Idaho National Engineering and Environmental Laboratory

MOV Stem Lubricant Aging Research

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- *The effectiveness of the lubricant used on the threaded portion of the valve stem can impact the output of motor actuators and the margin for operating MOVs.*
- *Recent INEEL test results (NUREG/CR-6750) indicate that elevated temperatures can lead to significant increases in stem thread friction.*
- *Lubricant aging may have similar effects on the output of motor actuators.*

Scope

- *Perform limited tests to evaluate the effects of aging on stem lubrication and friction.*
  - *Two lubricants from earlier testing.*
  - *One stem/stem nut combination from earlier testing.*
- *Perform limited tests with MOV Long Life.*
  - *One stem/stem nut combination from earlier testing.*
  - *Stem thread friction and rate-of-loading tests.*
  - *Elevated temperature tests.*
  - *Lubricant aging tests.*

Earlier INEEL Tests

- *Evaluated the effect of a temperature increase from ambient (70°F) to design basis (250°F).*
- *Evaluated the sensitivity of stem thread friction to incremental increases in temperature.*
- *Provided recommendations for stem lubrication aging research.*

Earlier INEEL Tests

- *Hardware included:*
  - *Two Limitorque actuators*
  - *Four stem/stem nut combinations*
- *Lubricants tested:*
  - *Exxon Nebula EP1*
  - *Chevron SRI*
  - *Mobil Mobilgrease 28*
  - *SWEPCO Moly 101*
  - *Loctite N5000 Anti-Seize*

Earlier INEEL Tests - Conclusions

- *The physical characteristics and frictional performance of each lubricant changed with increasing temperature.*
- *The repeatability from one stroke to another changed with increasing temperature.*
- *The stem/stem nut friction can increase significantly at elevated temperature.*
- *The end of stroke friction behavior is highly dependent on the unique stem tested, lubricant, and temperature.*
- *Each stem/stem nut combination has unique performance characteristics.*

Test Design

- *Hardware Tested*
  - *Limitorque SMB-0 actuator equipped with a Reliance 25 ft-lb 480V ac motor.*
  - *Stem 2, 1.750-inch-diameter, 1/4-pitch, 1/4-lead valve stem and stem nut*
- *Lubricants Tested*
  - *Chevron SRI*
  - *Mobil Mobilgrease 28*
  - *MOV Long Life (NLGI Grade-1)*

Actuators and stem nut area of the stems were held at elevated temperature during the aging period.

Stem thread friction and rate-of-loading tests (MOV Long Life only).

- *Determine the stability of the stem/stem nut friction at various load levels.*
  - *Low load - no flow, packing and stem rejection.*
  - *Medium load - pumped flow.*
  - *High load - high DP flow.*
  - *Max load - very high DP.*
- *Determine ambient temperature baseline performance.*
- *Determine rate-of-loading performance characteristics.*

Elevated temperature tests (MOV Long Life Only).

- *Elevated temperature test.*
  - *Evaluate the effect of a temperature increase from ambient to design basis.*
  - *70 - 250 - 70°F.*
- *Temperature step test.*
  - *Evaluated the sensitivity of stem thread friction to incremental increases in temperature*
  - *70 - 130 - 190 - 250 - 70°F.*

