

# Flex-GTR Humanetics presentation



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# Content

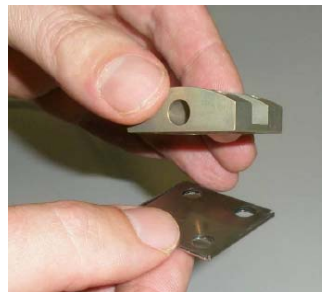
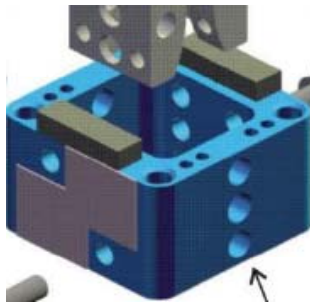
- Pendulum Corridors
- Analyses FLEX-GTR variability
- Gage calibration and sensitivity calculation
- Additional data
- Inverse certification

# Pendulum Corridors

- Humanetics agrees to keep pendulum corridors as they are
- Humanetics in-depth investigation on sources of variation
  - Reviewed tolerances, procedures, material control
  - Analyses of high response legs and low response legs
  - Reviewed data component tests: gages, tibia, femur and knee assy's
- Humanetics will refurbish any leg that is outside the GTR corridor
  - Our regional sales organisations will arrange with customers
- Bertrandt scatter investigation at Humanetics ongoing
  - Analyse and re-testing Bertrandt leg will take time
  - SN04 will be made available to Bertrandt for interim period

# Review sources variation

- Geometrical tolerances
  - Segment (blue nylon)
  - Links
  - Shoulder bolt for links
  - Rubber buffer thickness
  - Bone thickness controlled by stiffness test
- Materials
  - Rubber Buffer Stiffness
  - Bone material
  - Neoprene foam wrap
  - Knee spring stiffness
- Procedures
  - Spring adjustment
  - Shimming
  - 400Nm gage calibration and sensitivity



# Steps to tighten variations

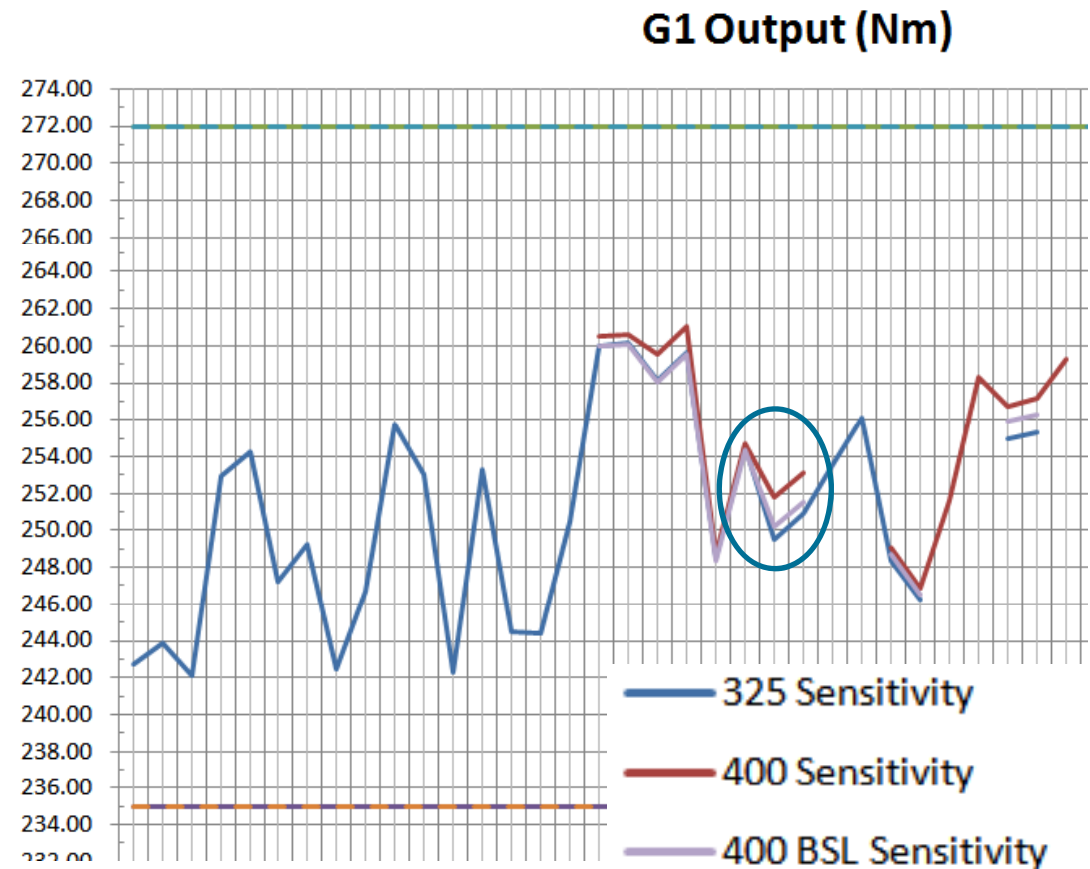
- Correction of internal corridors to GTR spec
- Current part tolerances are in default  $\pm 0.1$  mm
  - Tighten the critical dimension tolerance to  $\pm 0.05$  mm for metal parts
  - Keep current tolerance for Polyamide parts
- Rubber buffer
  - Change dimension from  $6.2 \pm 0.1$  to  $6.4 \pm 0.1$ ? TEG AGREES?
  - Inspection of rubber block and inner segment total height before bonding
- Improve shimming procedure
  - Always apply the thickest shim to use the least number of shims
  - Internal inspection after assembly
- Inspection of the links to ensure no locking after assembly

