EPRI SRV Spring Compression Analysis

What is the Value of 10x Compressions?

Nuclear

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NRC Pump and Valve Symposium
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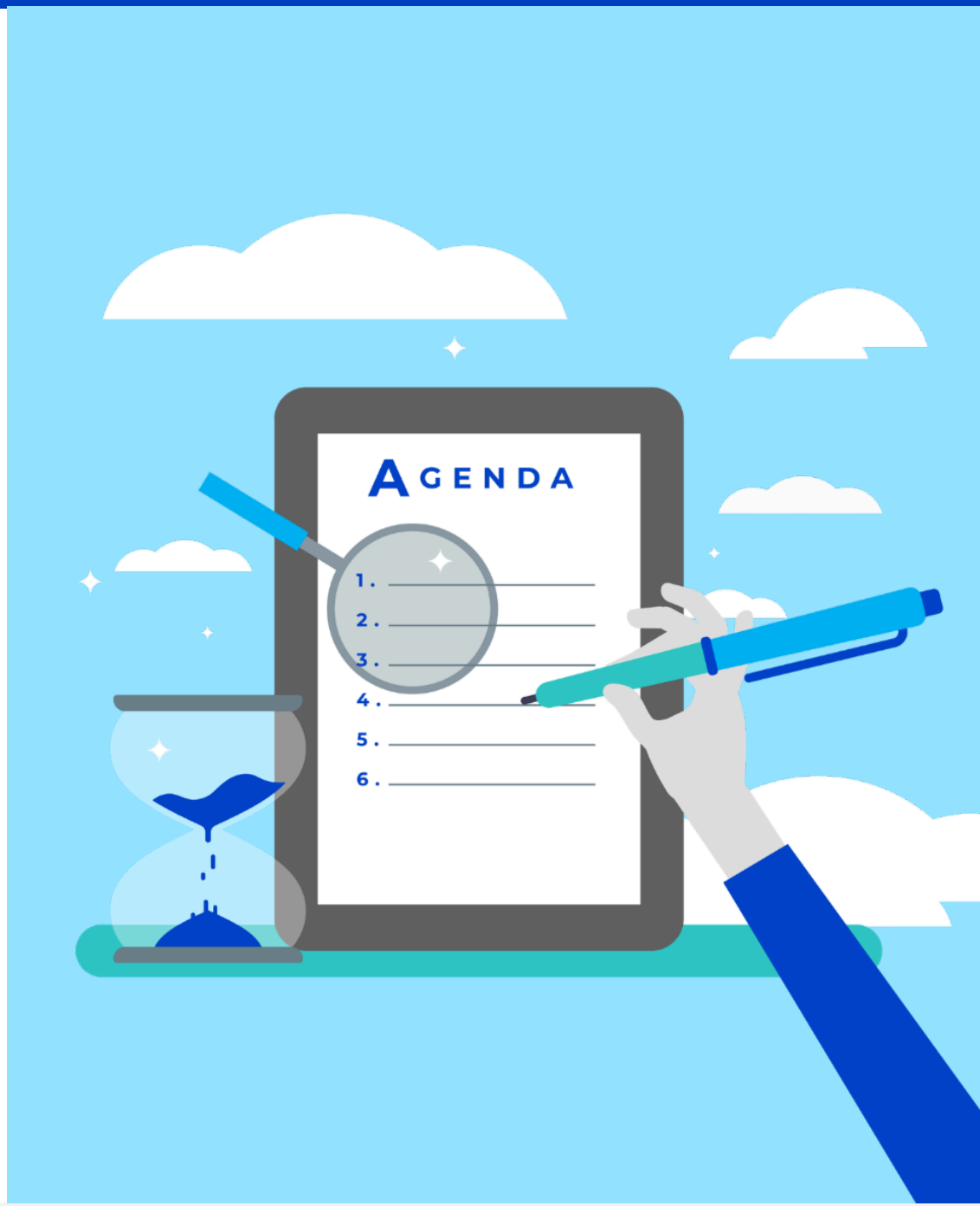
Agenda