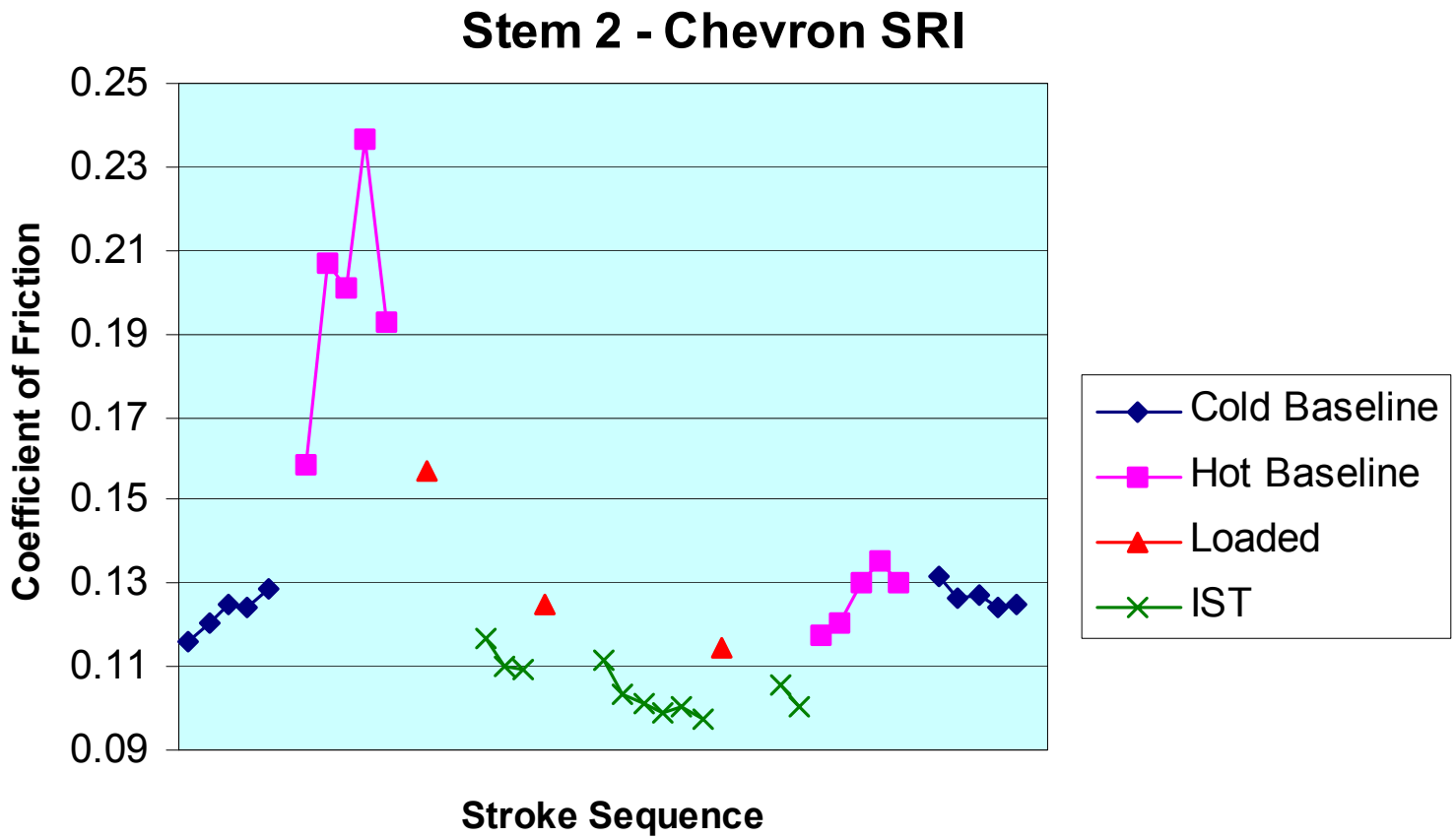
Accelerated Aging Tests

- *Baseline Tests.*
  - *Five loaded strokes at room temperature (70°F).*
  - *Five loaded strokes at aging temperature (250°F).*
- *Operational Tests.*
  - *One complete valve stroke under loaded conditions.*
  - *Performed at 0, 1, 2½, 4, and 5 year (simulated).*
- *Inservice Tests.*
  - *One complete valve stroke under light load conditions.*
  - *Performed at 3-month (simulated) intervals.*
- *Final Tests (Same a Baseline Tests - reverse order).*

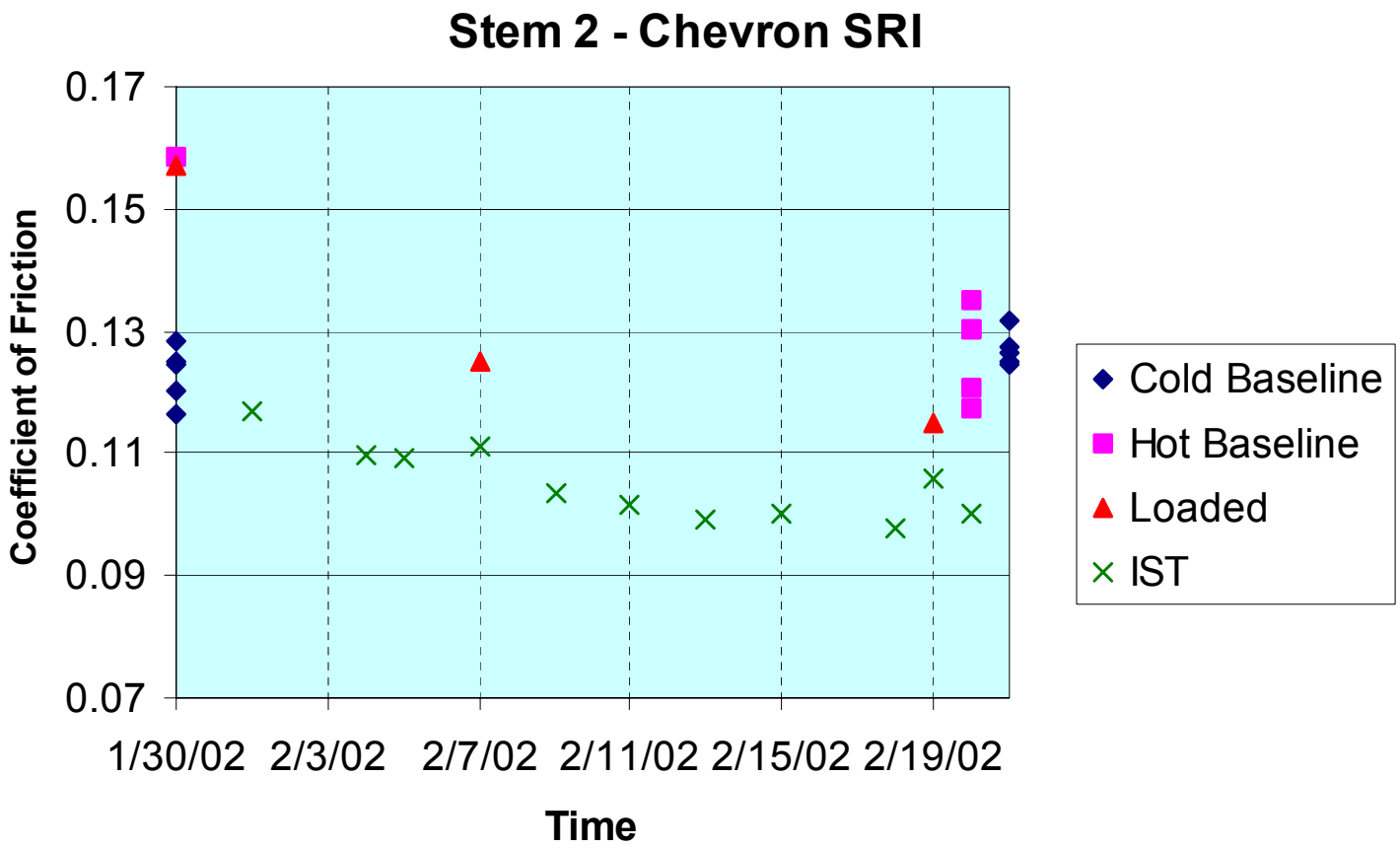
Test Results - Chevron SRI and Mobil Mobilgrease 28.

