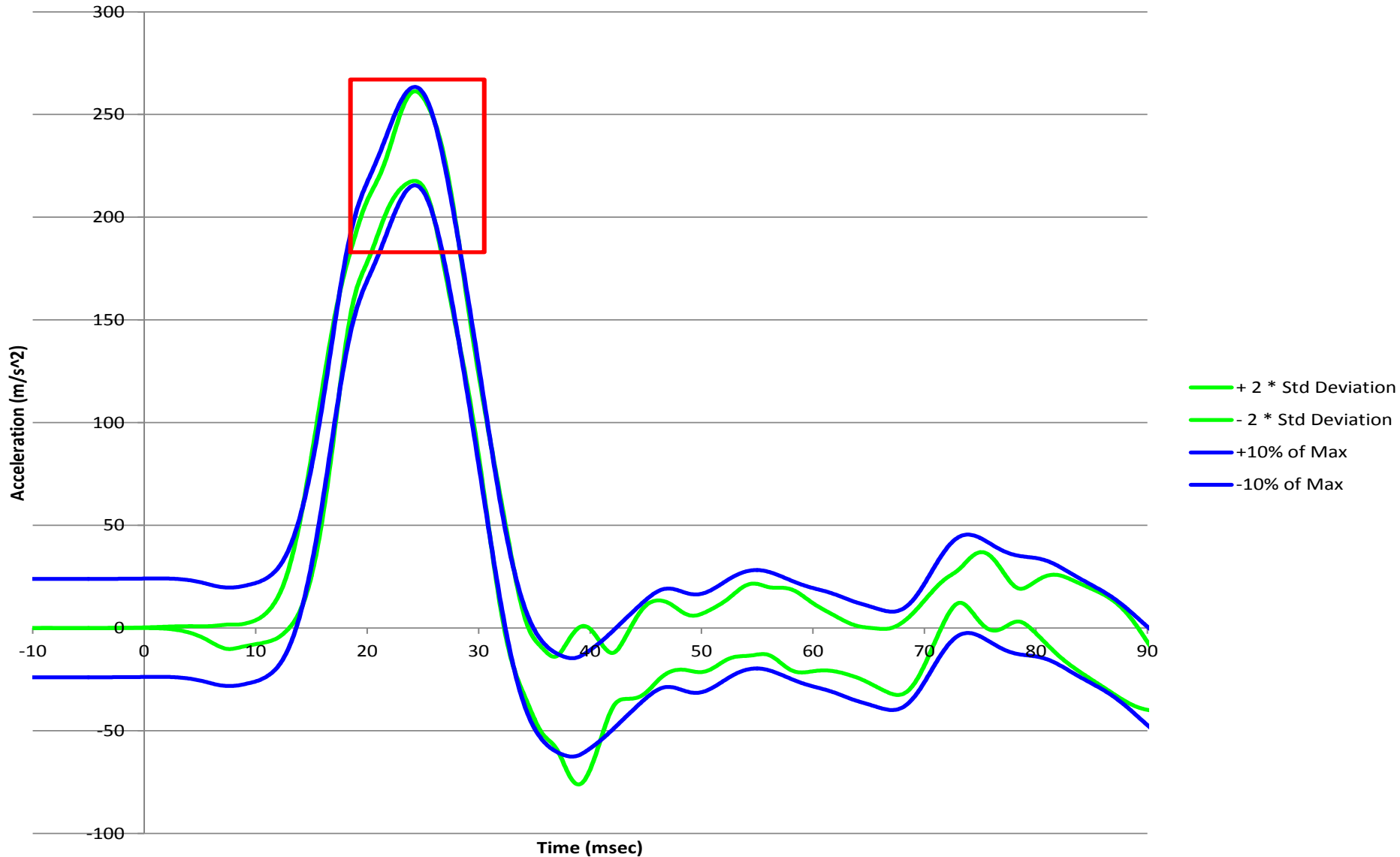
GR&R Dummies Sled Velocity



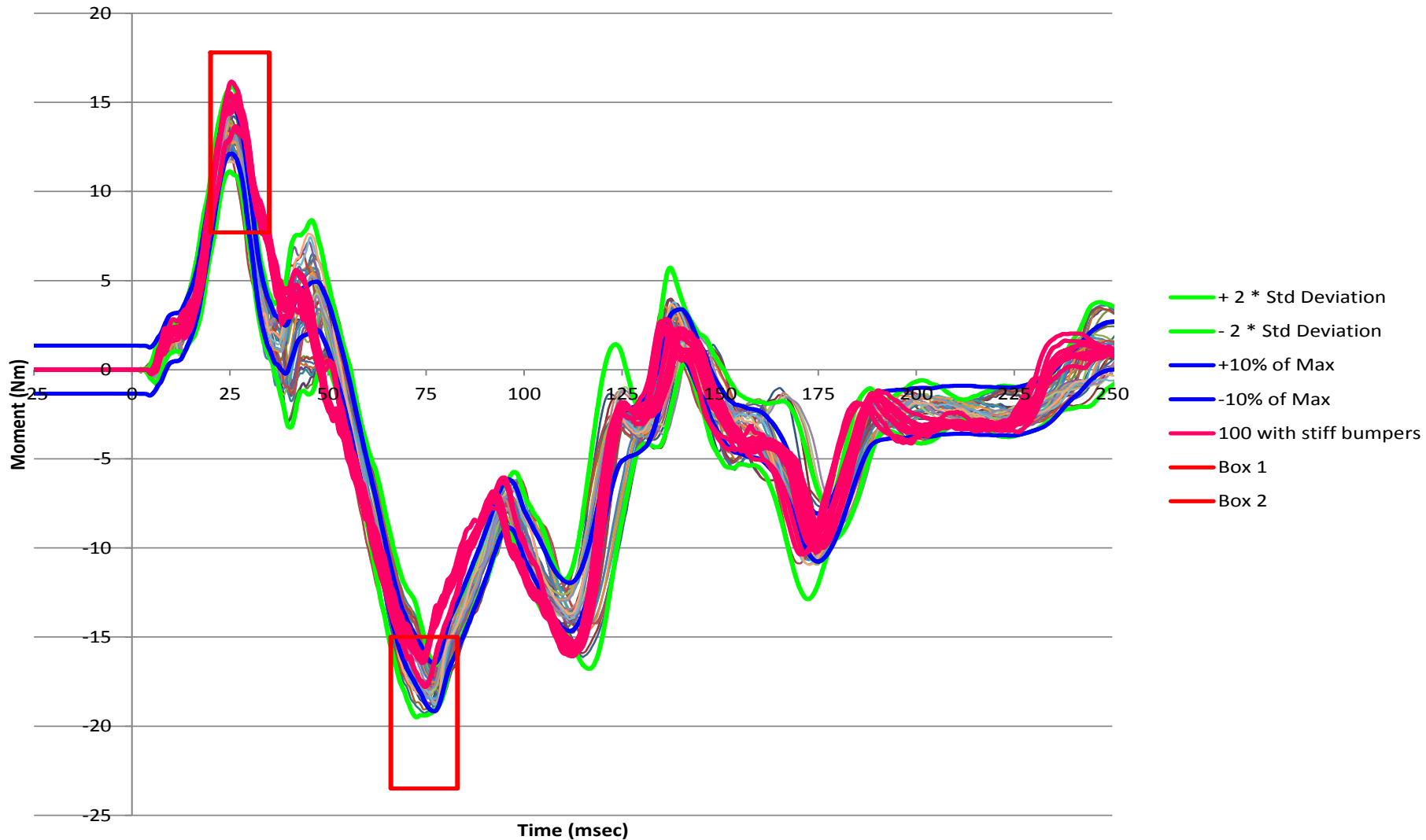
GR&R Dummies T₁ X Acceleration



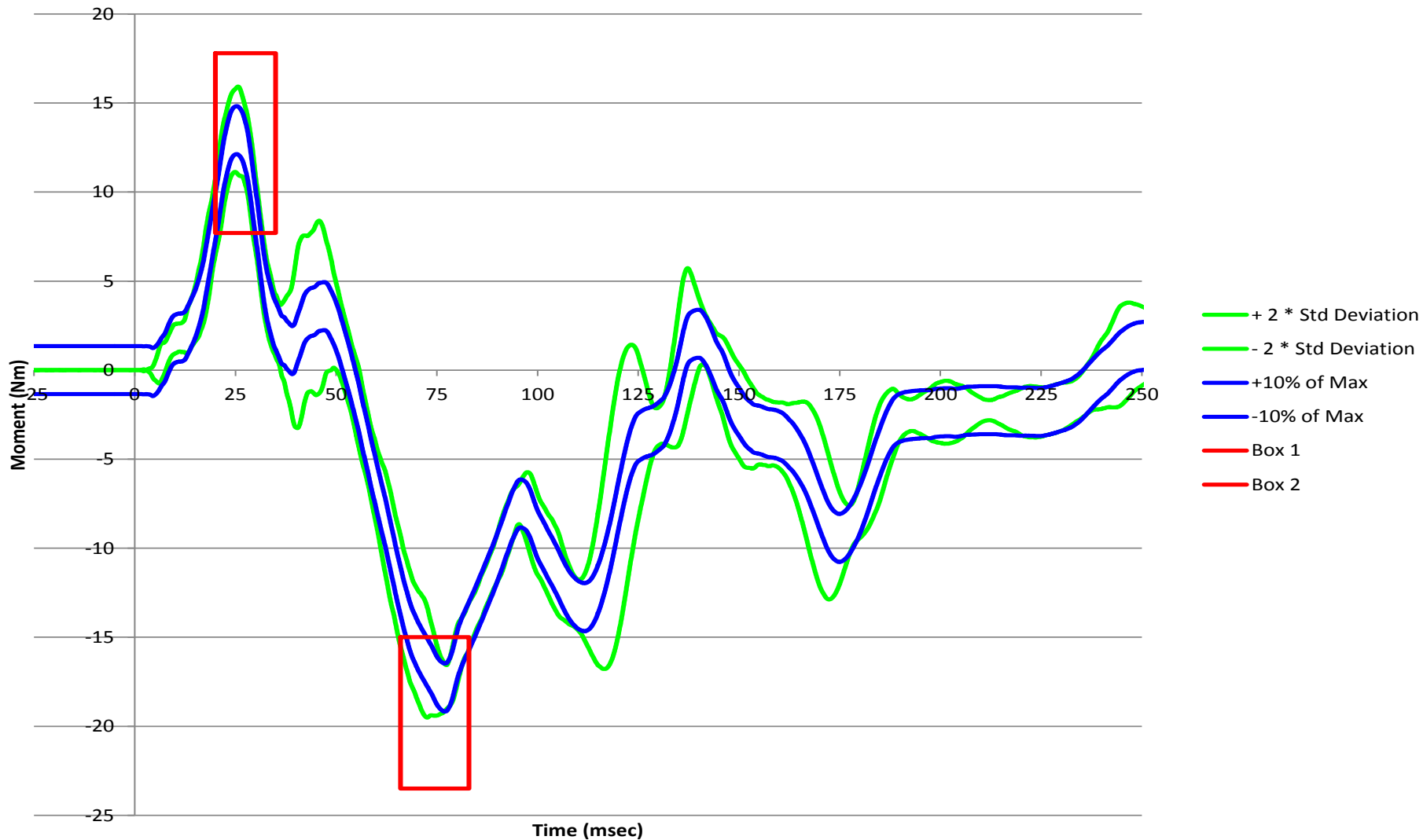
GR&R Dummies T1 X Acceleration



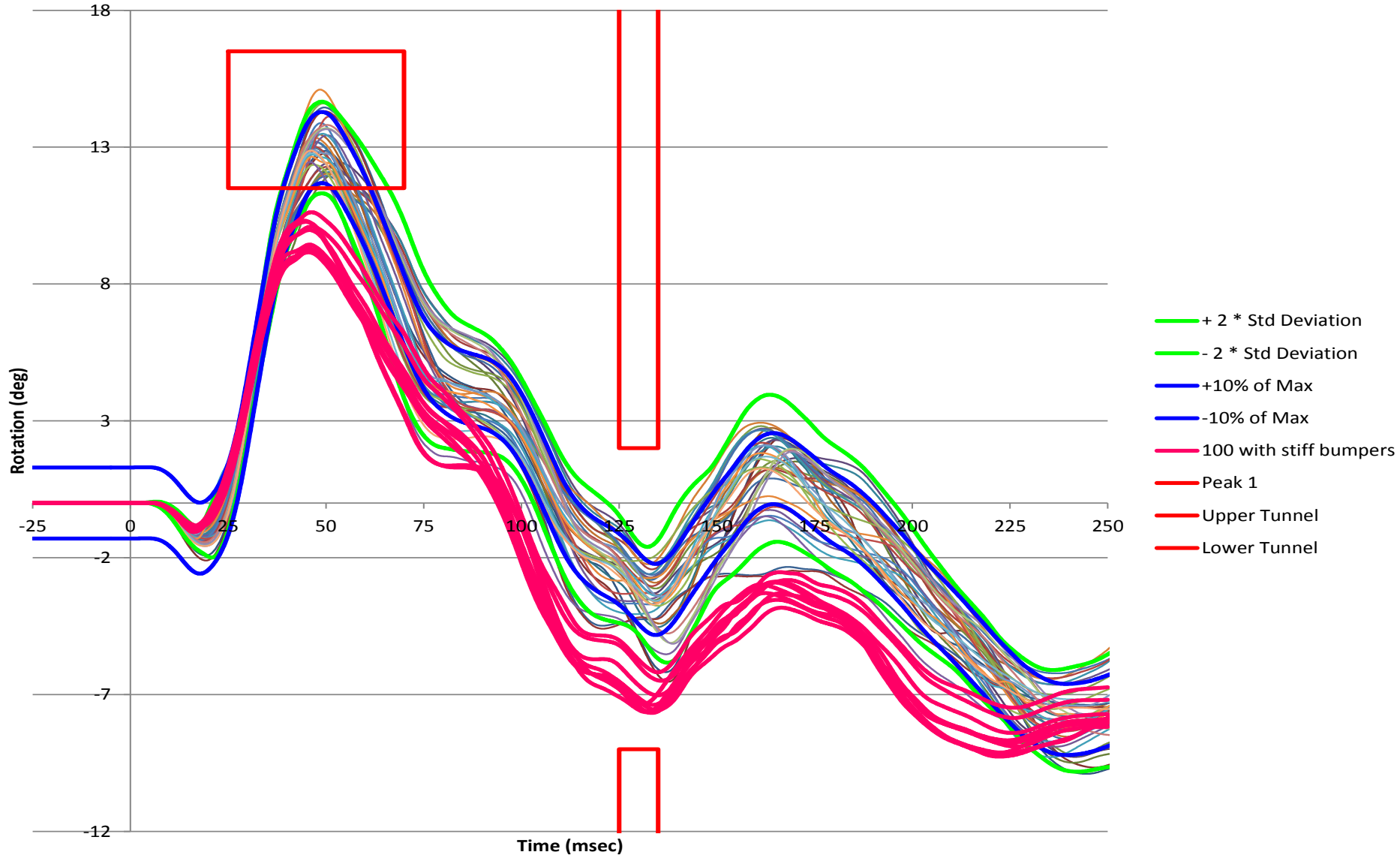
GR&R Dummies Upper Neck Moment MY



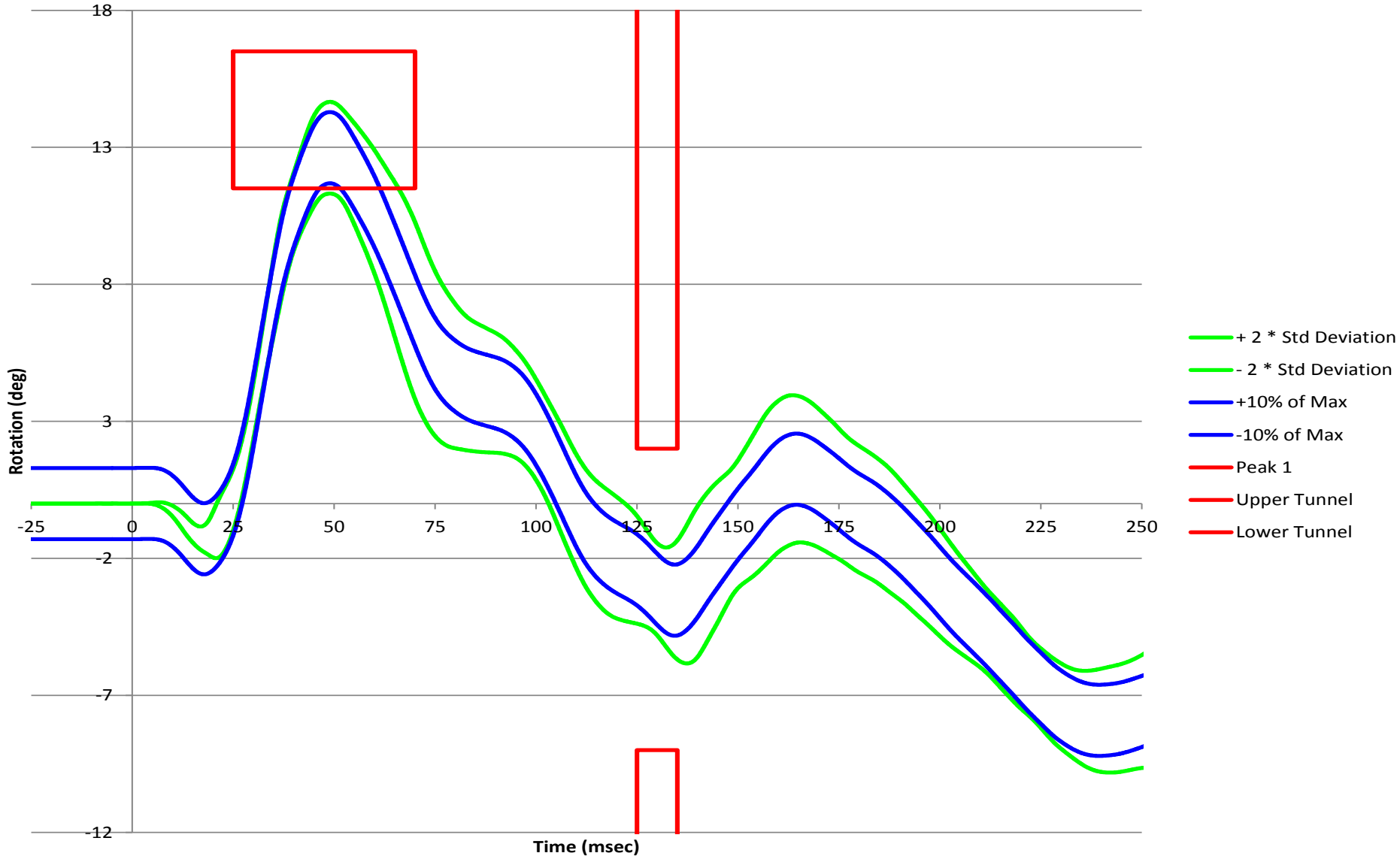
GR&R Dummies Upper Neck Moment MY