# Material Control

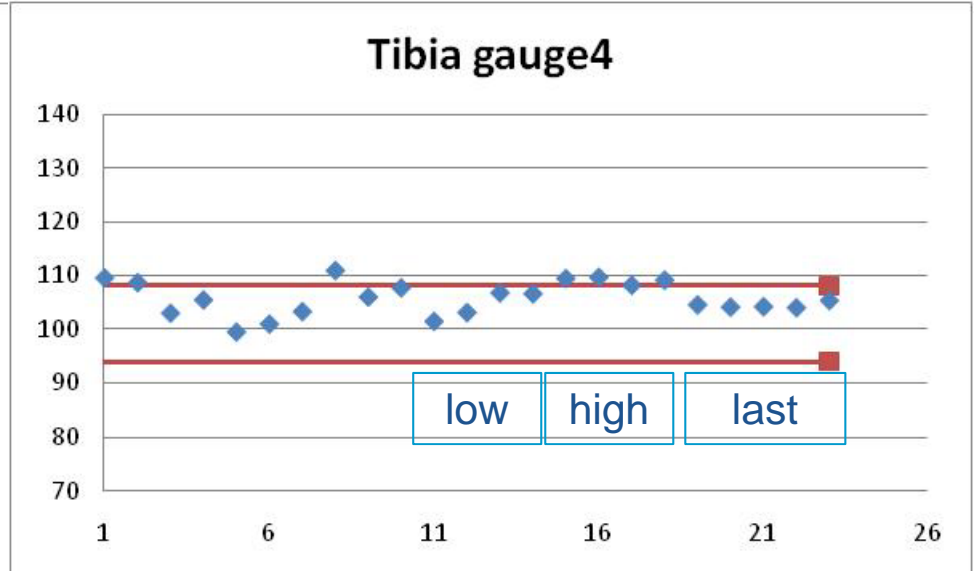
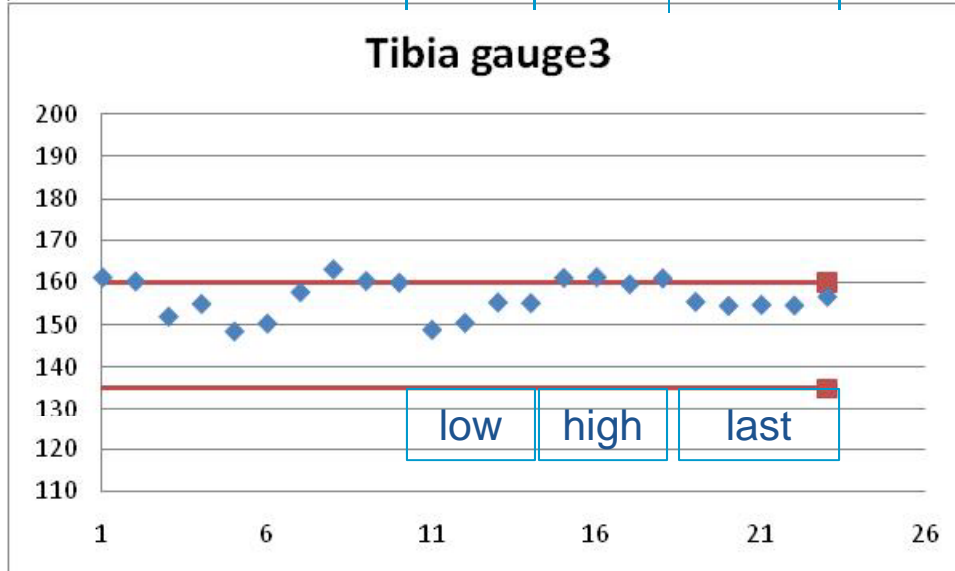
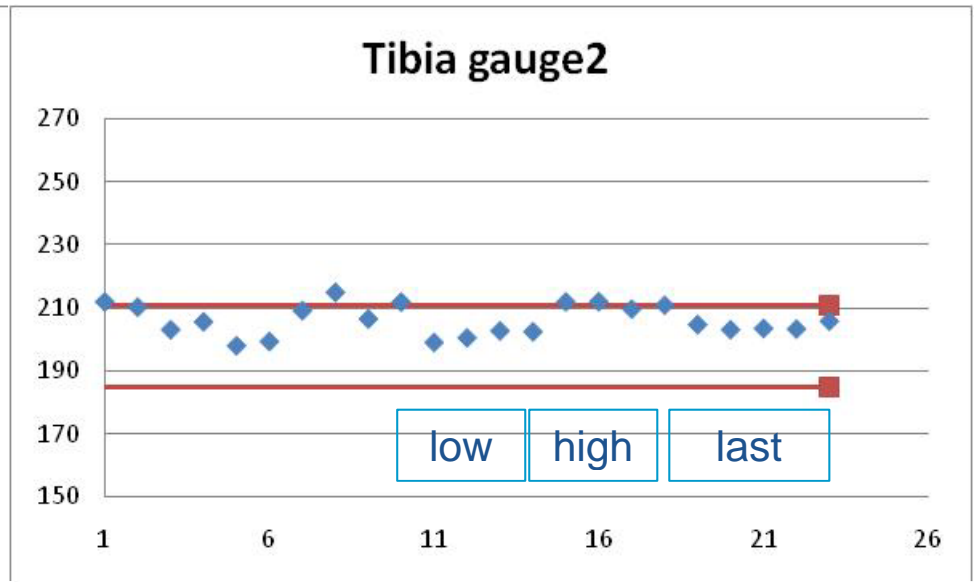
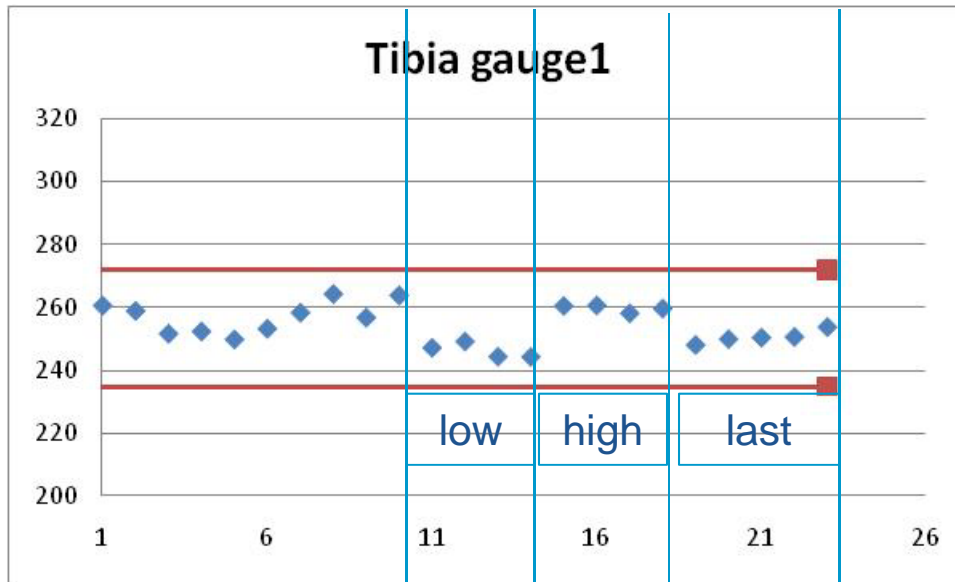
- Rubber buffer stiffness inspection procedure
  1. Check durometer and tolerance
  2. Drop bar fixture for dynamic test
  3. Collect data for analysis
- Flesh assembly test(s)
  1. Drop bar fixture testing on assembled flesh knee area
  2. Collect data for analysis (rubber/rubber/neoprene)
  3. Possible upper leg and lower leg area if applicable in the future