- *Each lubricant was applied to Stem 2 and tested for a simulated 2½-year period.*
- *Testing was limited to one application of each lubricant.*

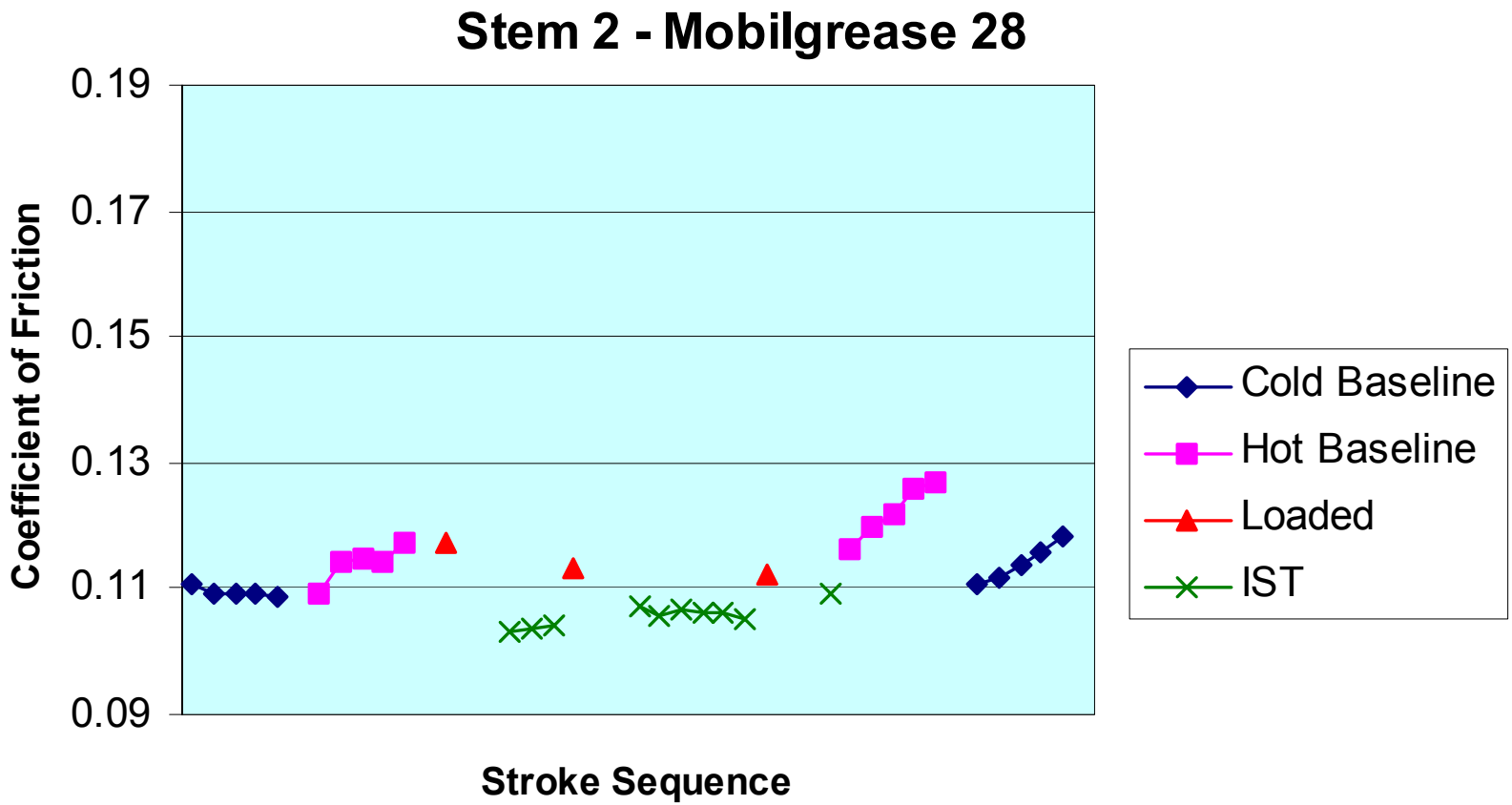
Aging test stroke sequence for Stem 2 with Chevron SRI