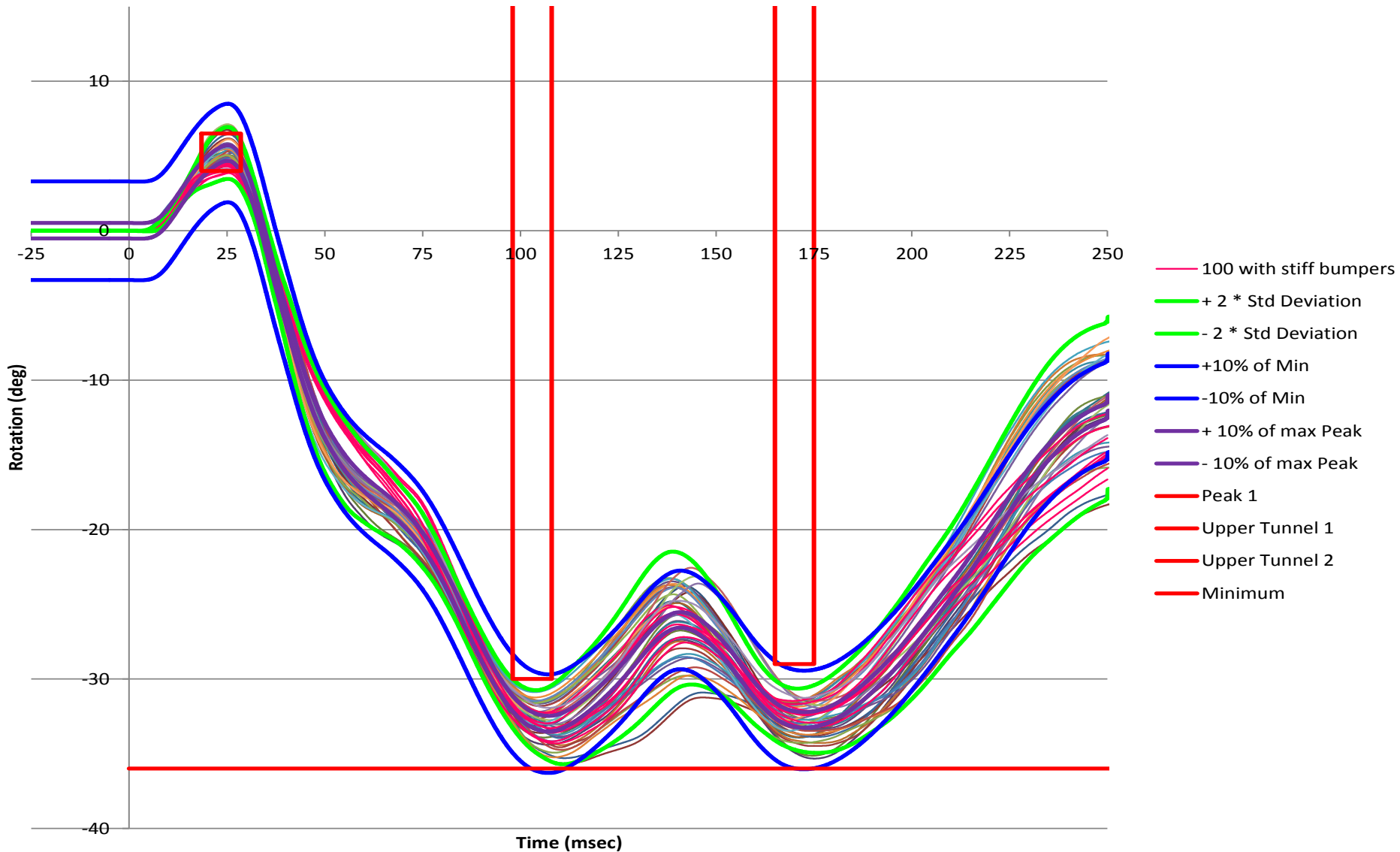
GR&R Dummies Pot A - Head Rotation about OC



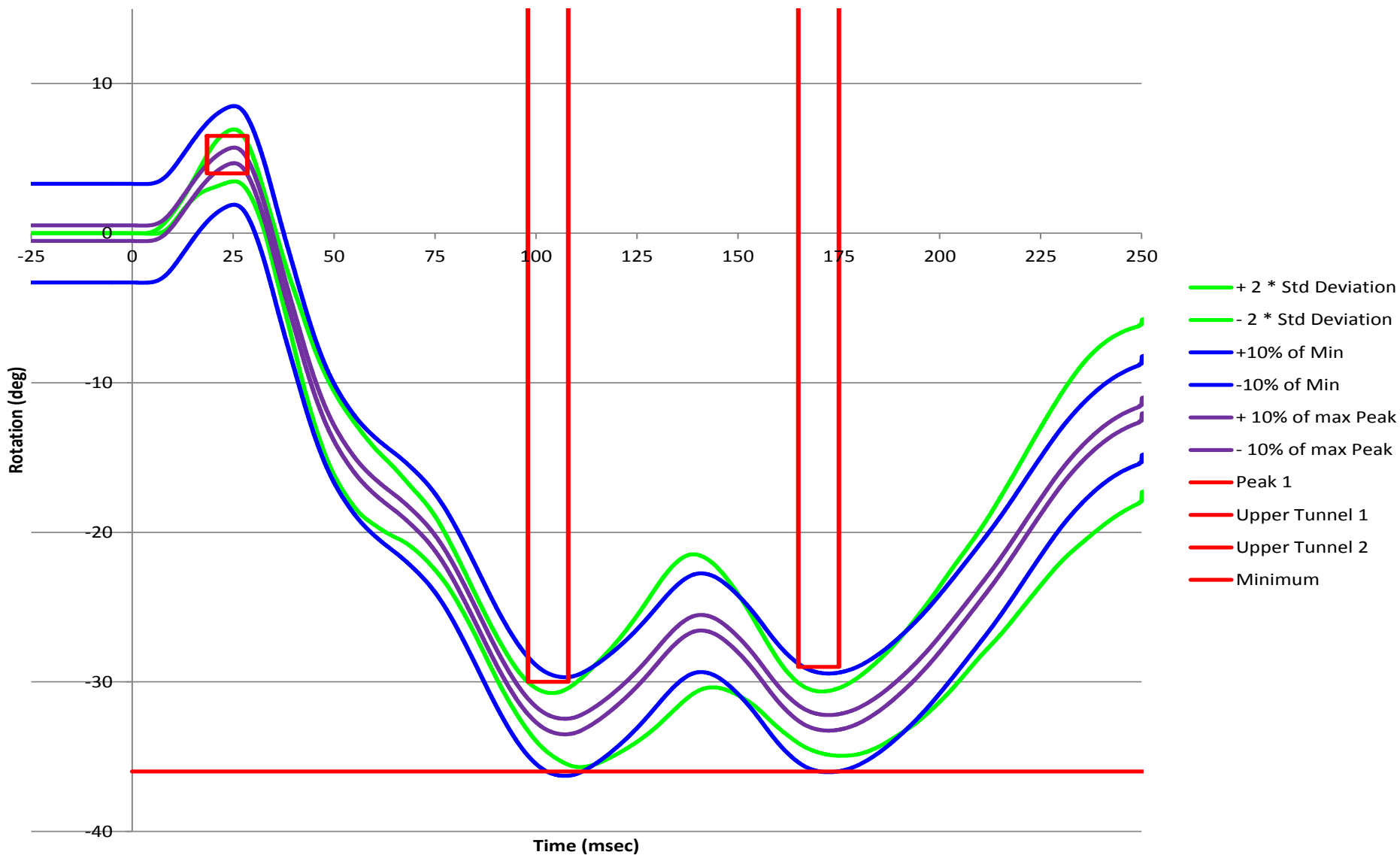
GR&R Dummies Pot A - Head Rotation about OC



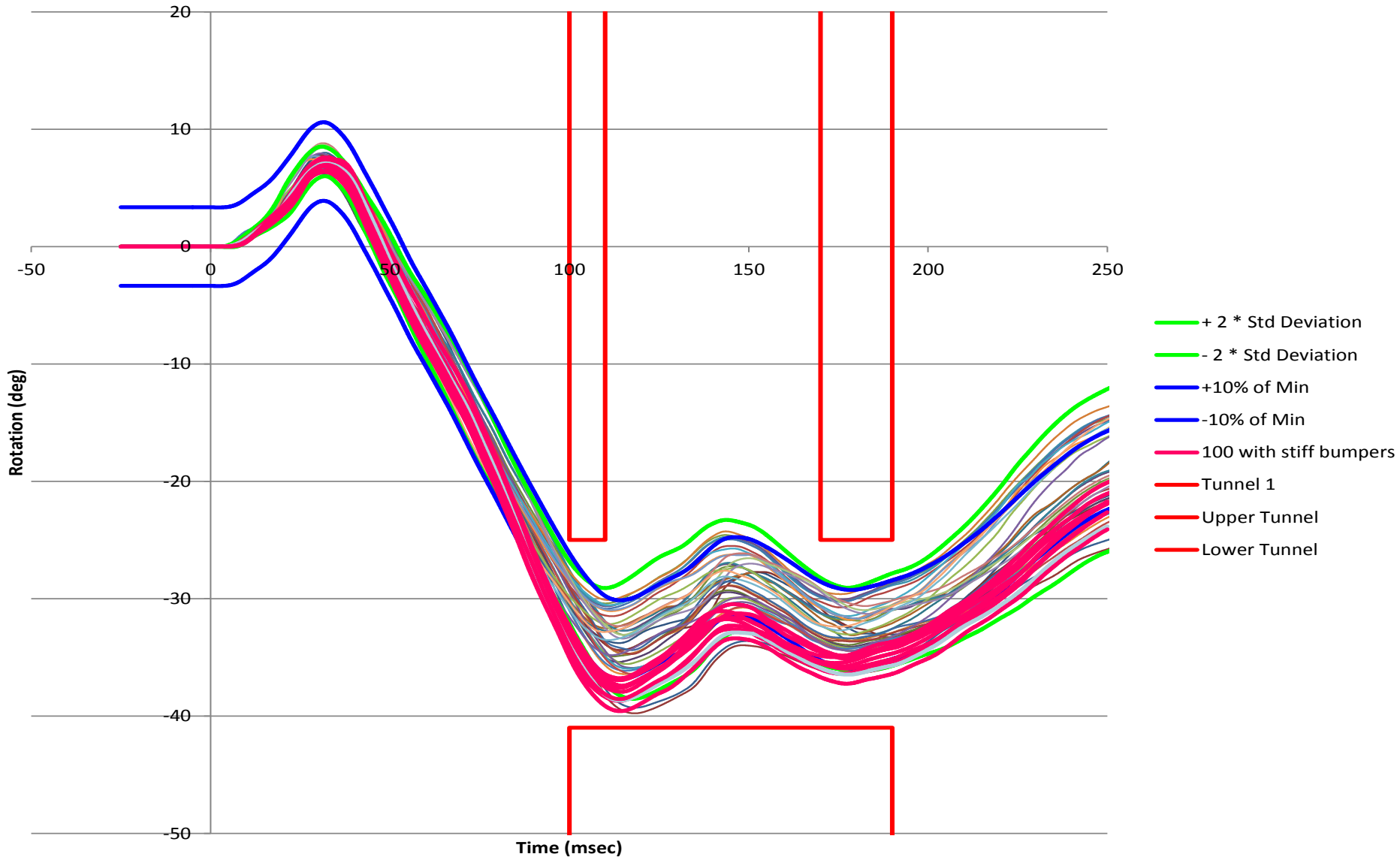
GR&R Dummies Pot B - Neck Link Rotation about T₁ - A.xlsx



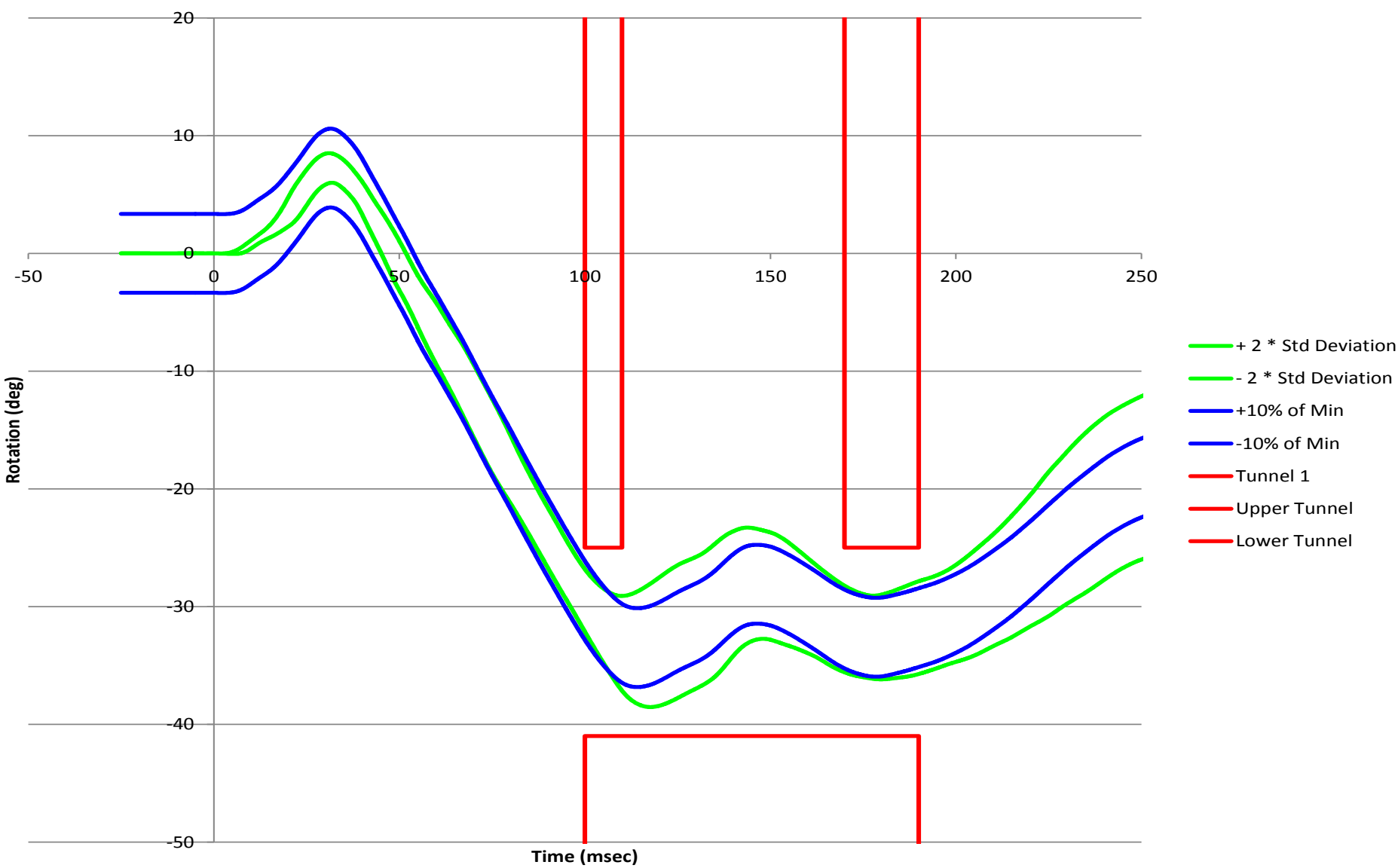
GR&R Dummies Pot B - Neck Link Rotation about T₁