# Effect of 400Nm gage calibration

- Largest effect
  - 400Nm full scale 0.9% up wrt 325
  - 400Nm linear regression 0.26% up
- Linear regression closer to 325 full scale in all cases
- TEG agrees apply linear regression?

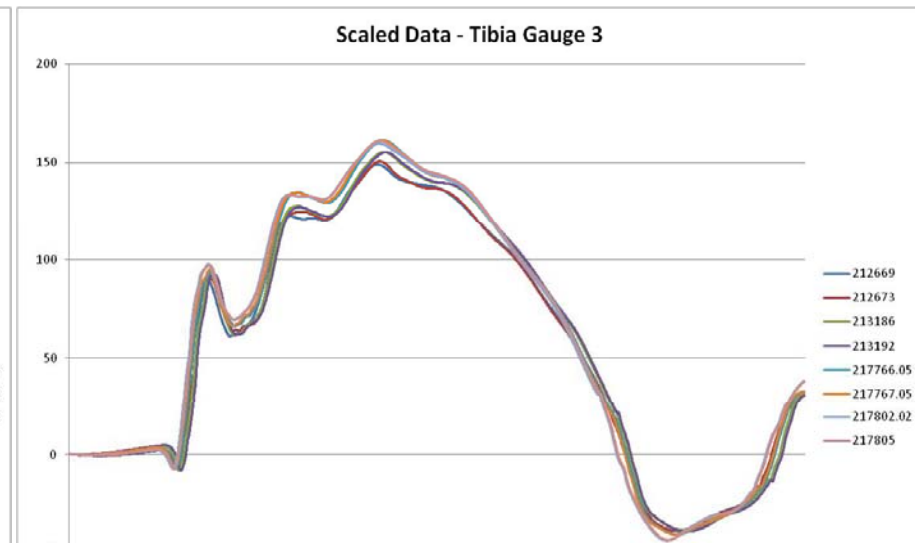
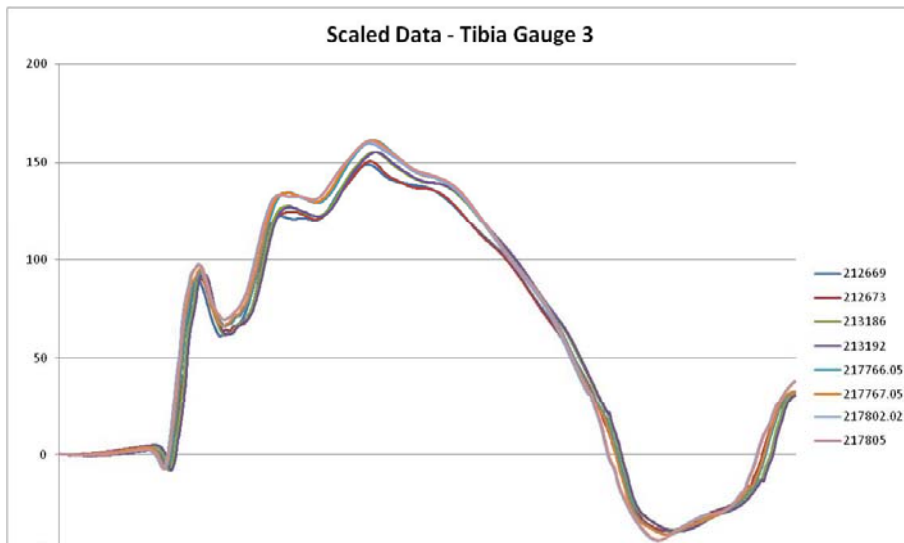
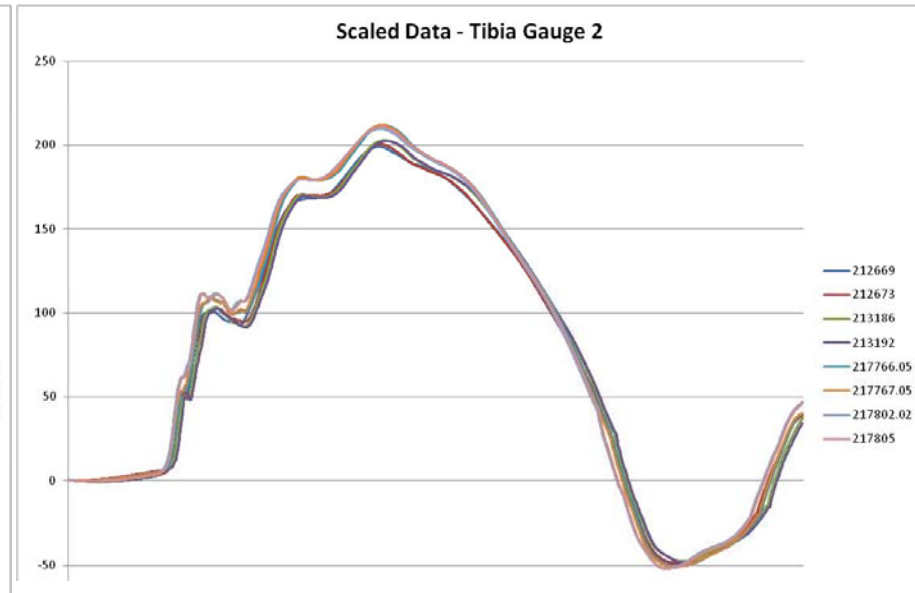
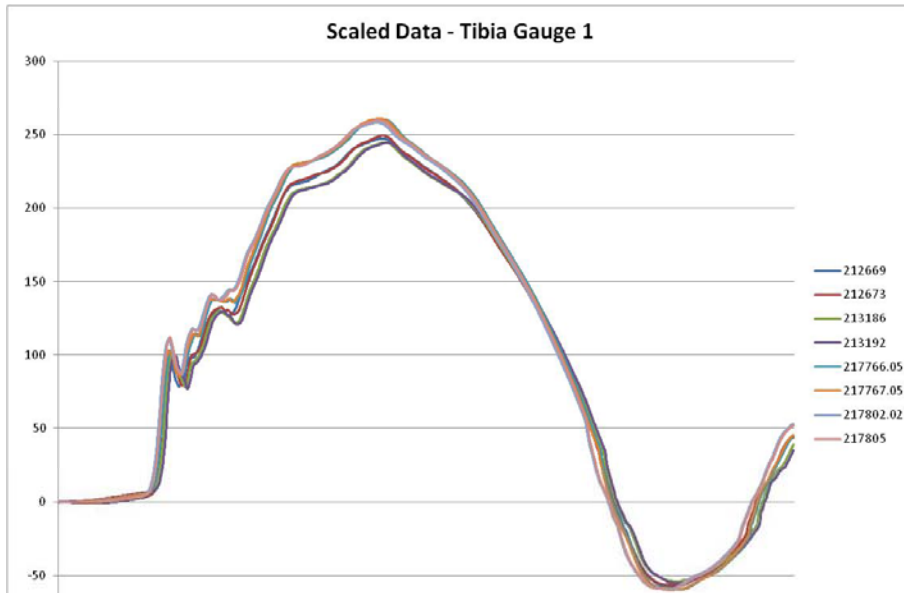