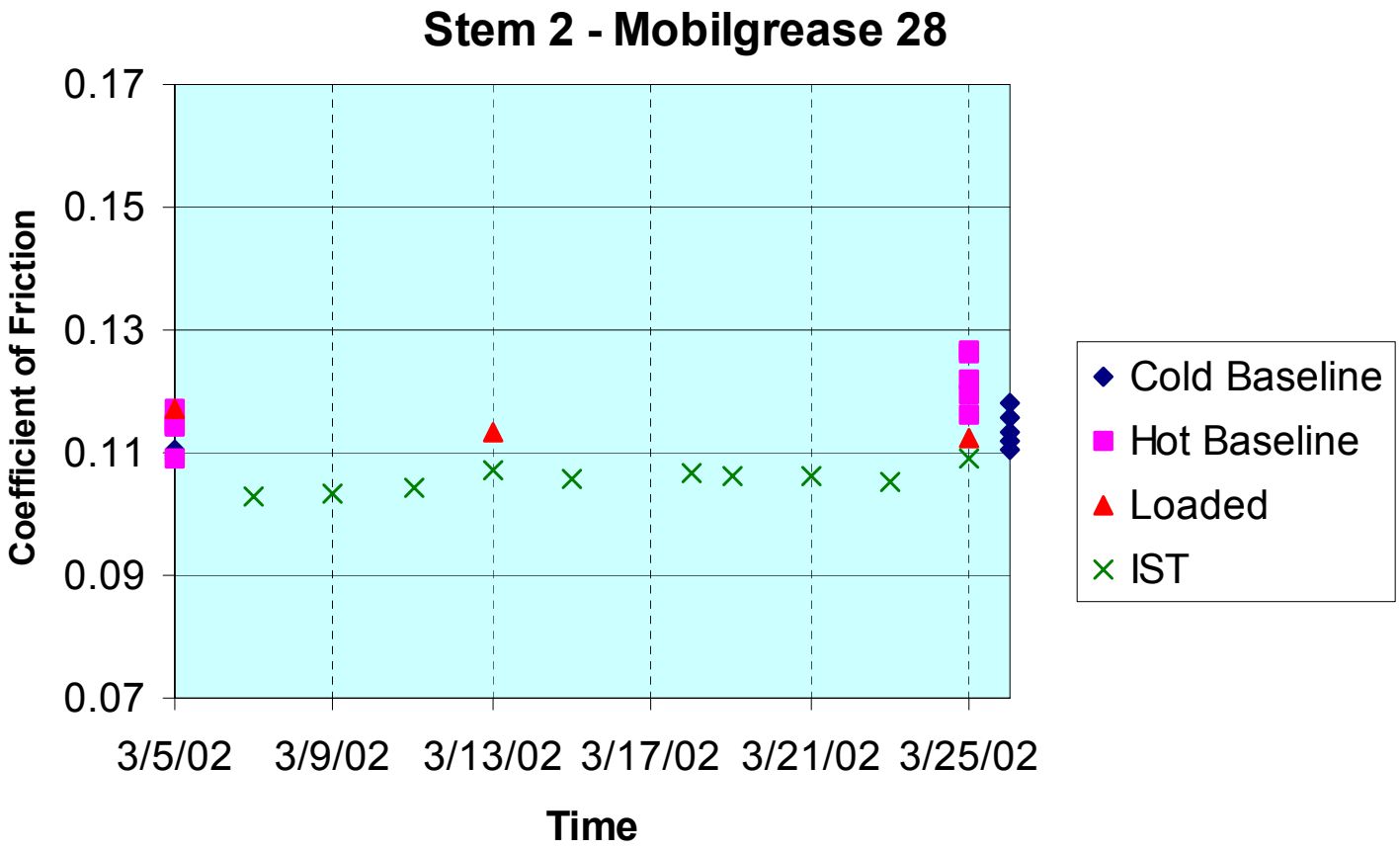
Aging test time line for Stem 2 with Chevron SRI