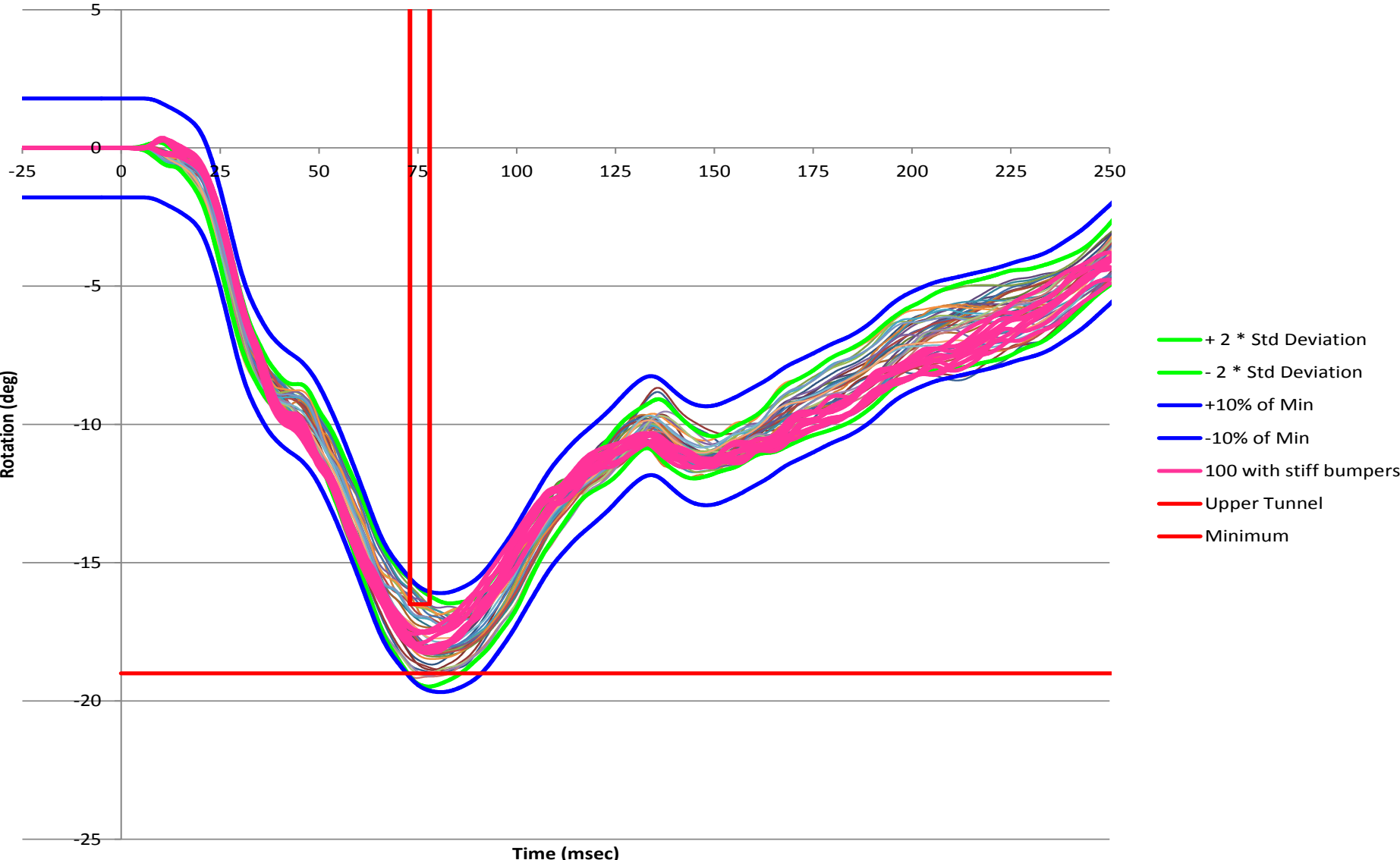
GR&R Dummies Total Head Rotation



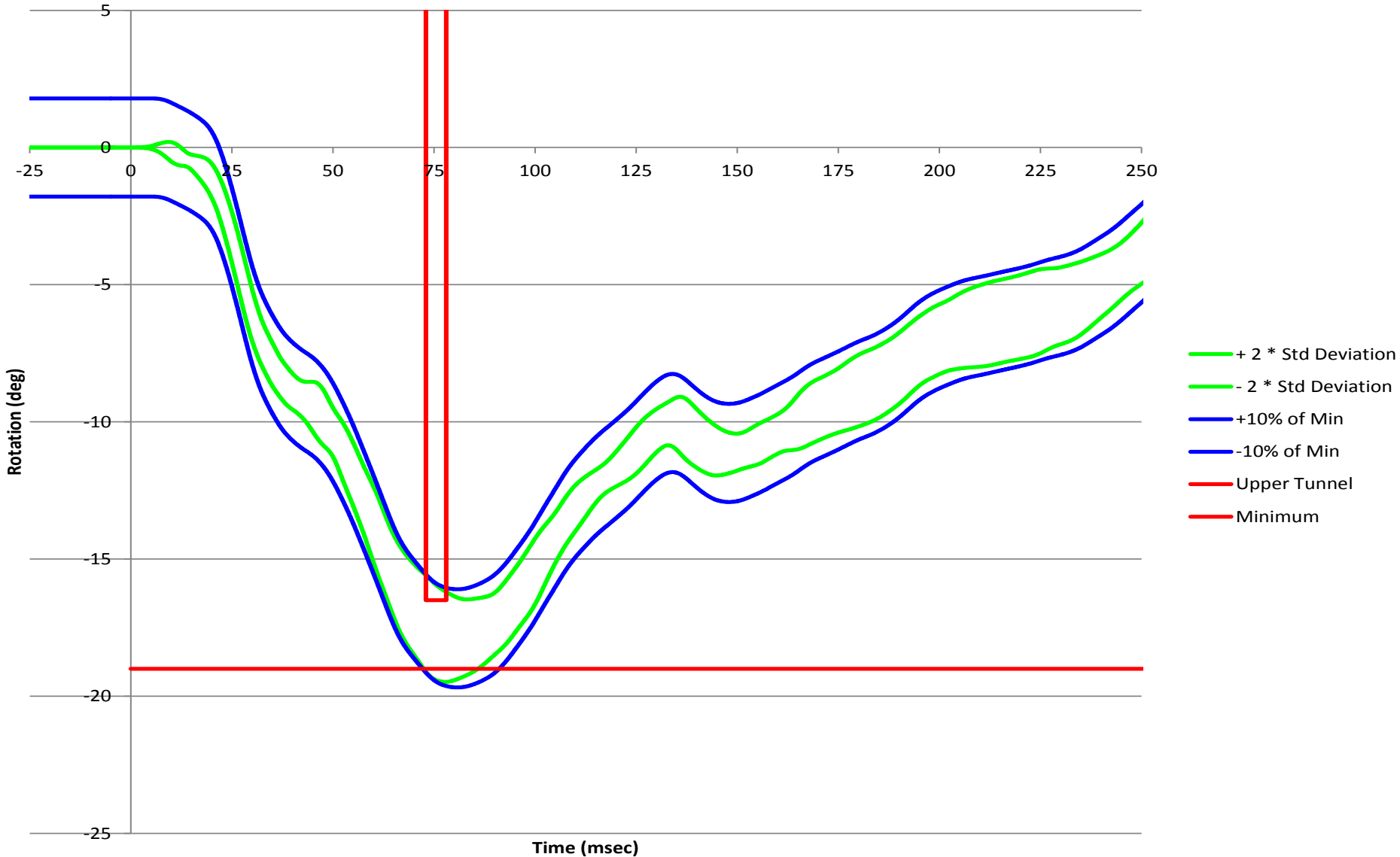
GR&R Dummies Total Head Rotation



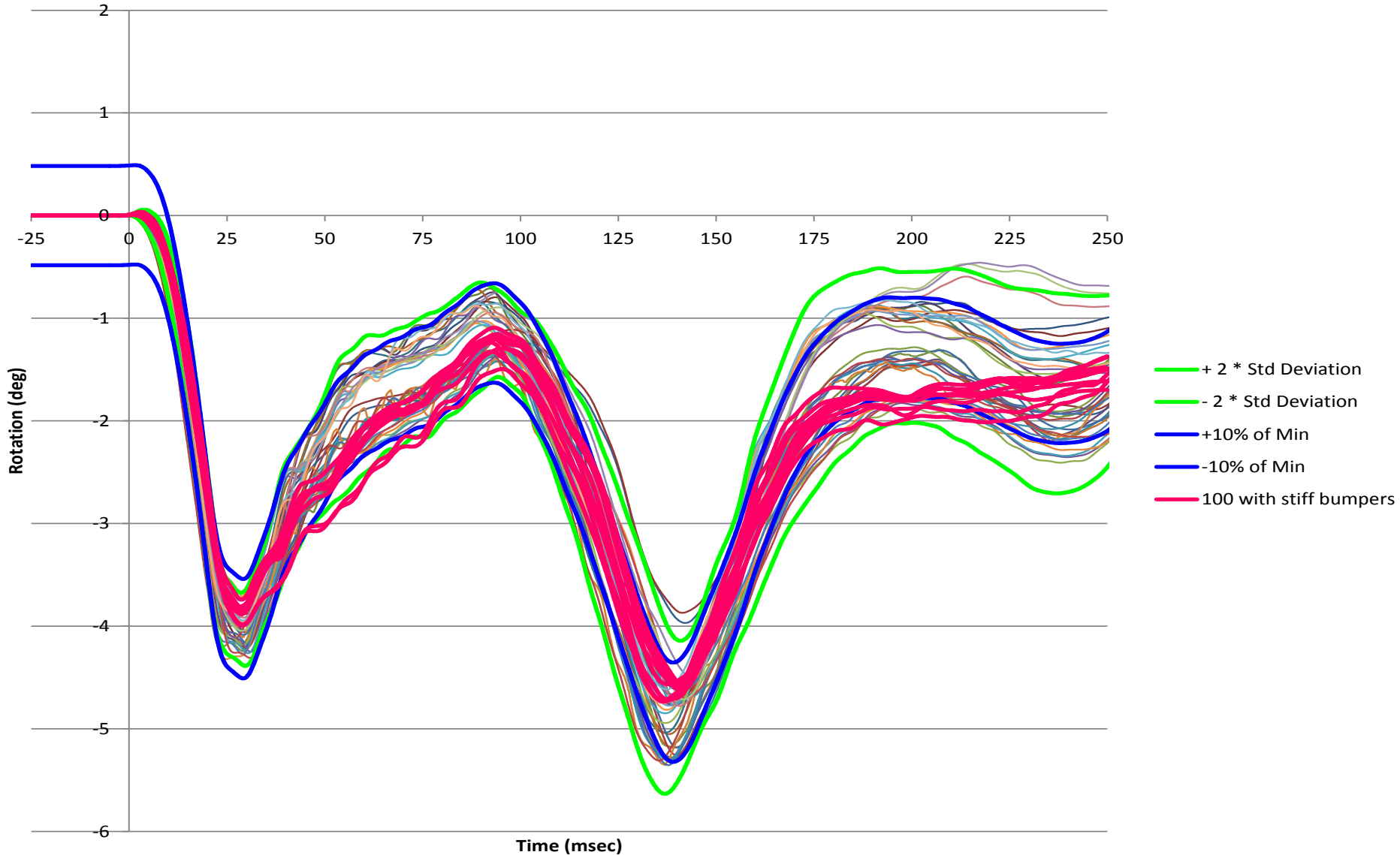
GR&R Dummies Pot C - T₁ Rotation



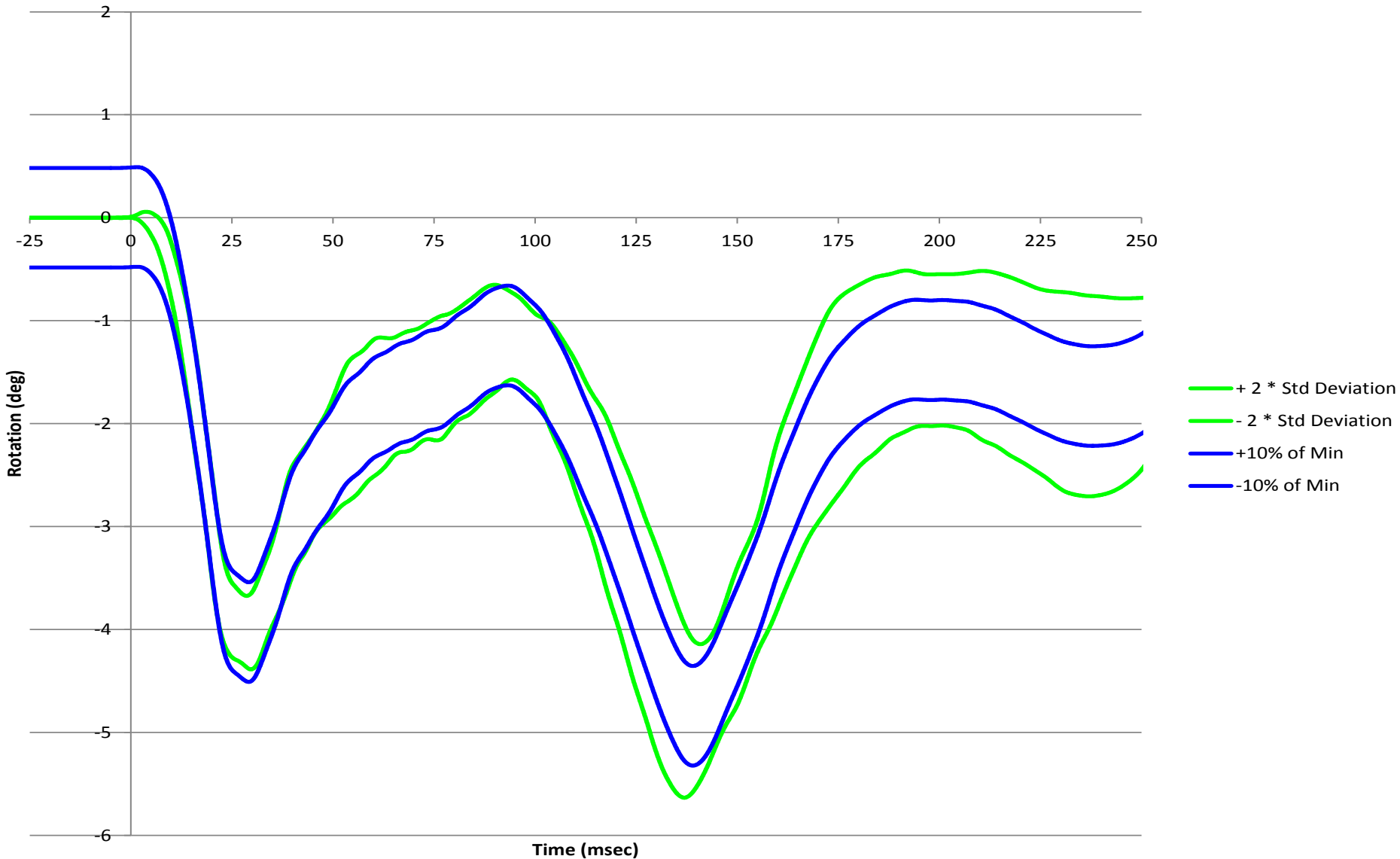
GR&R Dummies Pot C - T₁ Rotation



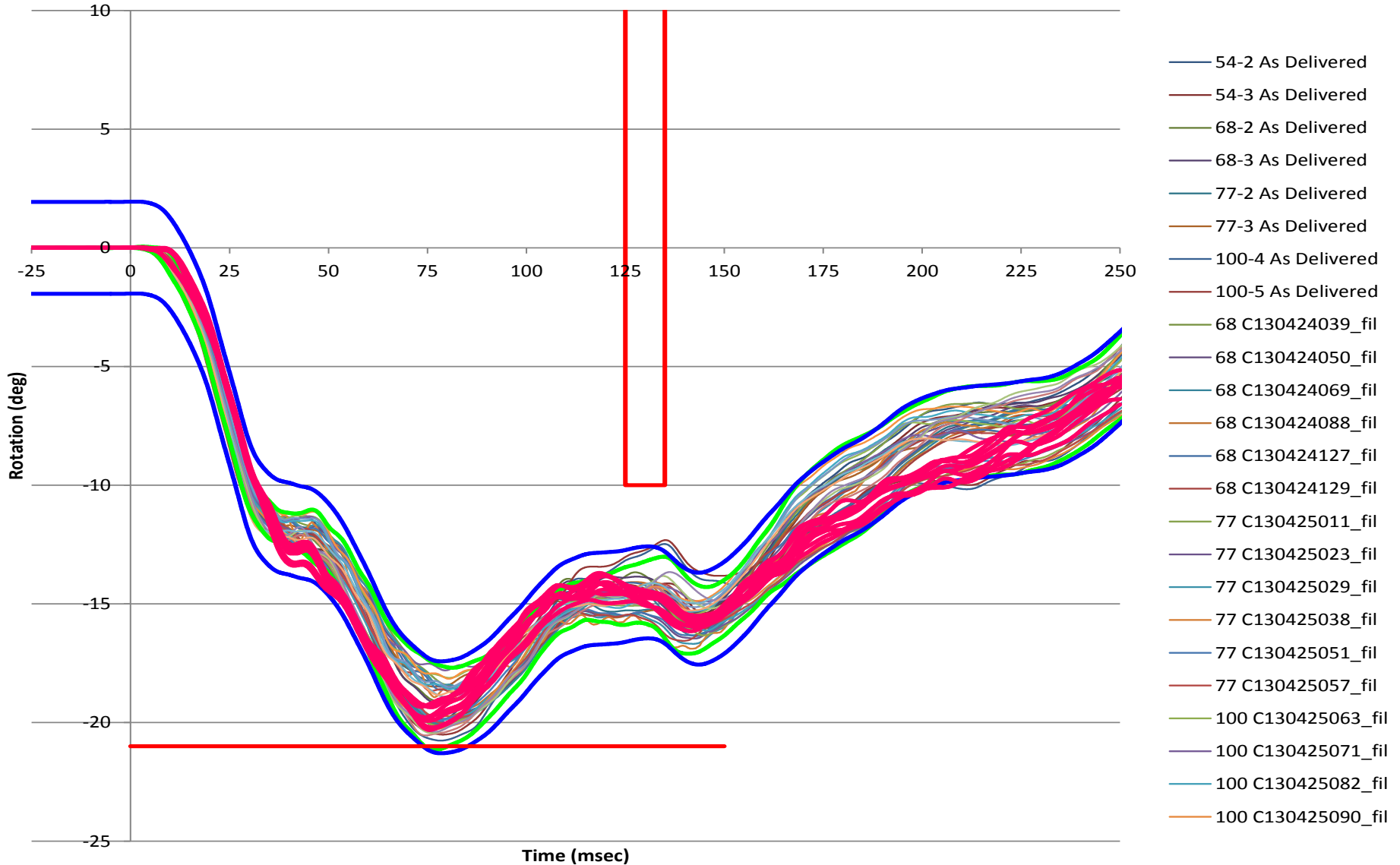
GR&R Dummies Pot D - Lower Thorax Rotation



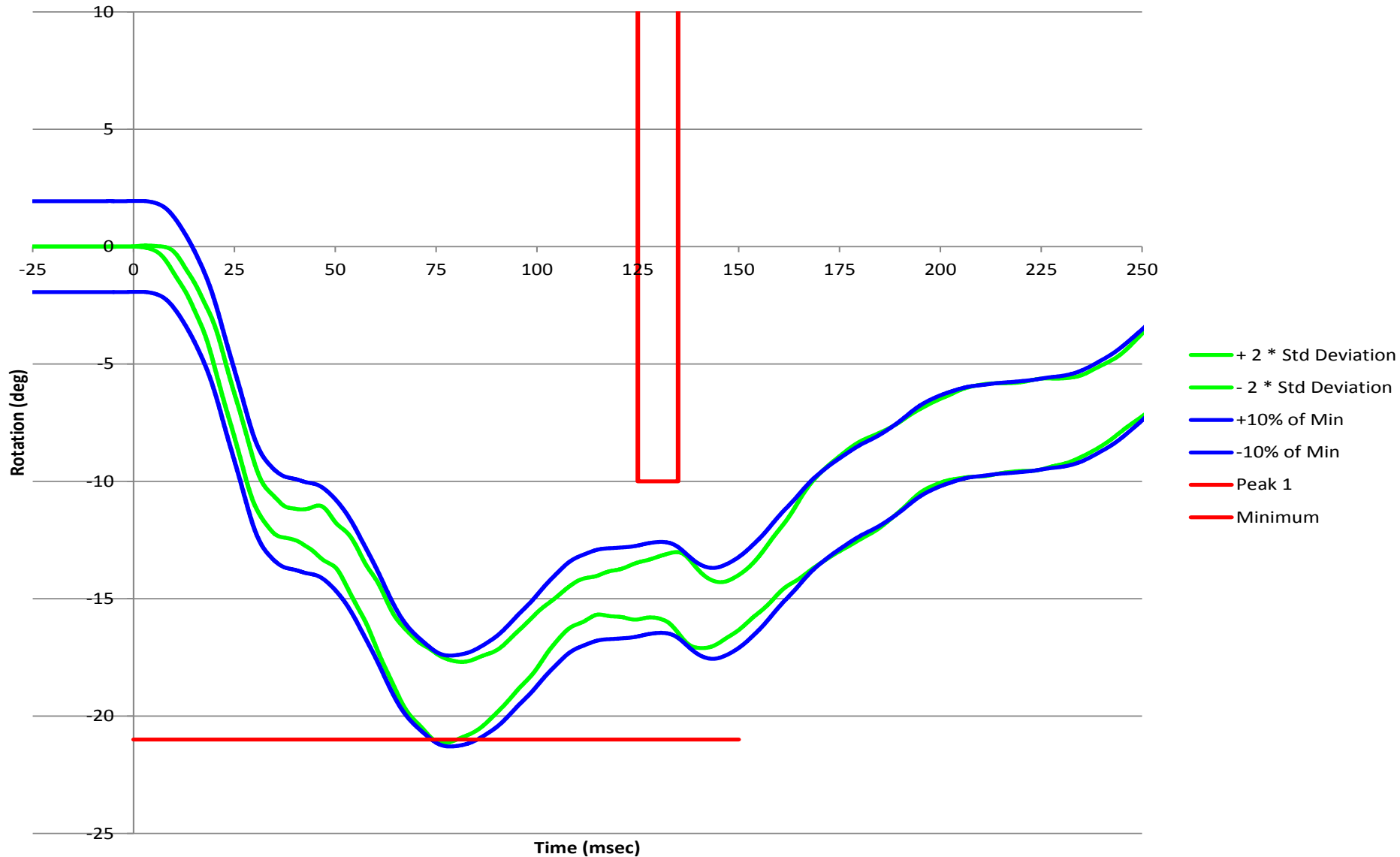
GR&R Dummies Pot D - Lower Thorax Rotation



GR&R Dummies Total Thoracic Rotation



GR&R Dummies Total Thoracic Rotation



Test Development

- Pelvis shape verification
 - Status: collecting data with prototype tool
 - Issues: not sure if R&R yet
- Pelvis quasi-static compression check
 - Status: collecting data with prototype tool
 - Issues:
 - ▶ not sure if R&R yet
 - ▶ Not sure if provides useful additional information



Test Development

- Bumper compression on spine
 - Status:
 - ▶ collecting data with prototype tool
 - › Done extensive testing on R&R dummies, engineering dummy, VRTC dummies
 - ▶ Interesting results
 - ▶ Probably an essential inspection
 - Issues:
 - ▶ R&R is poor
 - ▶ R&R must be improved to finalize procedure and methods
 - › Extensive work on this is currently being done