# Variation high and low legs



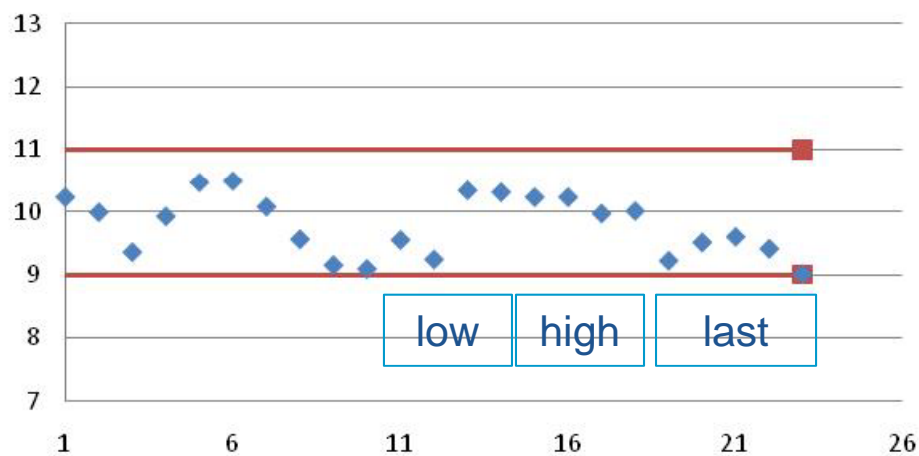


# Variation high and low

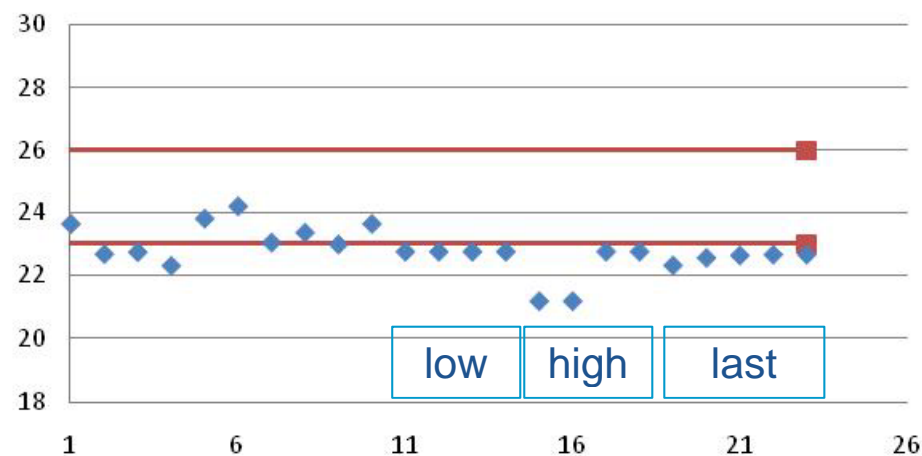


# Variation high and low legs

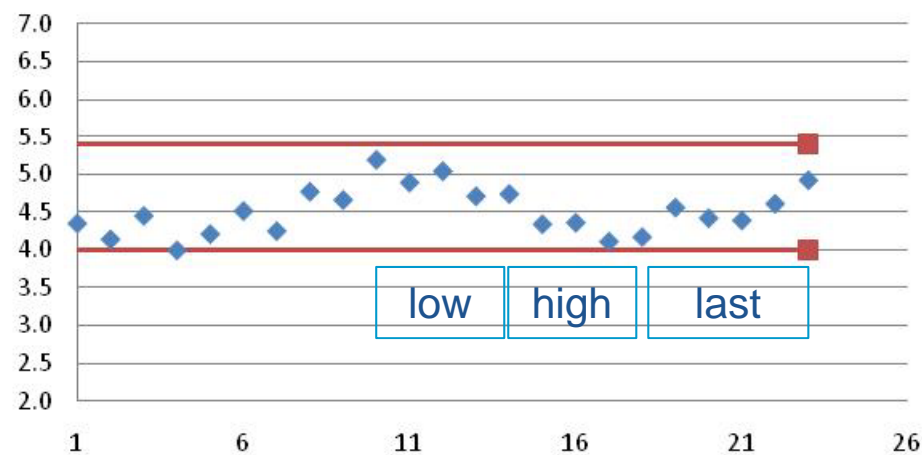