Aging test stroke sequence for Stem 2 with Mobilgrease 28



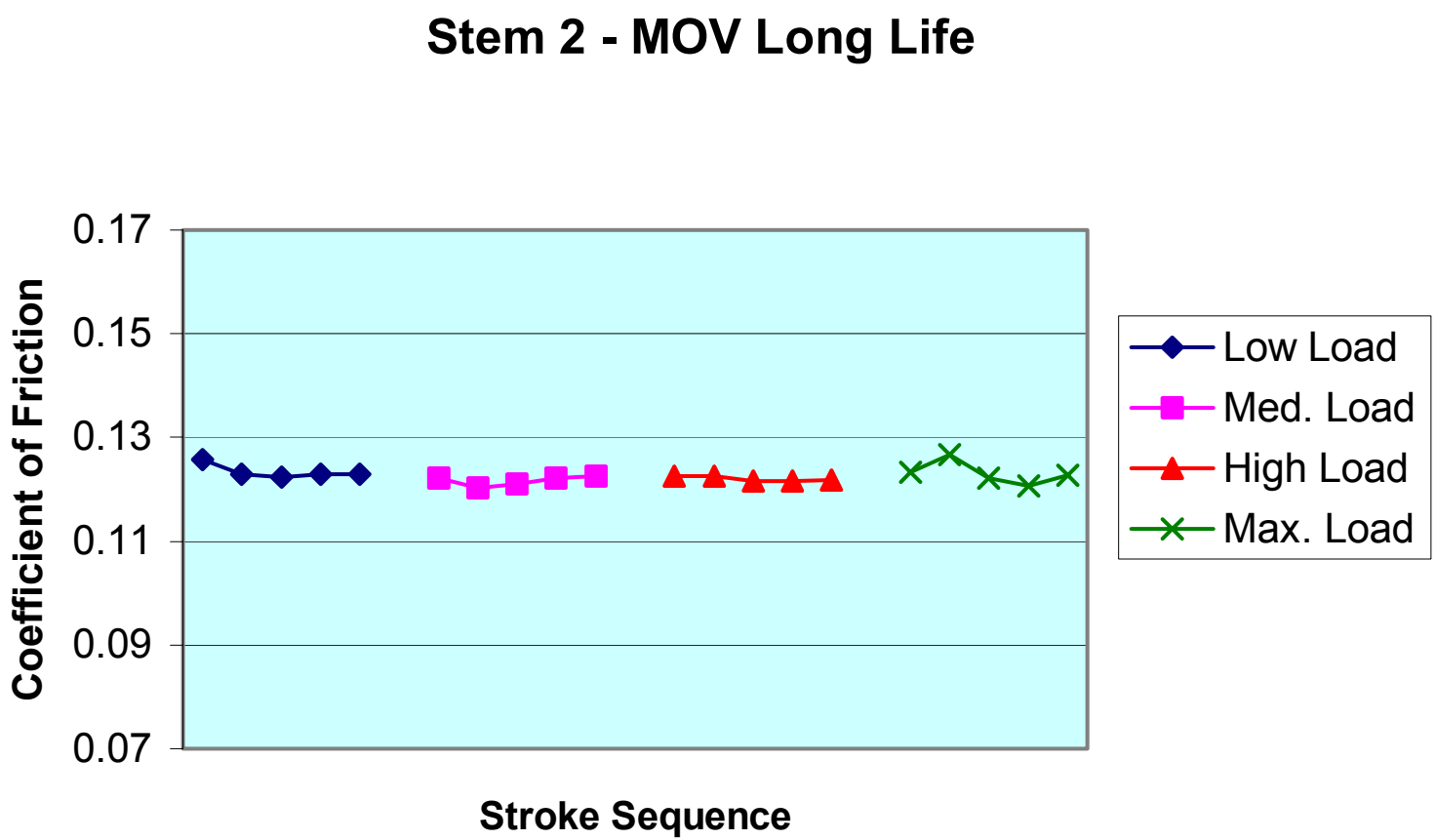
Aging test time line for Stem 2 with Mobilgrease 28