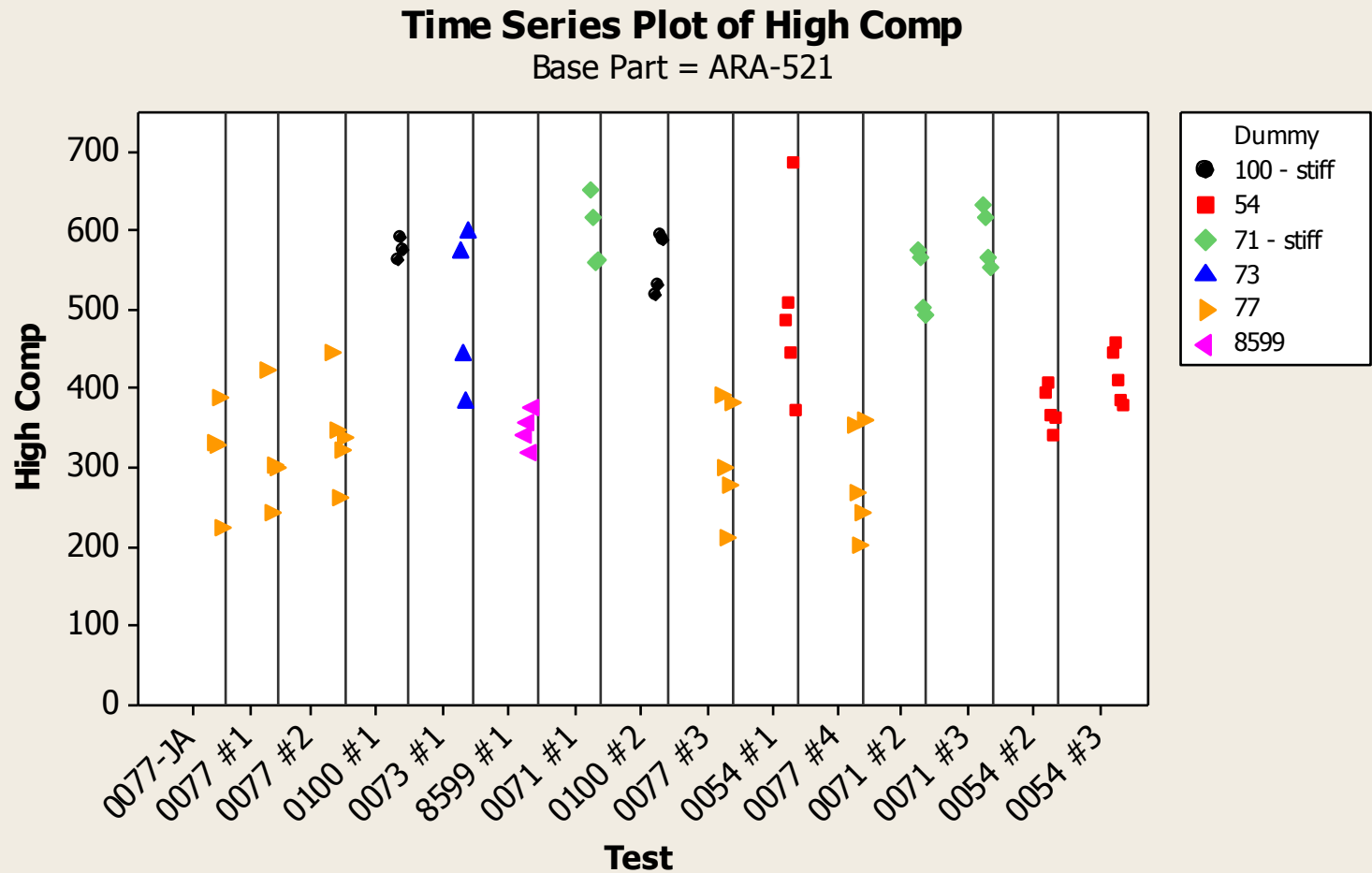


Tests Under Development

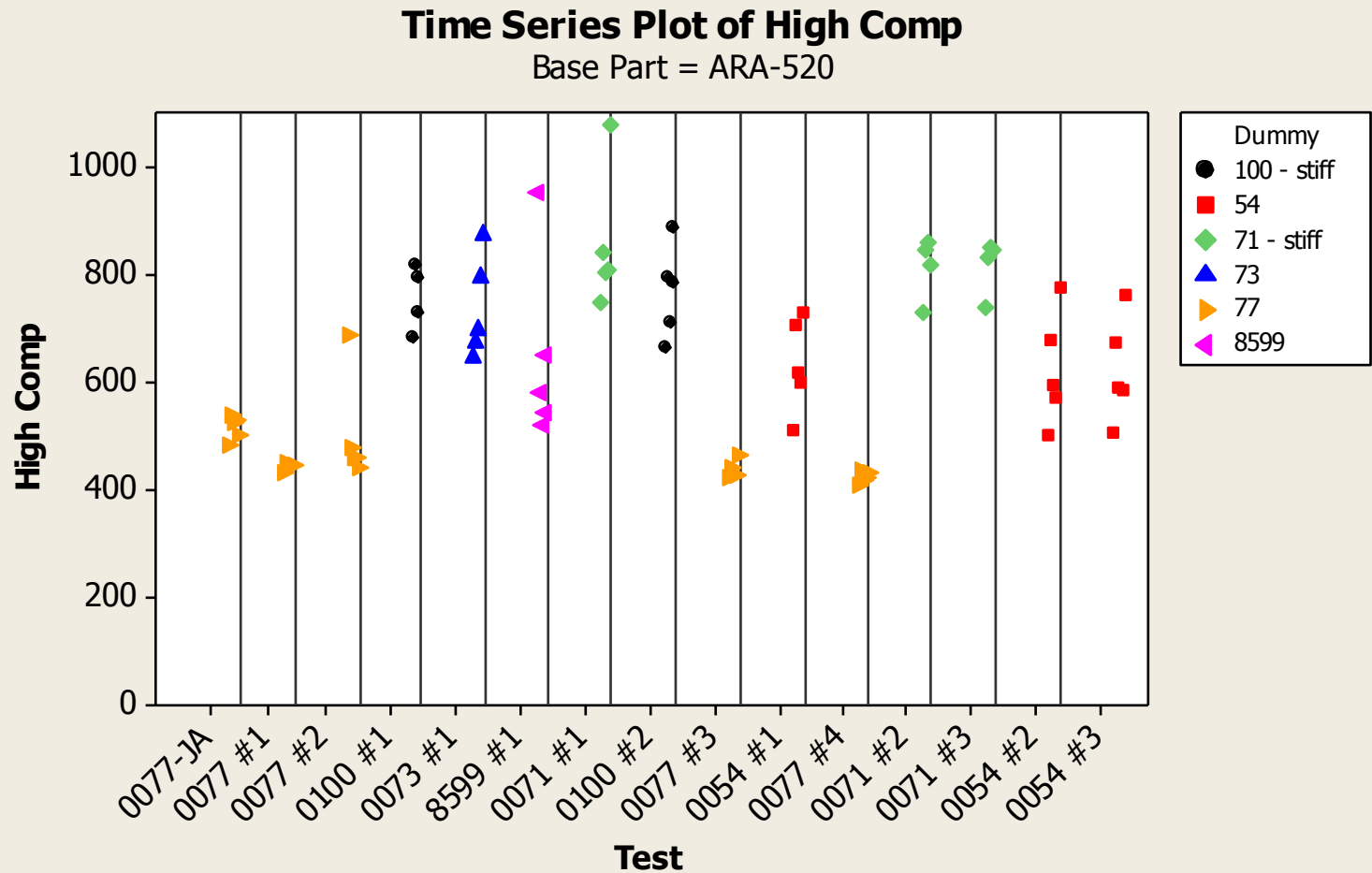
Bumper Compression On Spine



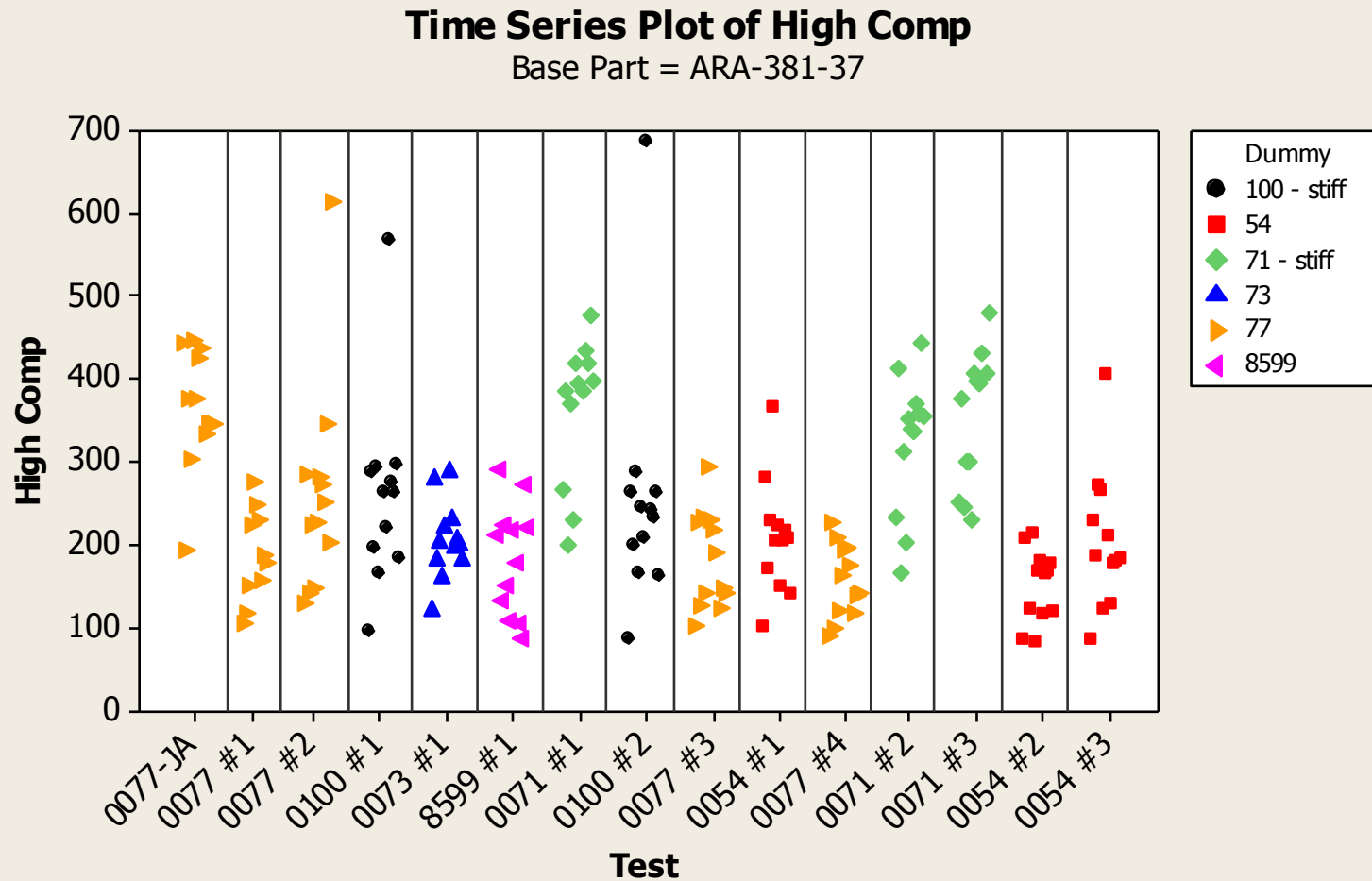
Bumper Compression on Spine



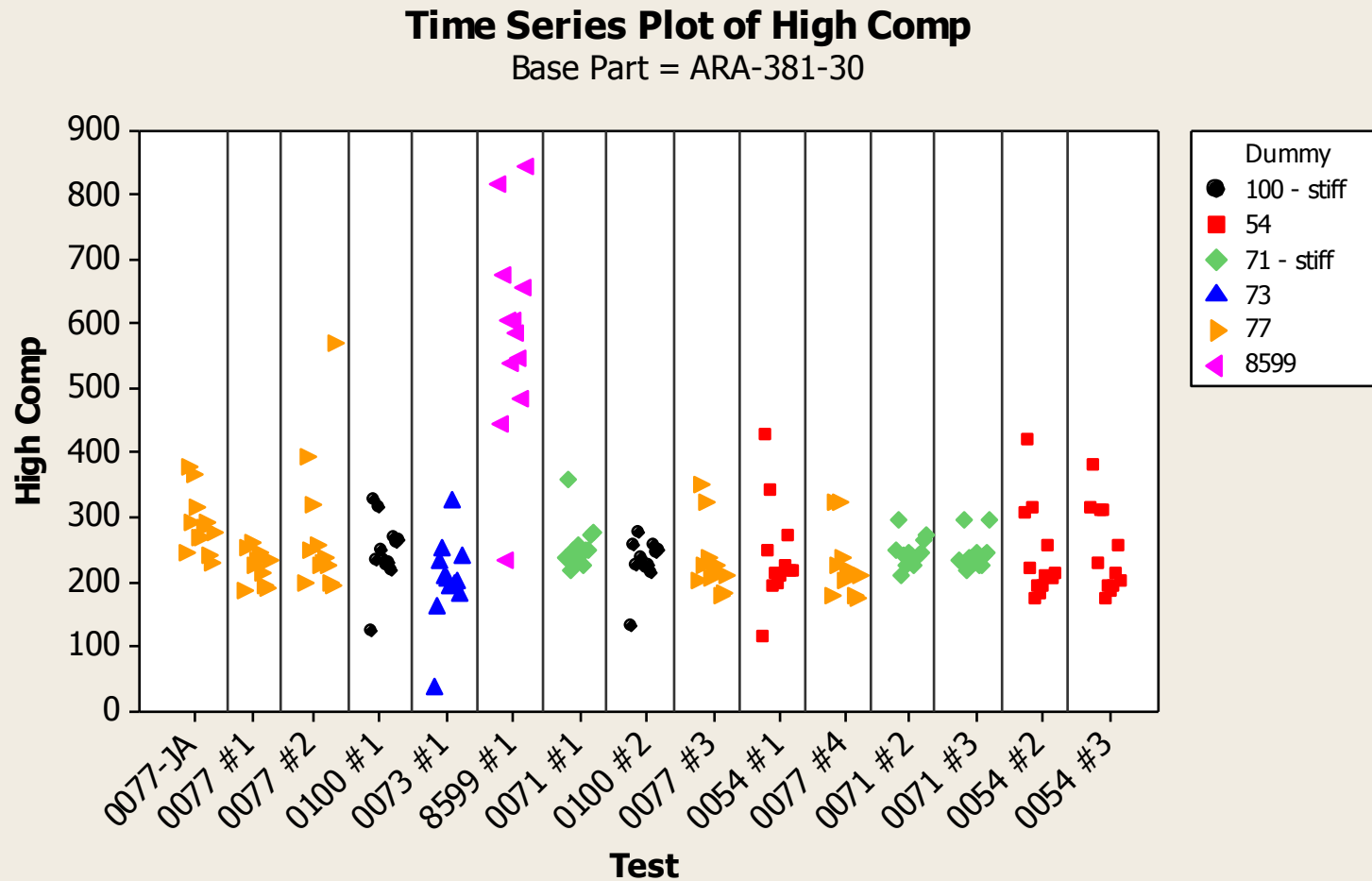
Bumper Compression on Spine



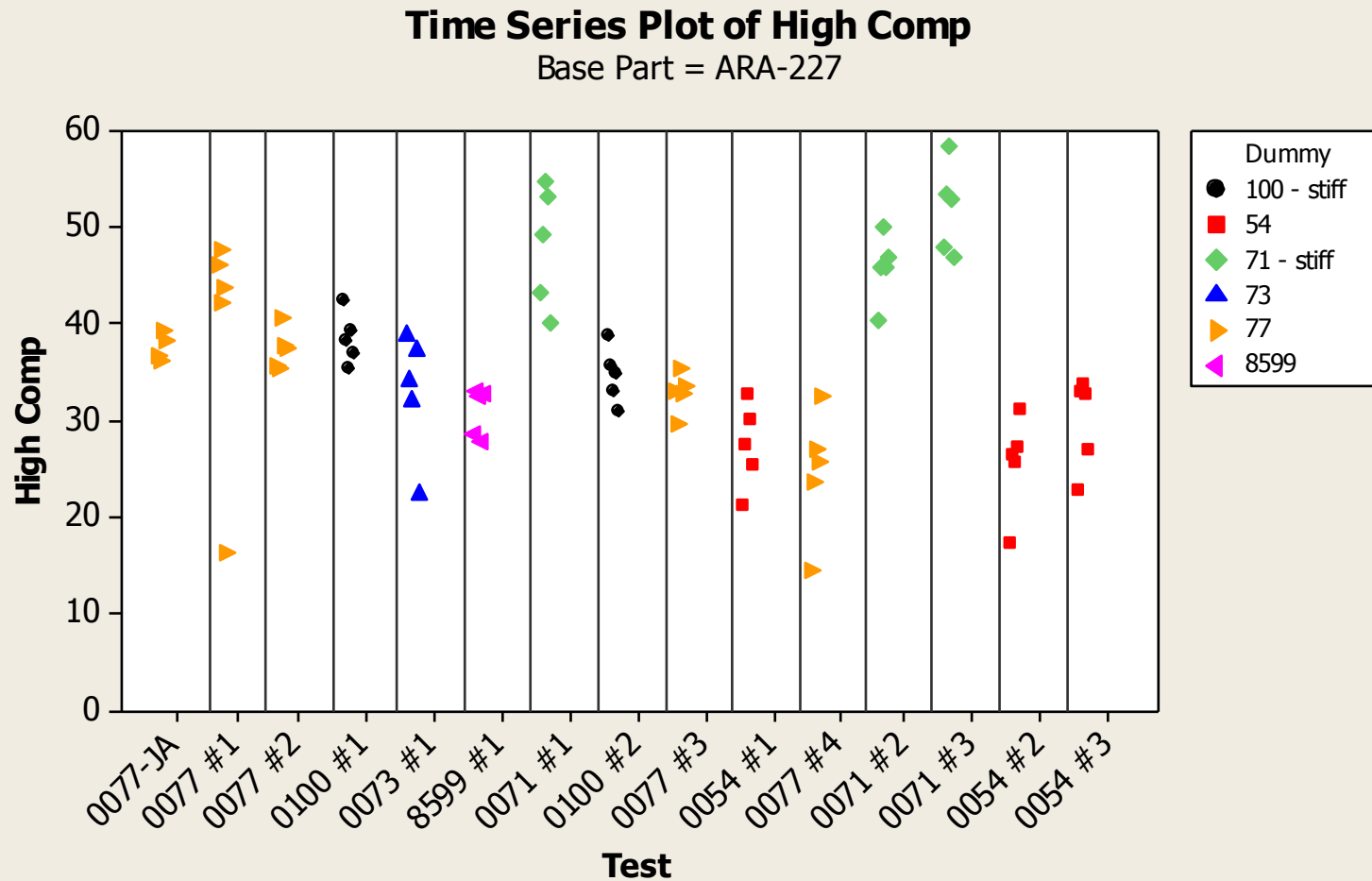
Bumper Compression on Spine



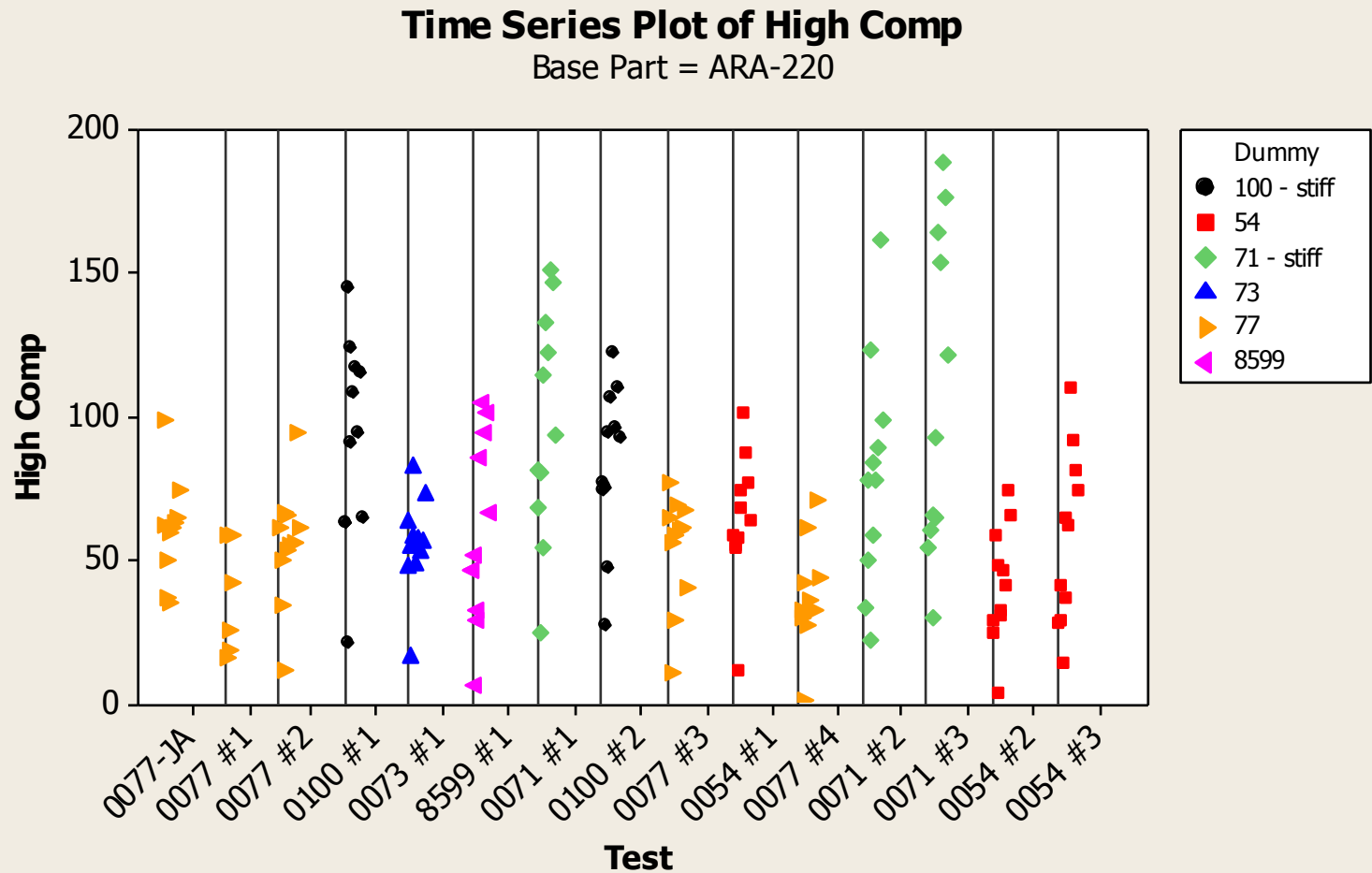
Bumper Compression on Spine



Bumper Compression on Spine



Bumper Compression on Spine

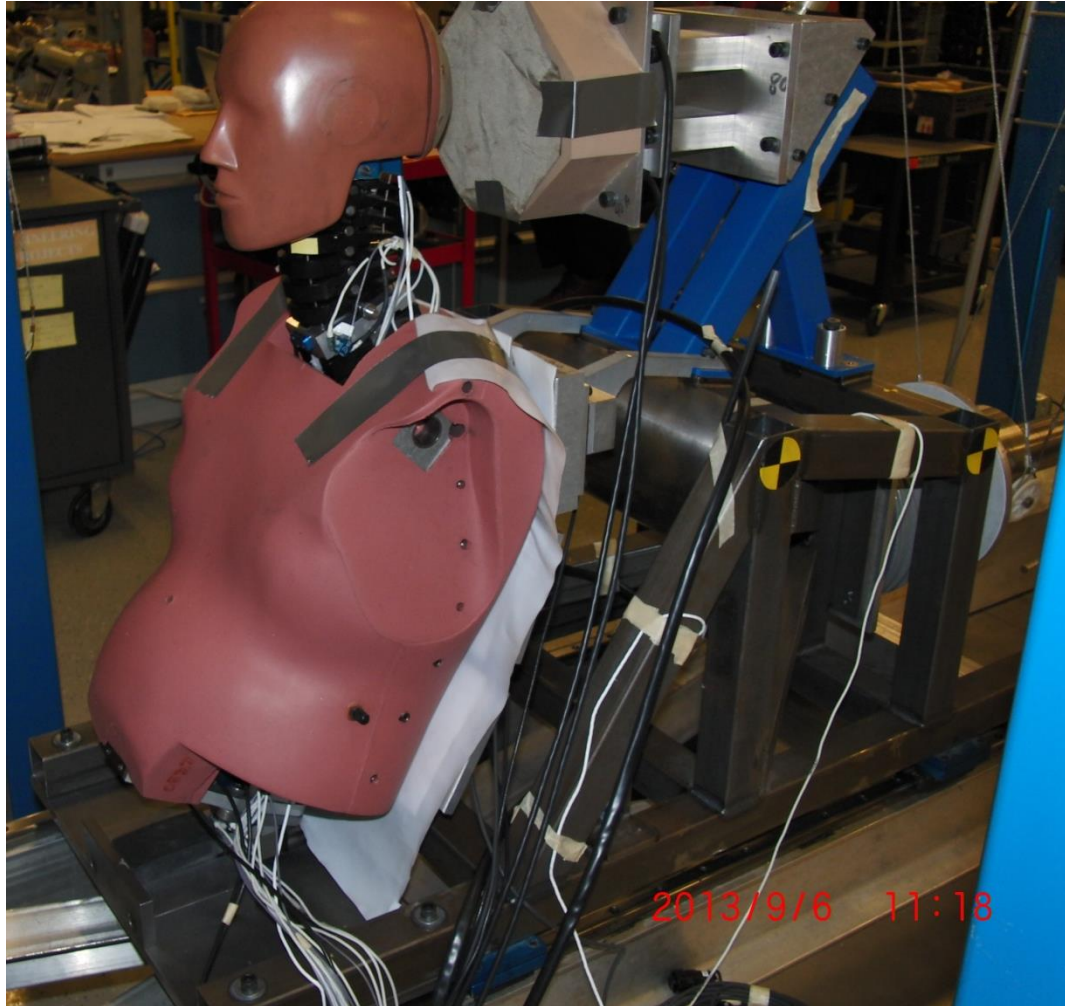


Test Development

- Dummy certification with head rest
 - 2 methods under discussion
 - ▶ With Back support – fairly new
 - ▶ Without back support – in use for some time
 - ▶ At last meeting some objected to dropping older method without more data
 - Status:
 - ▶ Collecting data post test on R&R dummies, VRTC dummies, engineering dummy with multiple stiffness bumpers on back support method
 - ▶ Collect and review more lower neck data and with several stiffness bumpers on no back support method
 - ▶ Data not ready to present yet
 - Issues: need better bumper information