## ACL



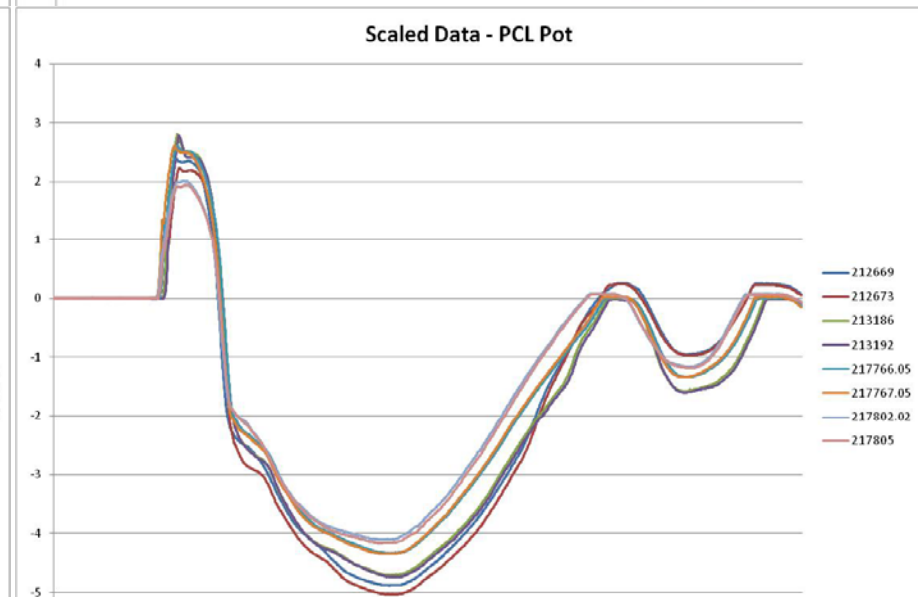
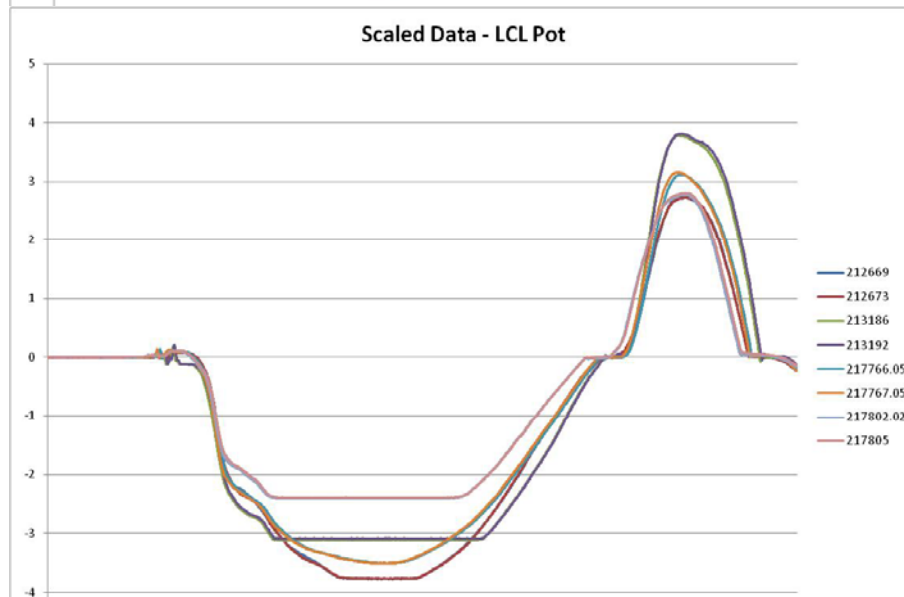
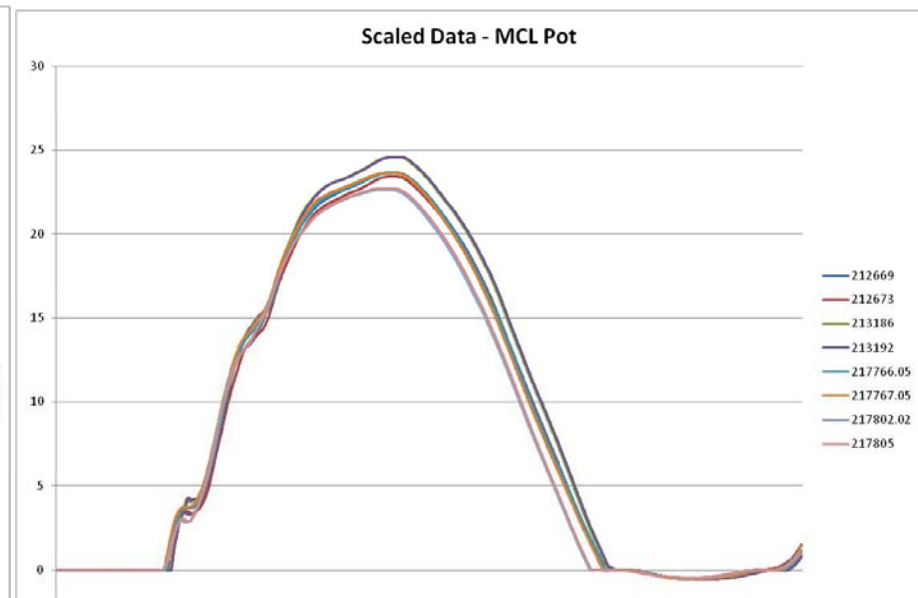
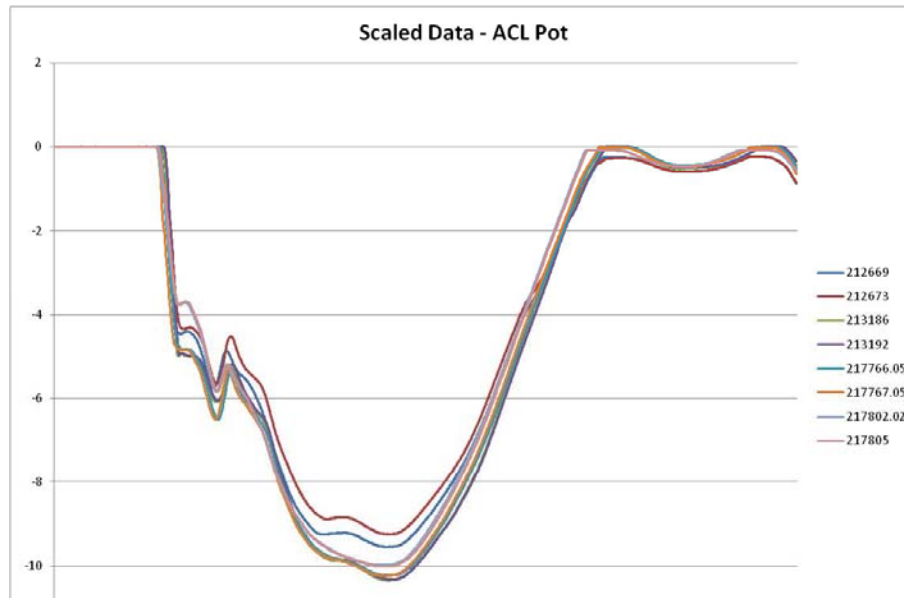
## MCL