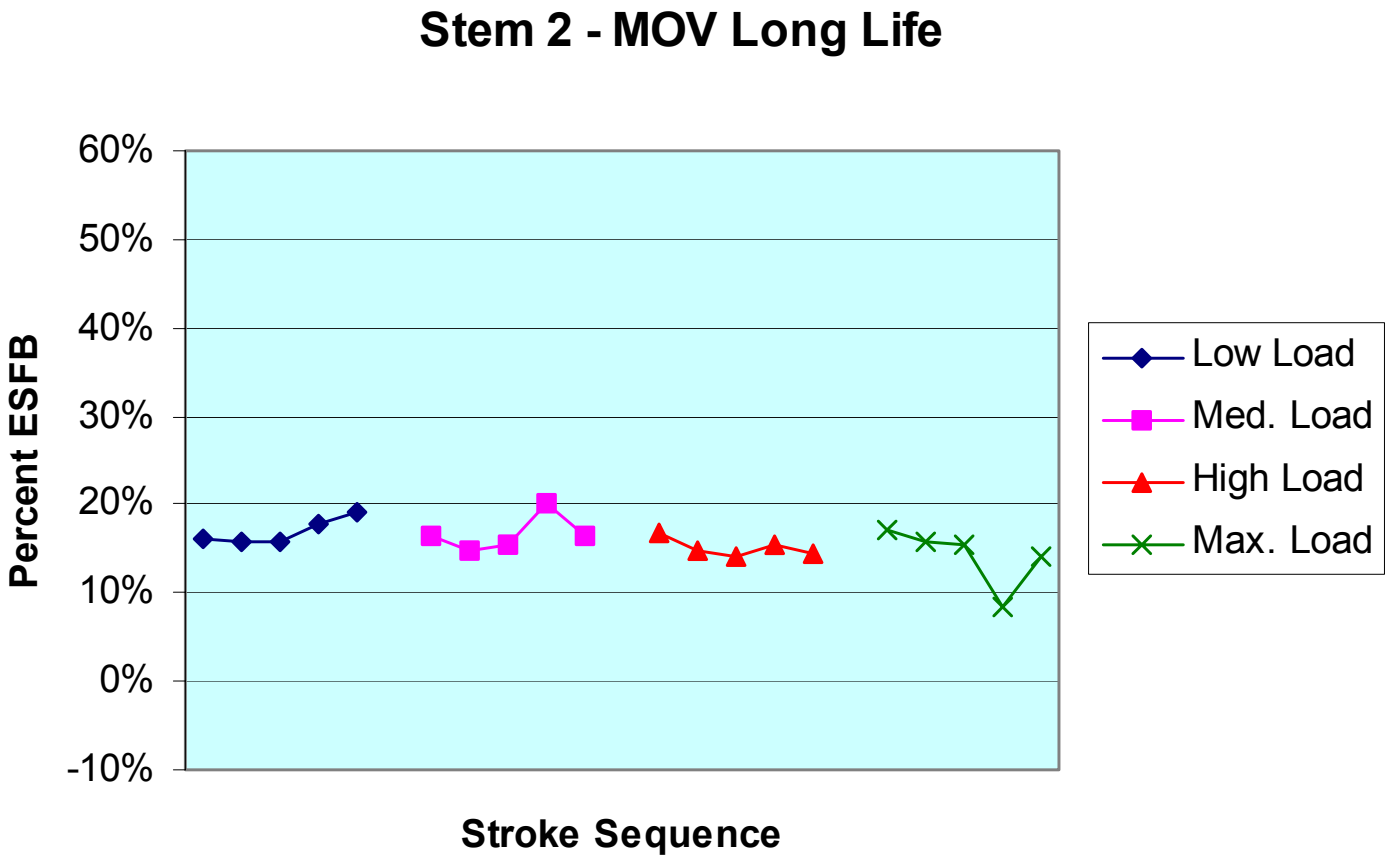
Test Results - MOV Long Life.

- *MOV Long Life (Grade 1) was applied to Stem 2 and tested for a simulated 5-year period.*
- *Testing was limited to one application of MOV Long Life.*