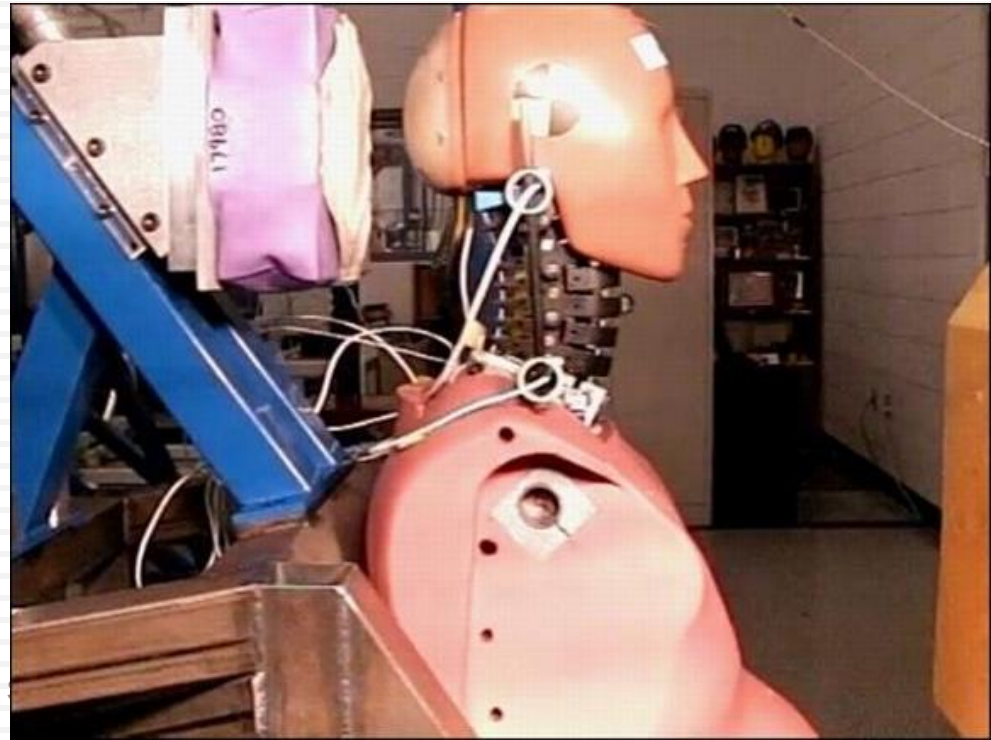


Mini-sled with seat back & head restraint



Tests Under Development

Mini-sled WITH Head Restraint



Test Development

- Bumper stiffness control procedure
 - Historically controlled by hand durometer gage
 - ▶ This method has very high variability – wide range of “real” durometers pass
 - Purchased new durometer stand
 - ▶ Probably as good as it get
 - ▶ On ASTM samples – best corridor possible is about +/- 3.5 points based on R&R study done on gage
 - Anecdotal: I have yet to find any company who has run a GR&R on durometer who will claim to be able to hold tighter than +/- 3 based on the results
 - Working on Compression test of bumpers



Test Development

- Compression test
 - 20% compression test using Universal test machine (UTM)
 - Our old stand has been giving us questionable data at times over last year
 - We have ordered a new, much more sophisticated stand
 - ▶ Will be able to do far more extensive material testing
 - ▶ Should be delivered in February



Test Development

- Bumper control is important to spine control
 - We have focused much of our time on this problem
 - Are having significant problems
- Two issues:
 - How to manufacture to a tight corridor
 - ▶ Humanetics problem
 - How does material change over time
 - ▶ Need to understand
 - ▶ Need good certification/inspection tests to control dummy

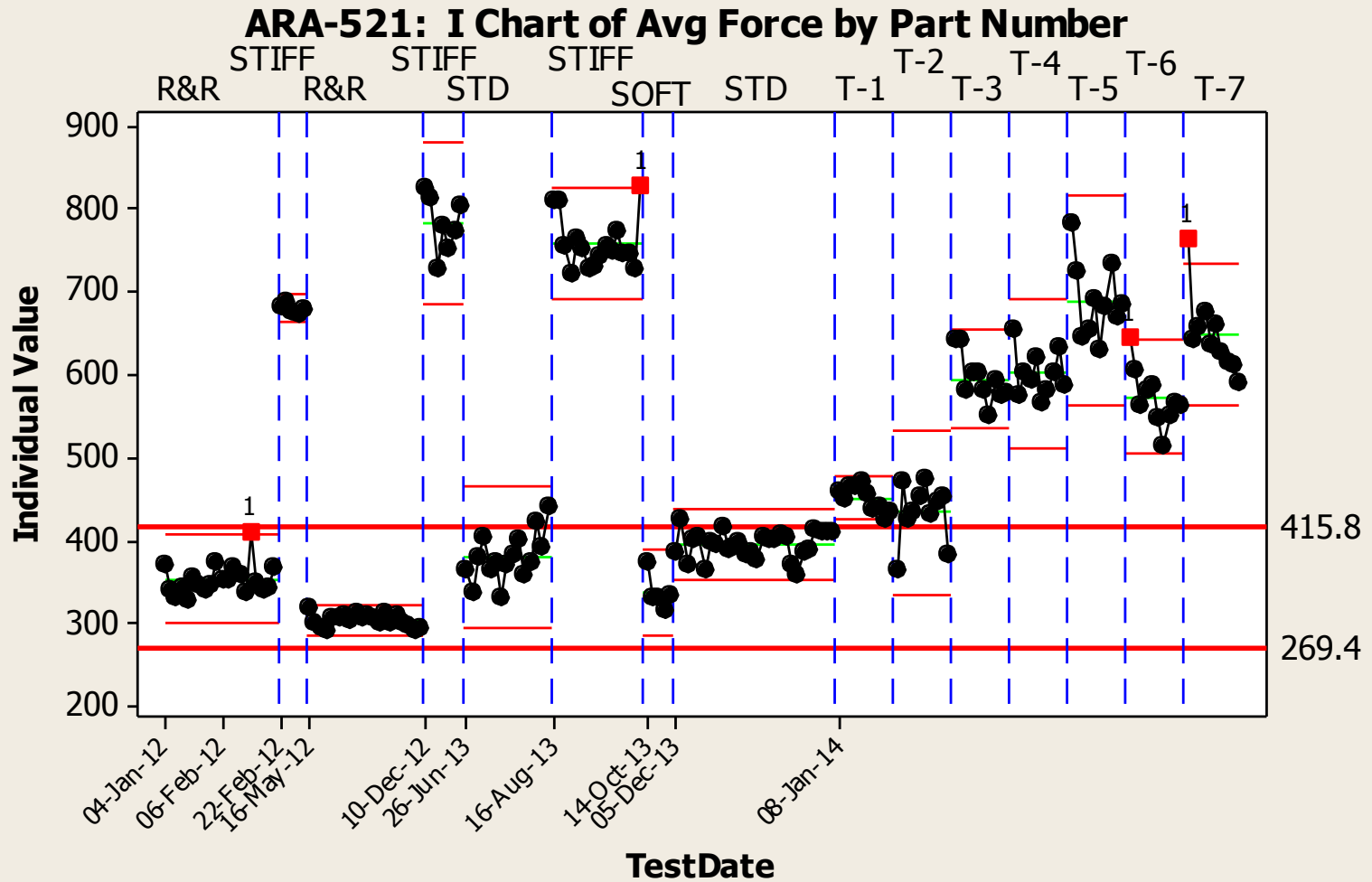


Bumper Control

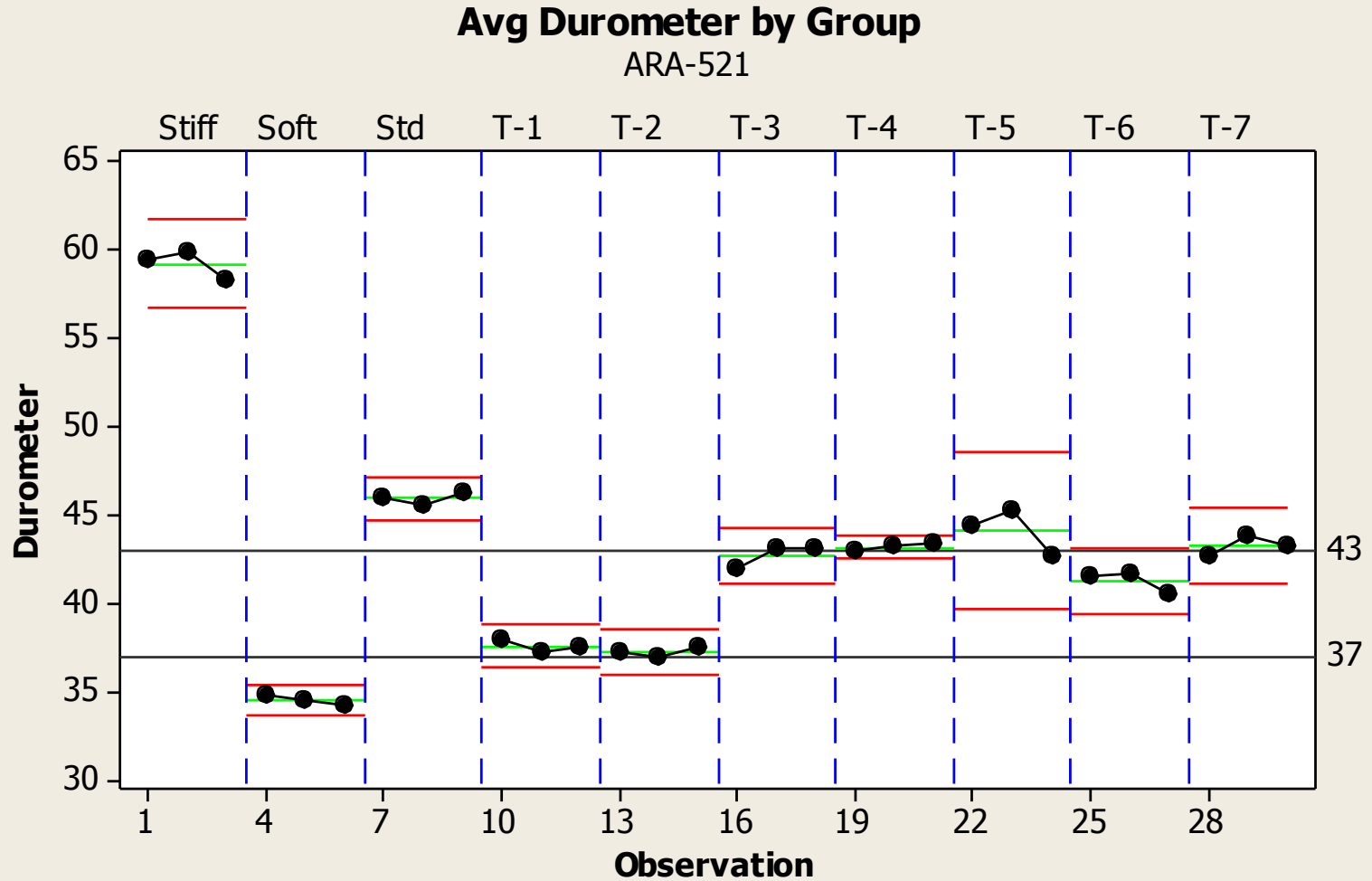
- Have created targets for compression stiffness based on R&R dummy bumpers