## PCL

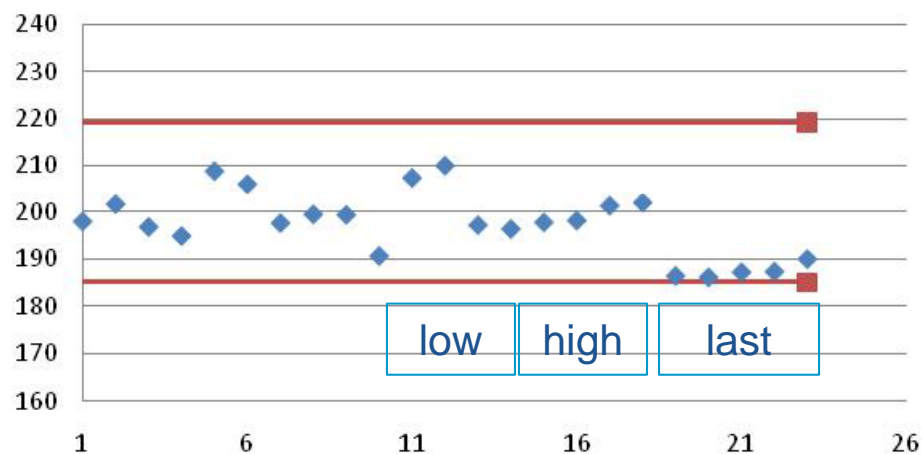


# Variation high and low

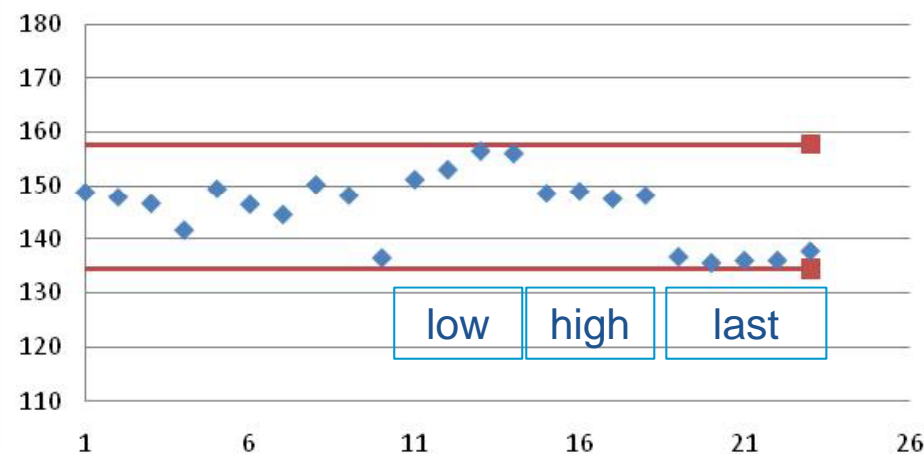


# Variation high and low legs

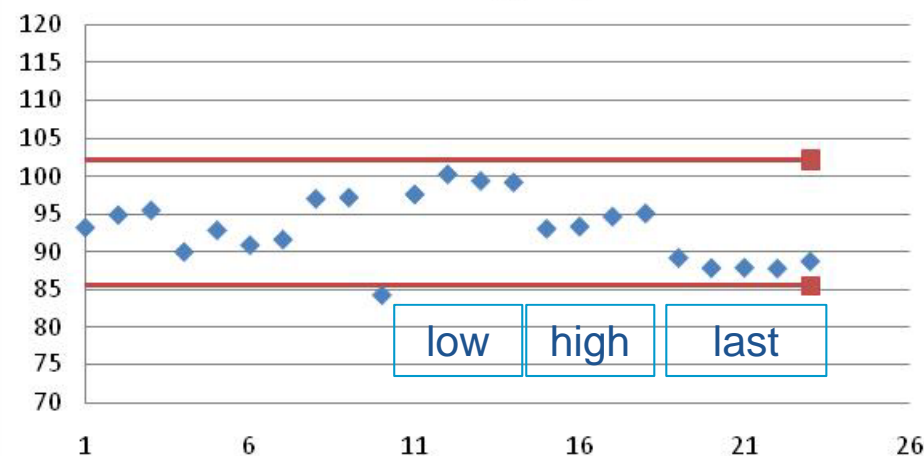
### Femur gauge1



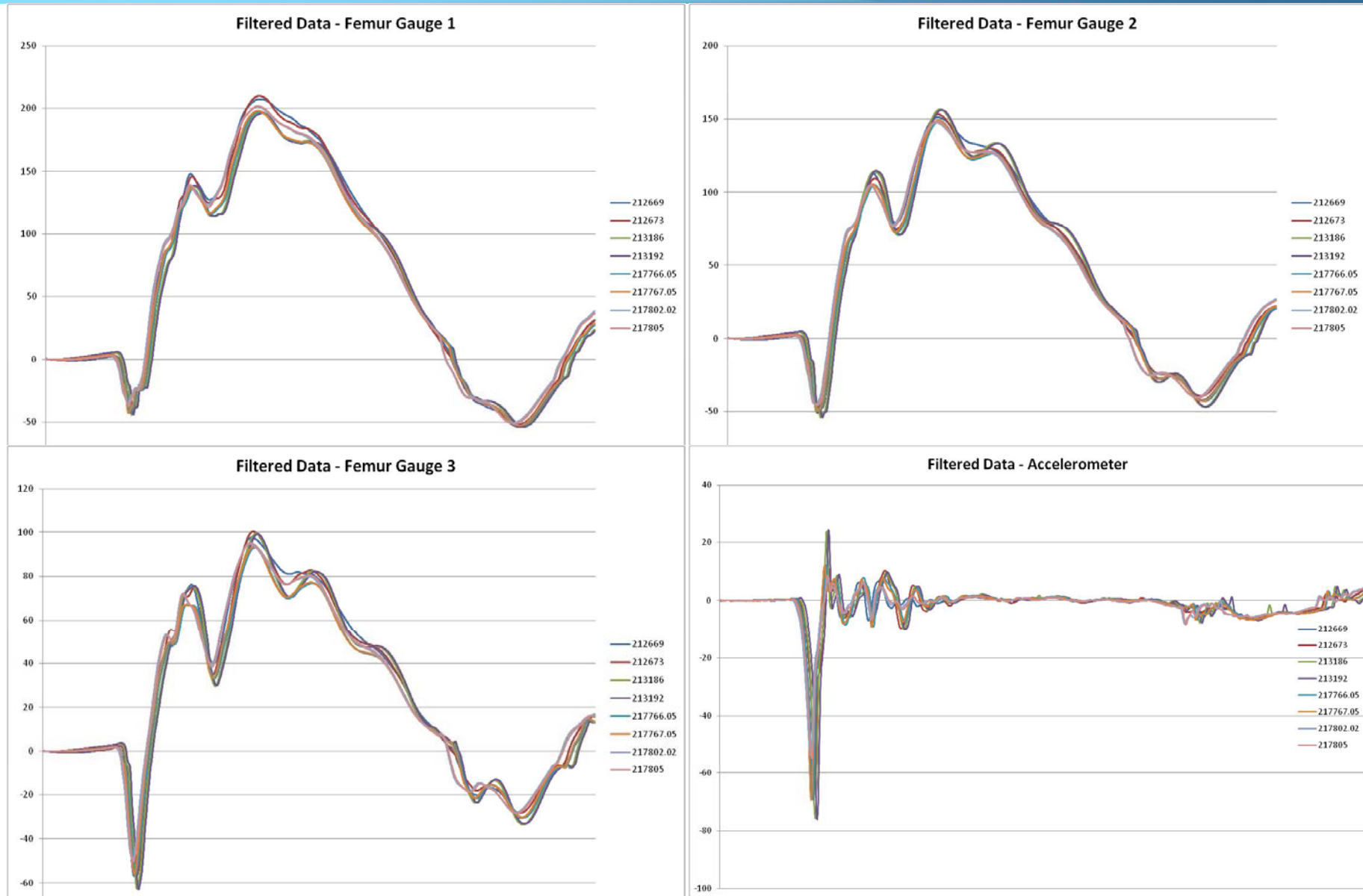
### Femur gauge2



### Femur gauge3



# Variation high and low



# Inverse Testing

- Humanetics will deliver new product with Inverse certification report
  - In-house test equipment expected 1st quarter 2011
  - Outsource at BAST or JARI(?) intermediate period
- Humanetics willing to co-operate with TEG obtaining inverse data from all product
  - Humanetics will facilitate inverse tests at BAST
  - EU customers Bertrandt, Opel, PDB