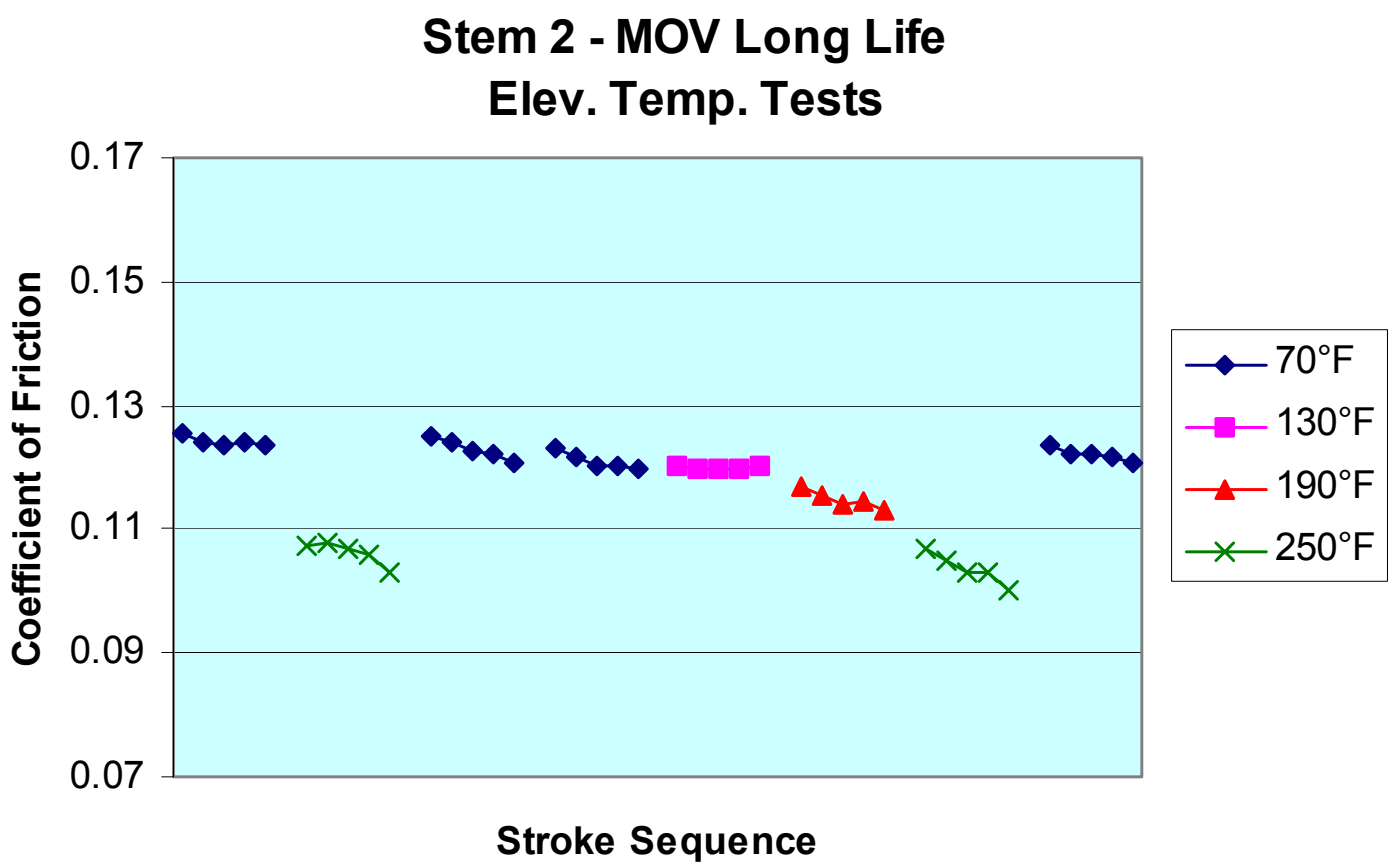
Stem nut friction at various stem loads for Stem 2 with MOV Long Life



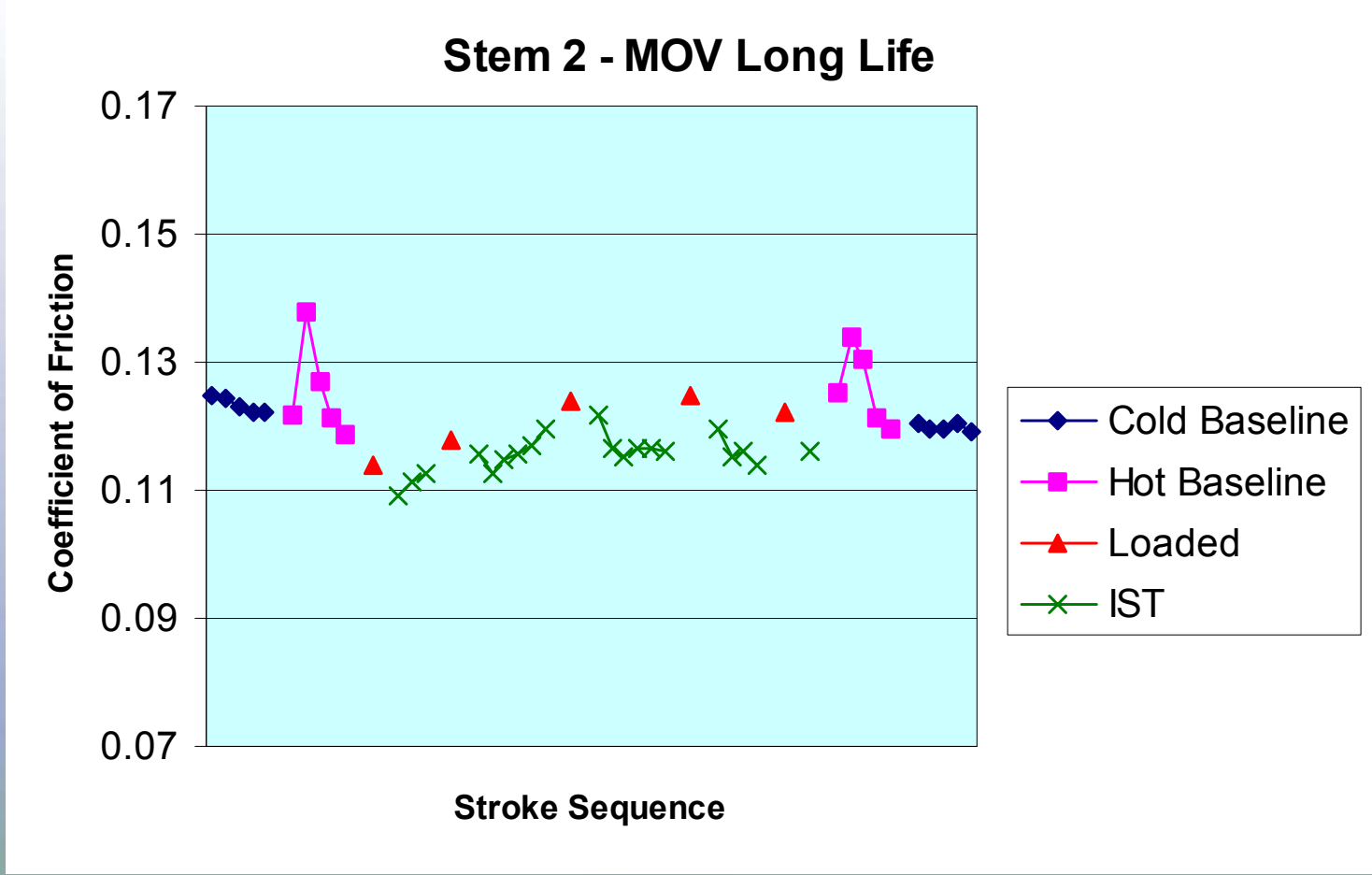
End-of-stroke friction at various stem loads for Stem 2 with MOV Long Life