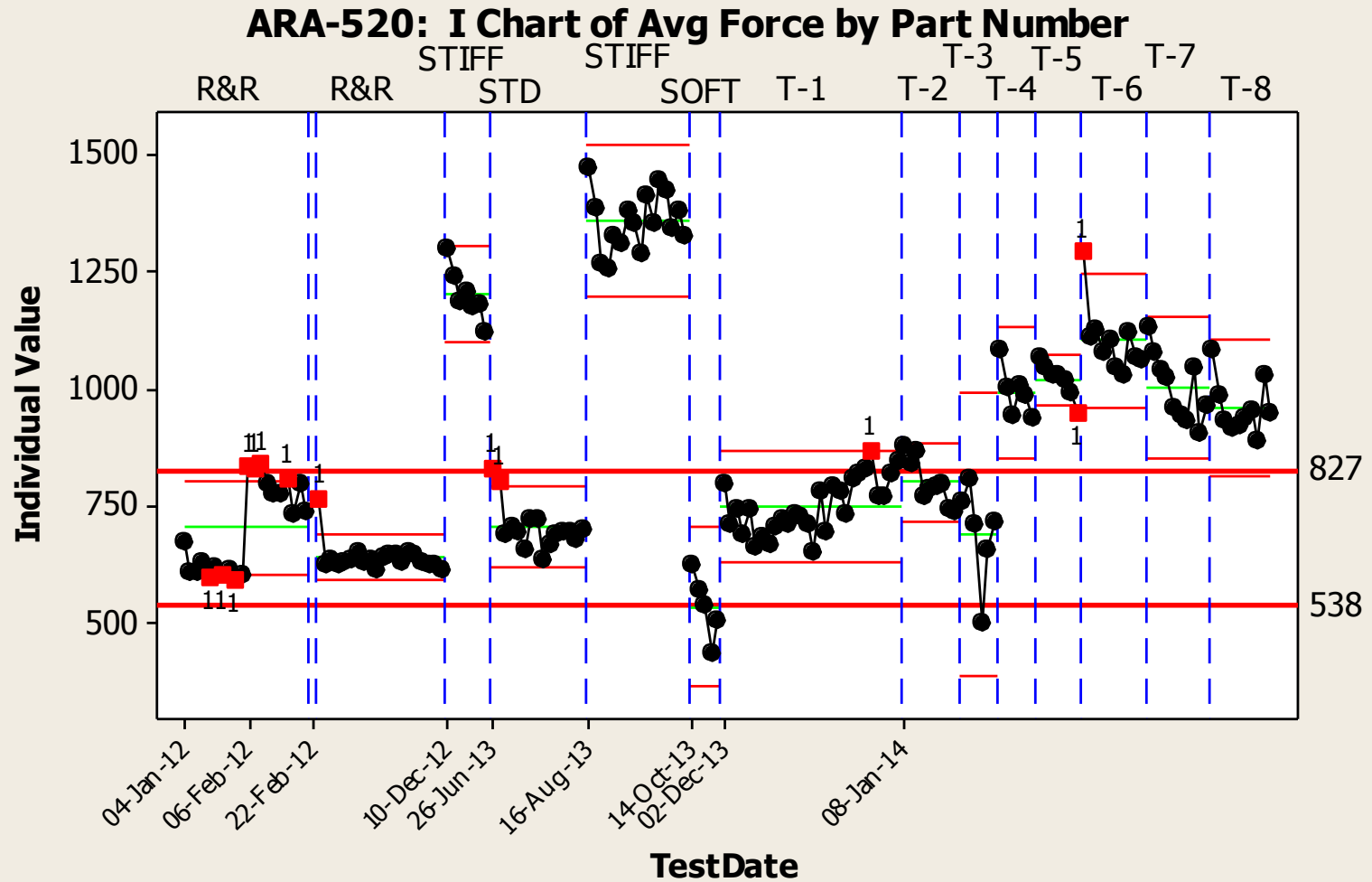
Bumper Control – Status & Issues



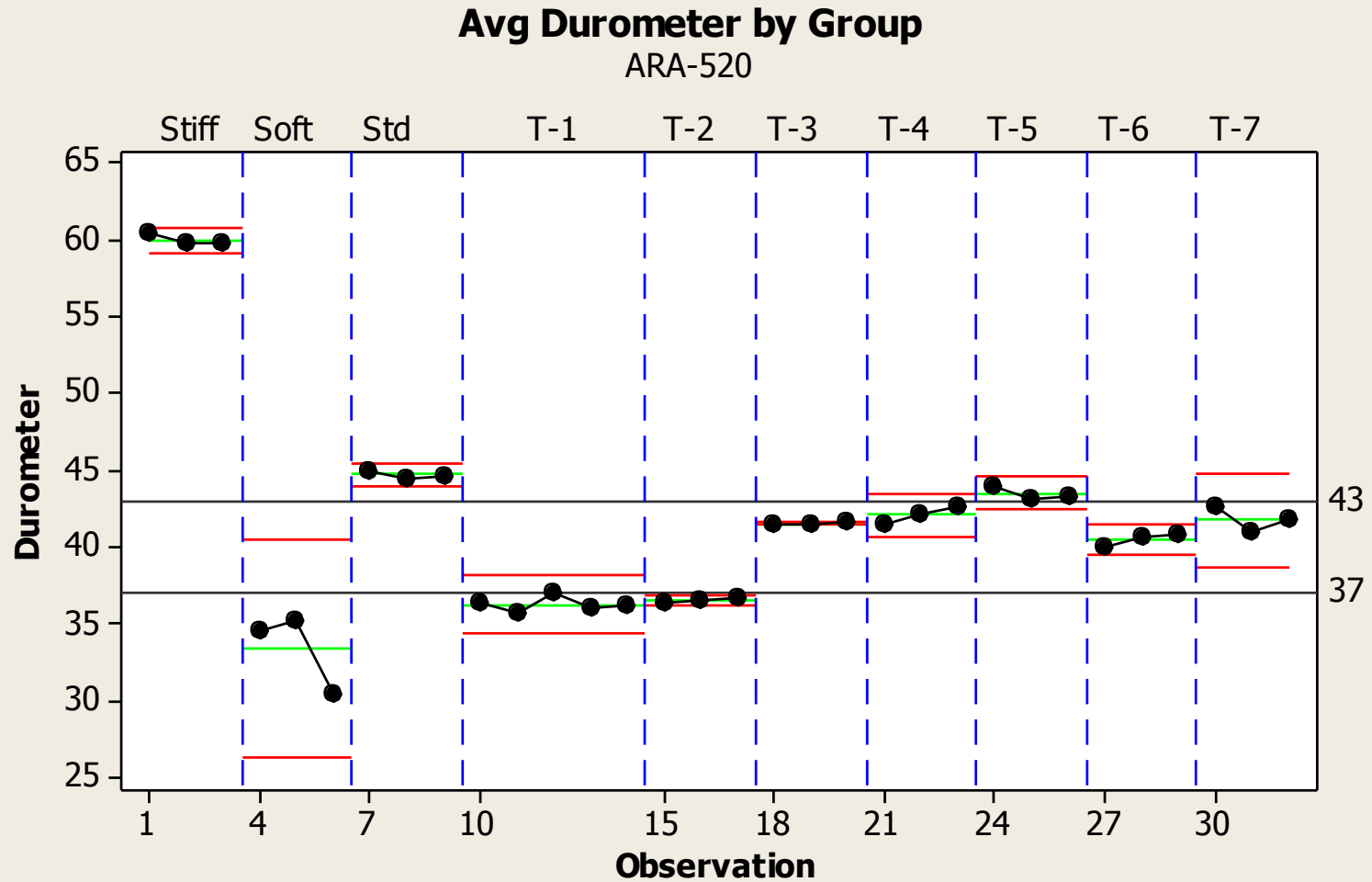
Bumper Control – Status & Issues



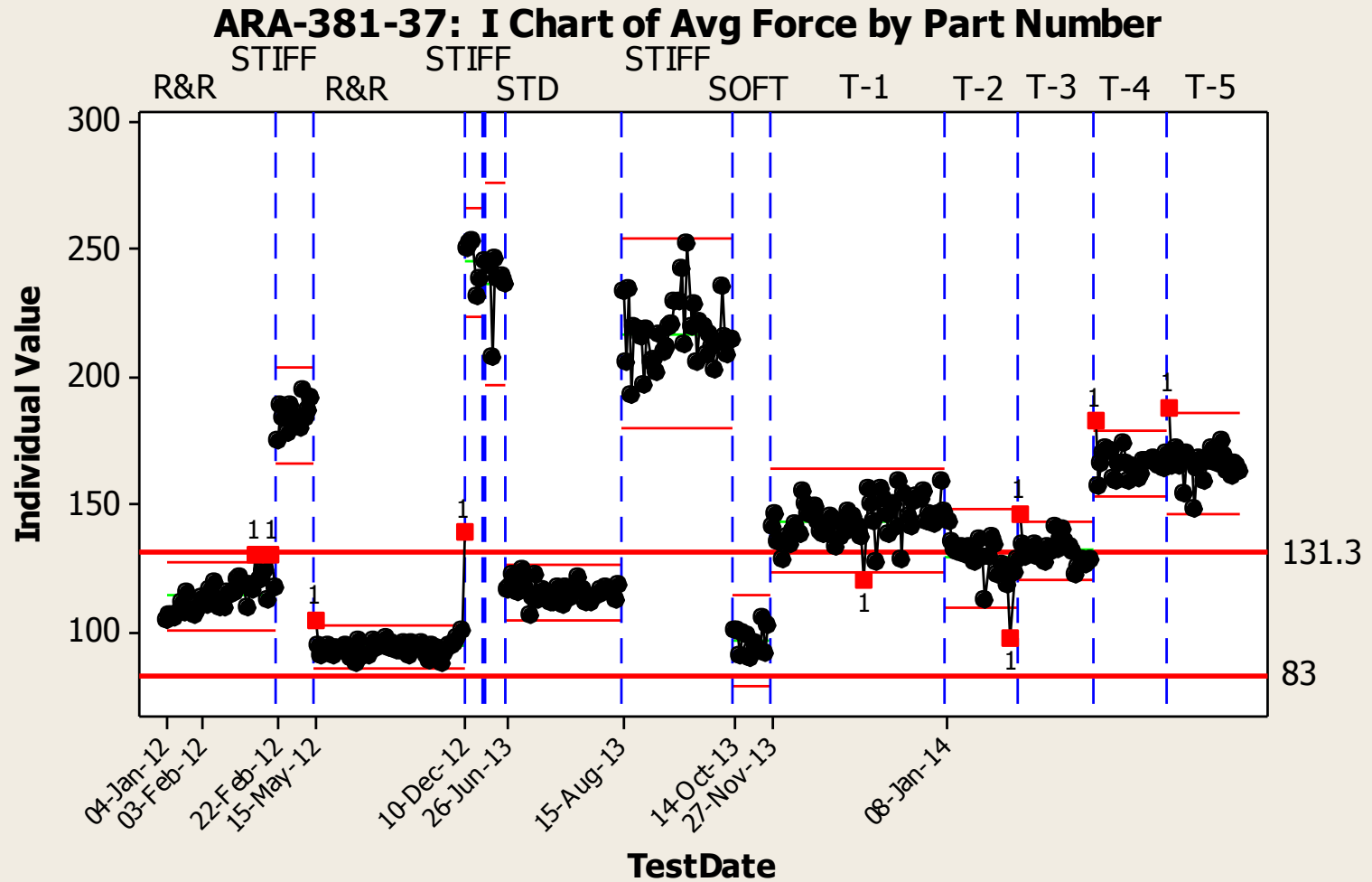
Bumper Control – Status & Issues



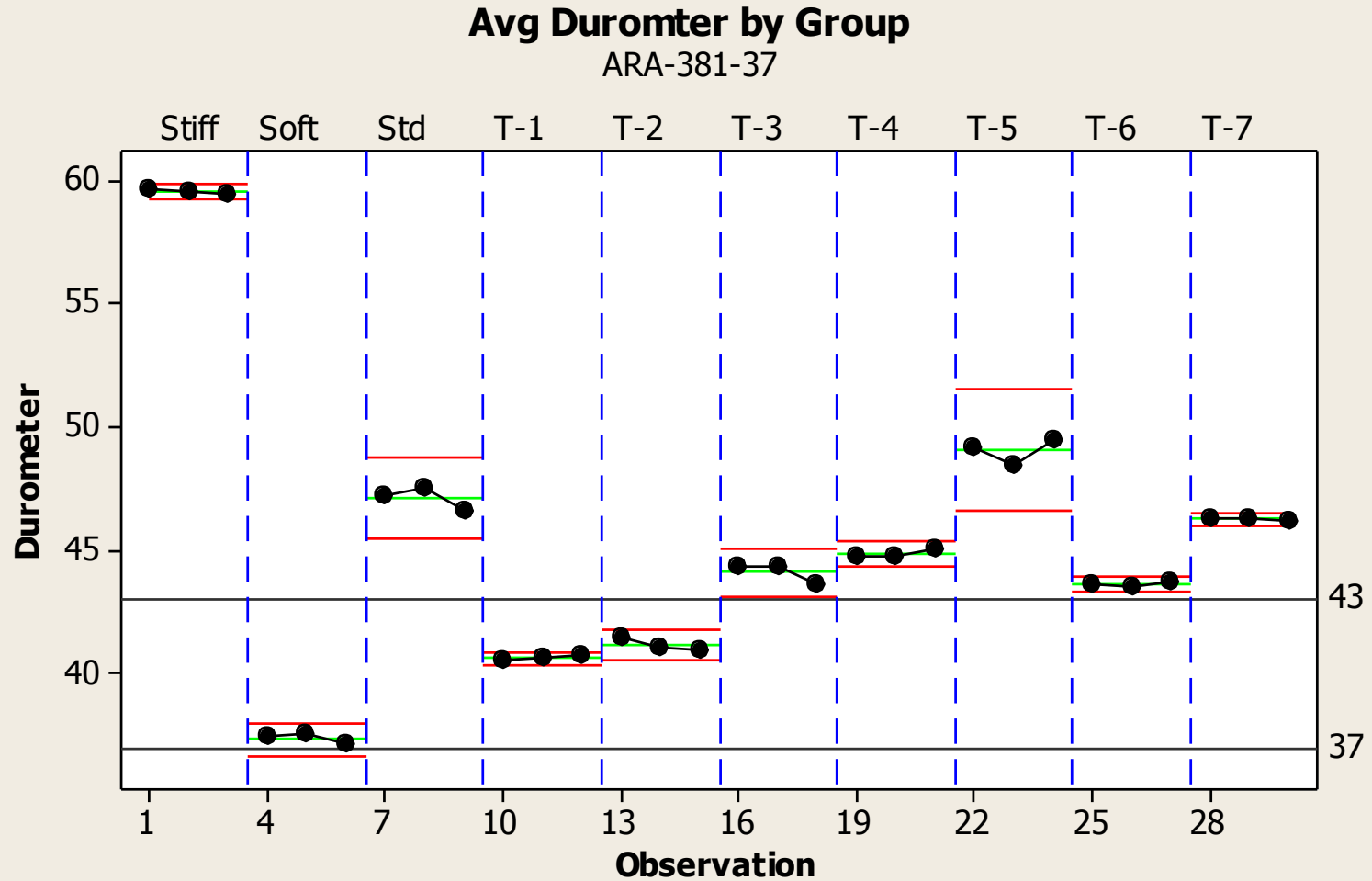
Bumper Control – Status & Issues



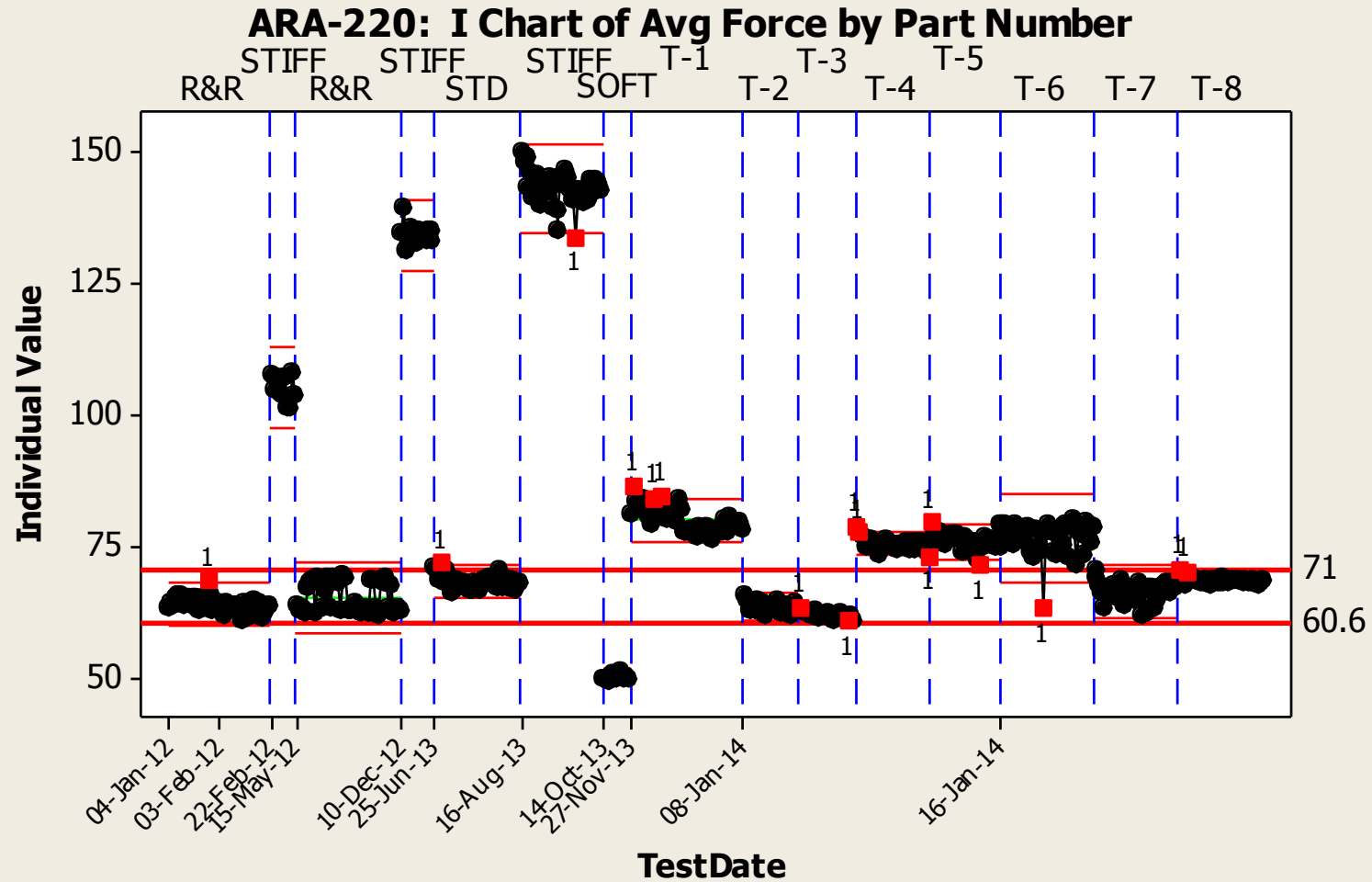
Bumper Control – Status & Issues



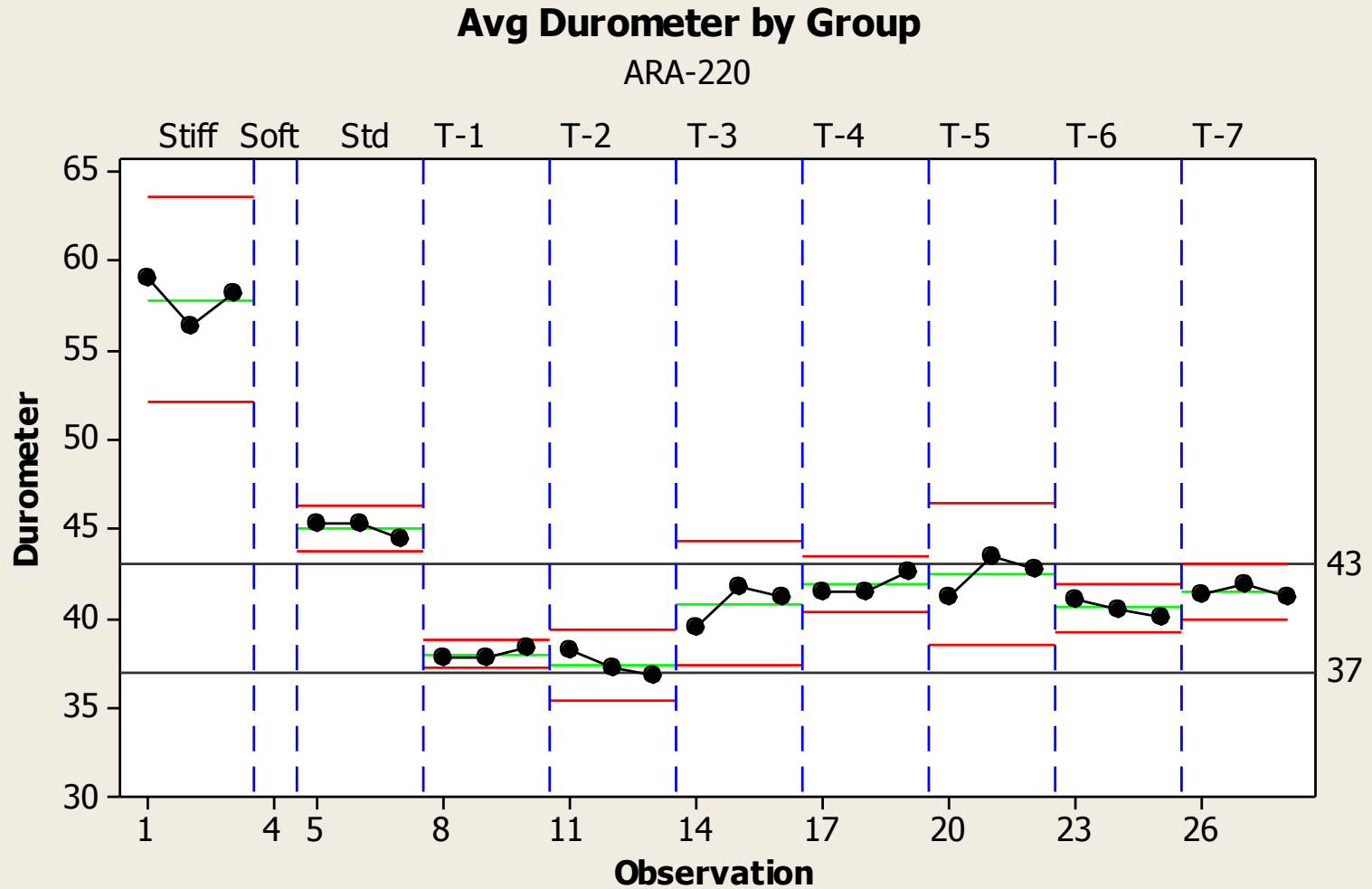
Bumper Control – Status & Issues



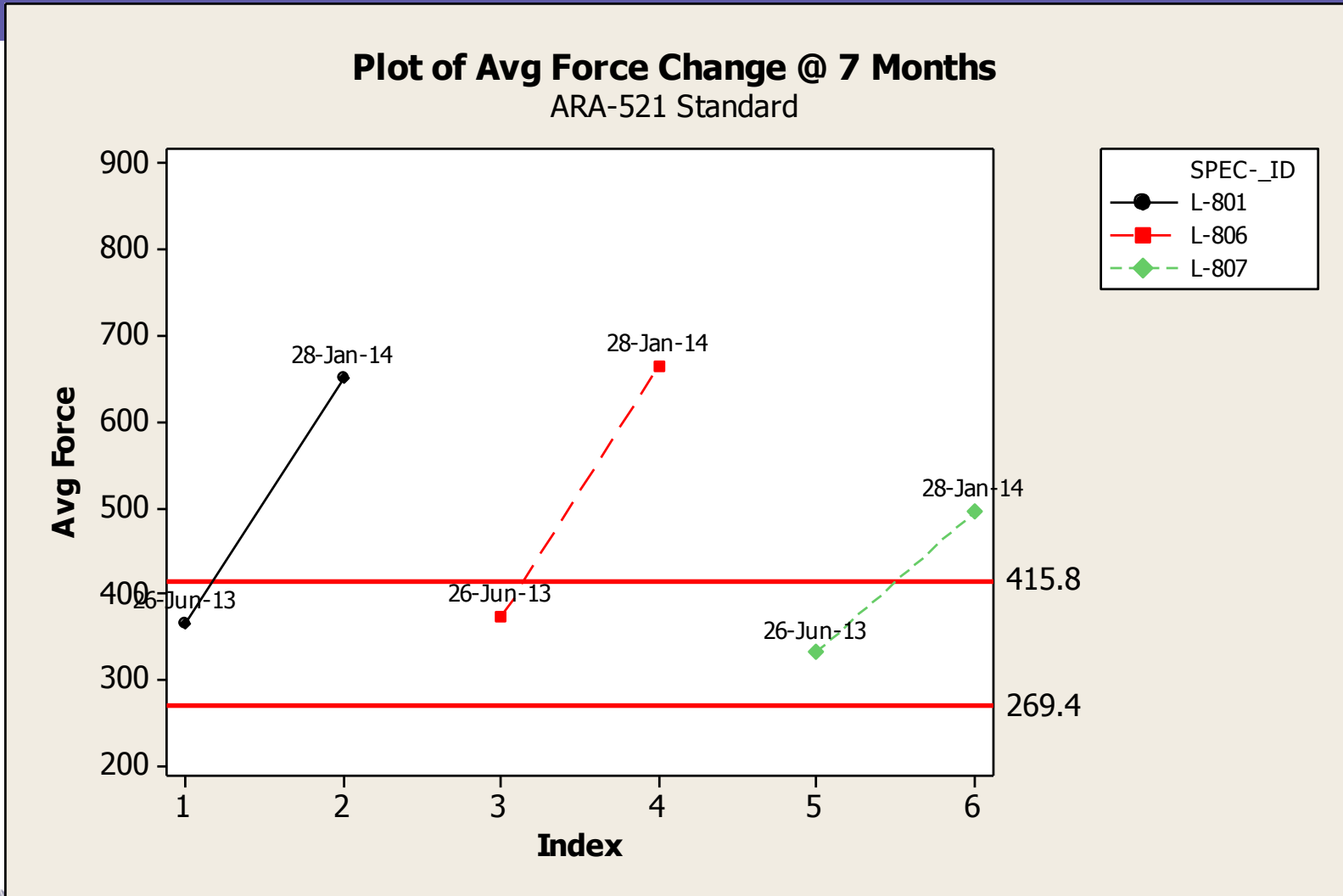
Bumper Control – Status & Issues



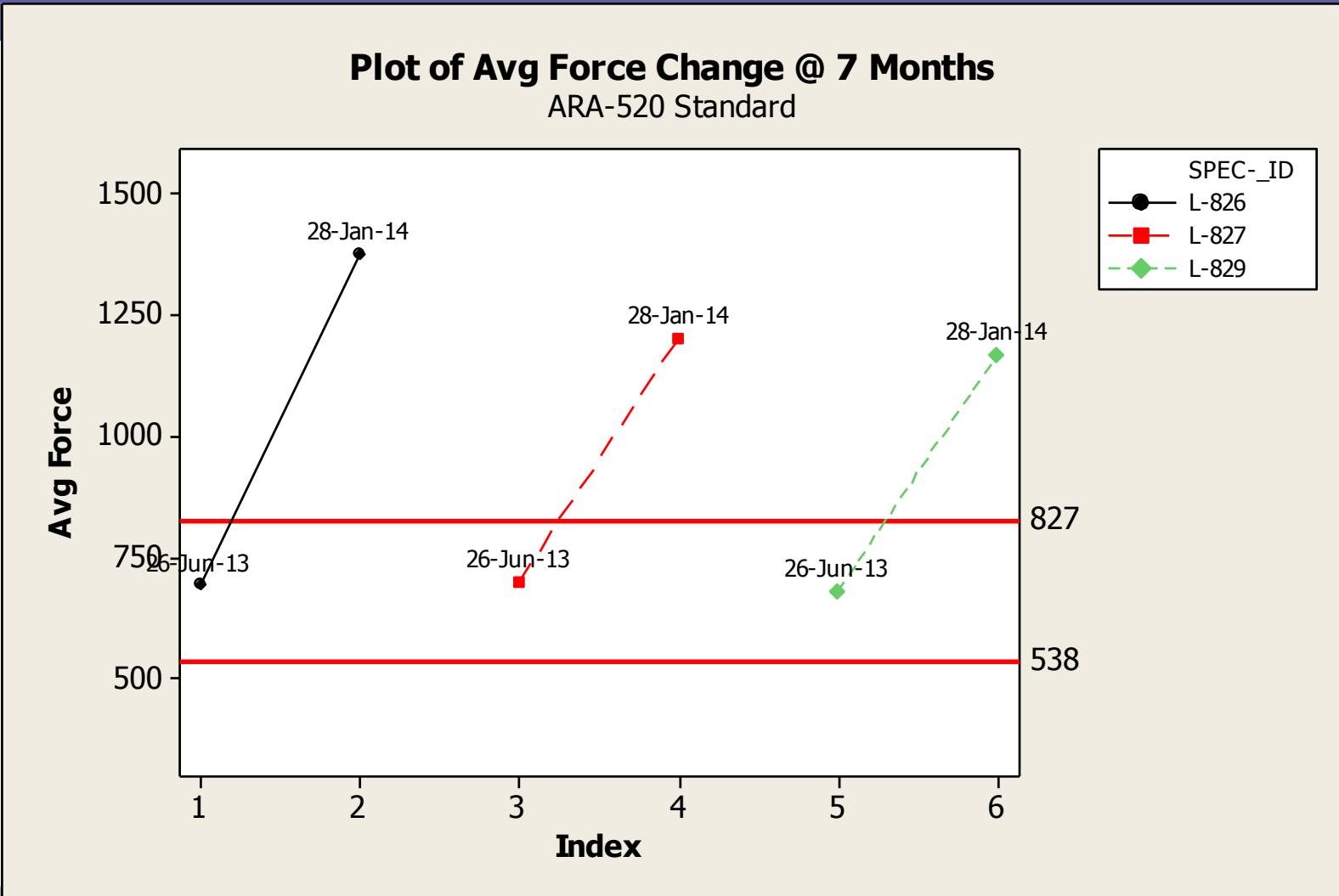
Bumper Control – Status & Issues



Bumper Control – Status & Issues

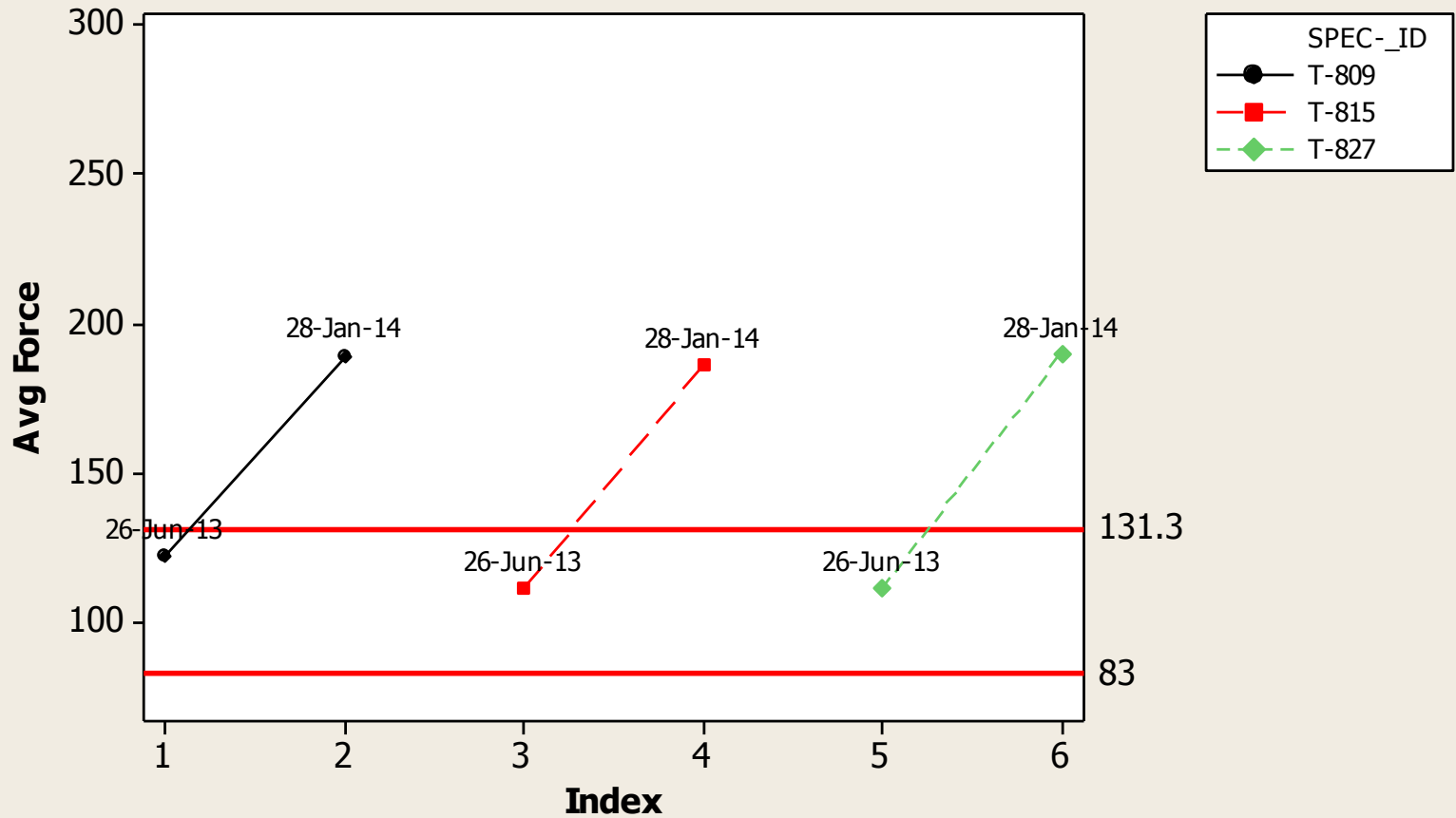


Bumper Control – Status & Issues

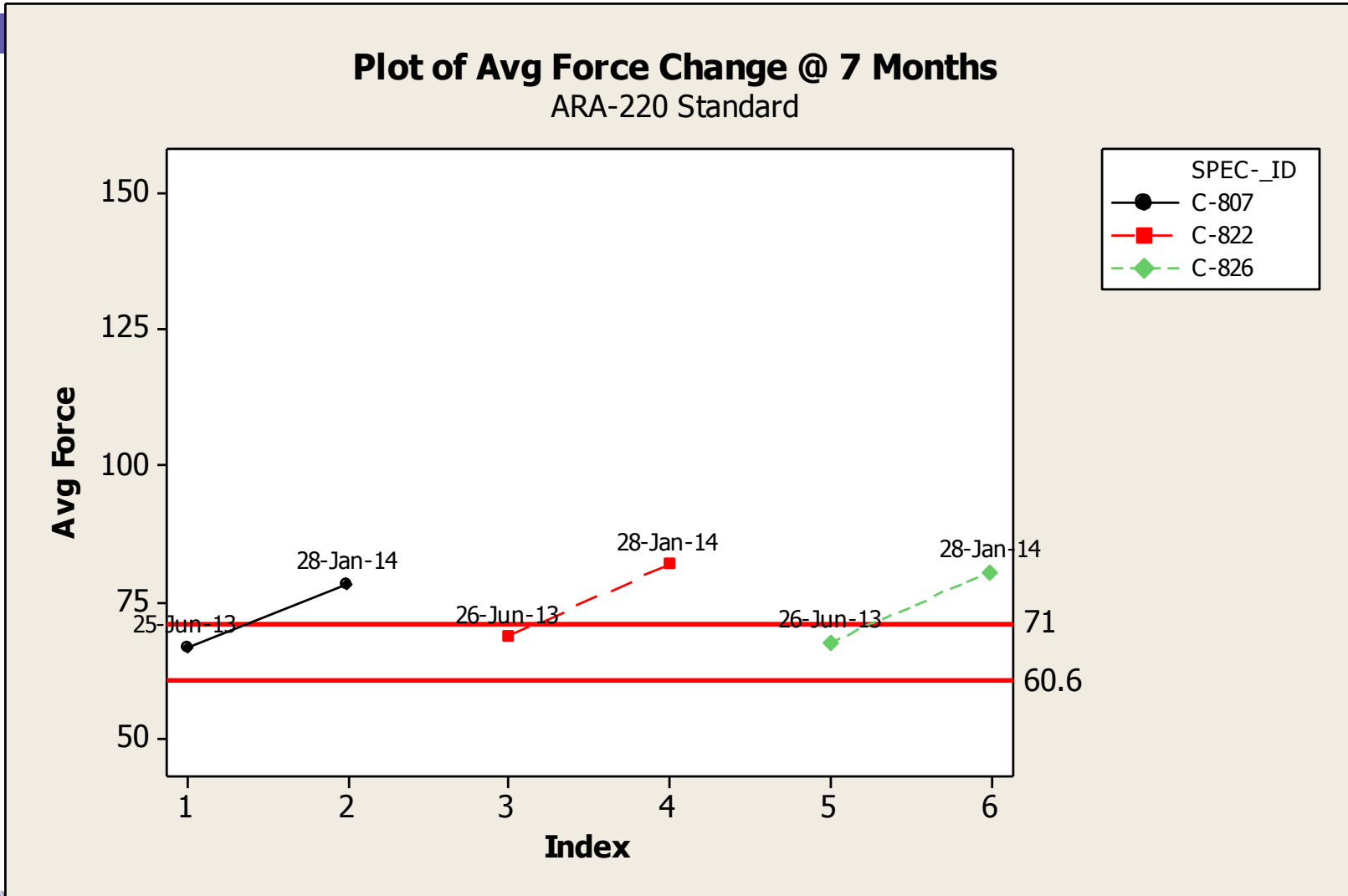


Bumper Control – Status & Issues

Plot of Avg Force Change @ 7 Months
ARA-381-37



Bumper Control – Status & Issues



Bumper Control – Status & Issues

- Hope to have more information by next week's meetings
- Question for group: does anyone know of a good, standard accelerated aging test for urethane?
 - What standard # (ASTM, ISO, other)?
 - Any experience?



Finishing dummies for Injury Criteria Development

- VRTC dummies, BASt dummy
- Pelvis & jacket work done
- Need to get bumpers right
- Hope to have better update on timing by next week meeting



Questions?