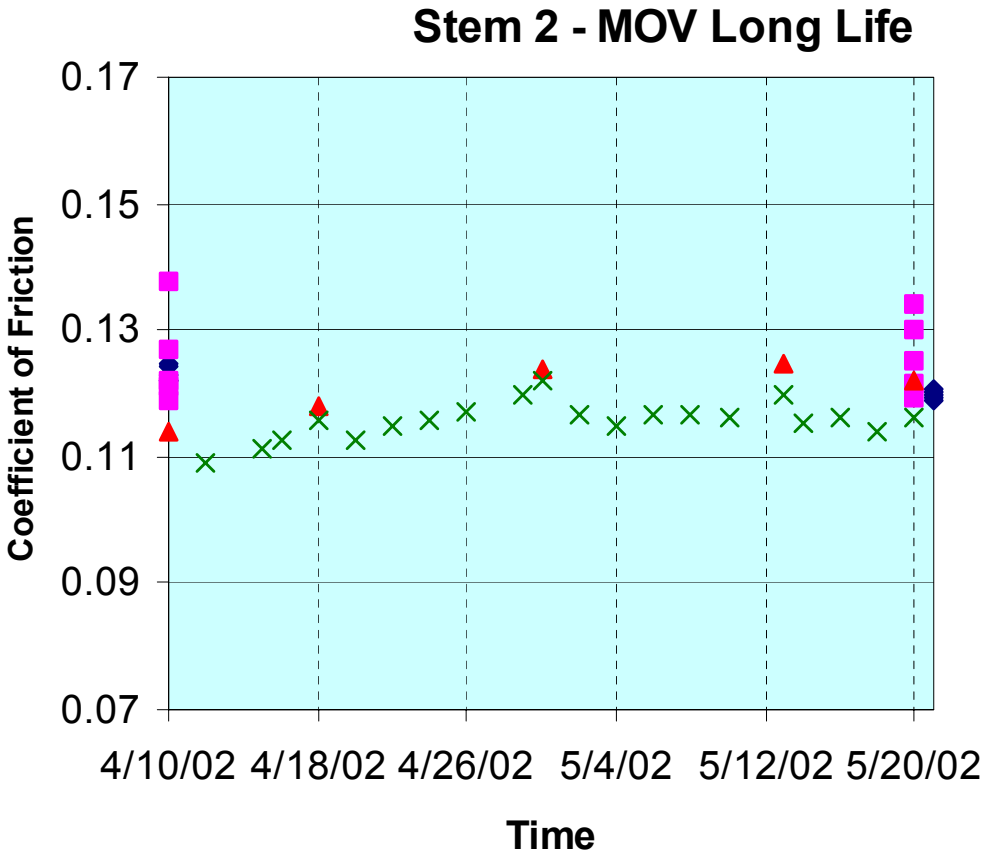
Stem nut friction at elevated temp. for Stem 2 with MOV Long Life



Aging test stroke sequence for Stem 2 with MOV Long Life



Aging test time line for Stem 2 with MOV Long Life



Conclusions

- *For Stem 2 with Chevron SRI and Mobilgrease 28*
  - *Lubrication aging did not appear to degrade the performance during the 3-week accelerated aging period.*
  - *Friction did not increase during the aging period.*
  - *Final friction values for both the hot and cold tests were similar to the initial values.*

Conclusions (Continued)

- *For Stem 2 with MOV Long Life*
  - *Performance was similar or an improvement over that of other lubricants previously tested.*
  - *Frictional performance, including rate-of-loading, was stable and repeatable over a wide load range.*
  - *Elevated temperature resulted in a lower friction coefficient that that observed at room temperature.*
  - *Stem nut friction appeared to be stable over the simulated aging period.*