01 Background

02 Data Review

03 Conclusions



Research Updates
Safety Relief Valve Spring Compression Study

(3002029236)

Background

Critical attributes of the springs must be measured and trended routinely to ensure reliable and repeatable as-found performance

Trending of critical spring attributes can help to identify degradation due to aging and/or may explain set pressure changes between as-found and as-left testing

Springs found outside of acceptance criteria are replaced

New springs can have inherent stresses created during fabrication challenging 1st refuel performance

Objective

Review historical spring testing data from a PRV test and repair facility from January 1, 2020, through May 1, 2024

Categorize data by valve class, valve type, age of spring, and # of compressions

Address the Industry debate

Does performing 10x compressions on new springs result in more repeatable valve performance?

Data Collection

- Rate testing of valve springs is common
- In-service springs and/or new springs
  - Dimensional profile of the spring
  - Calculate the effective compression range
  - Performing 3X compressions over that range and report the average **OR**
  - Perform 10X compressions over that range and report the average of the last 3 tests
- Calculate K-Rate
  - Overall free length, avg free height, sum of coil diameters
  - Load recorded at 20% and 60% deflection

Note: Should a higher-than-normal deviation be noted during the 3X compressions, additional compressions may be performed.

Spring Data and Categorization

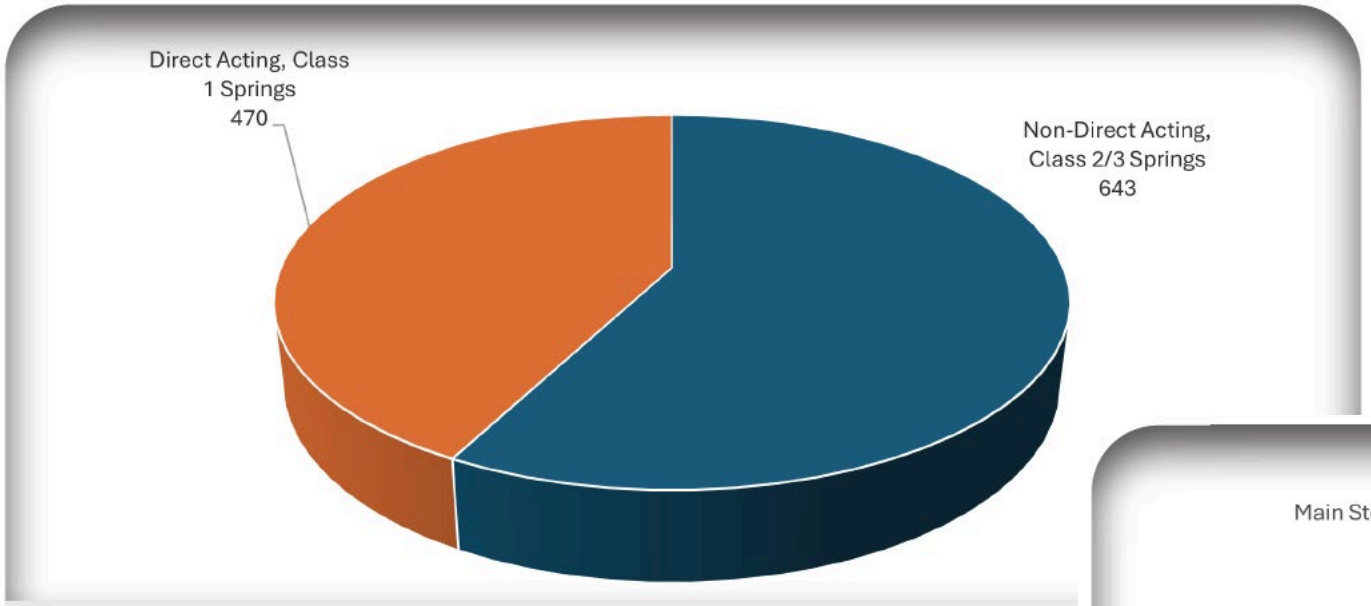


Figure 1. *Spring population review and breakdown*

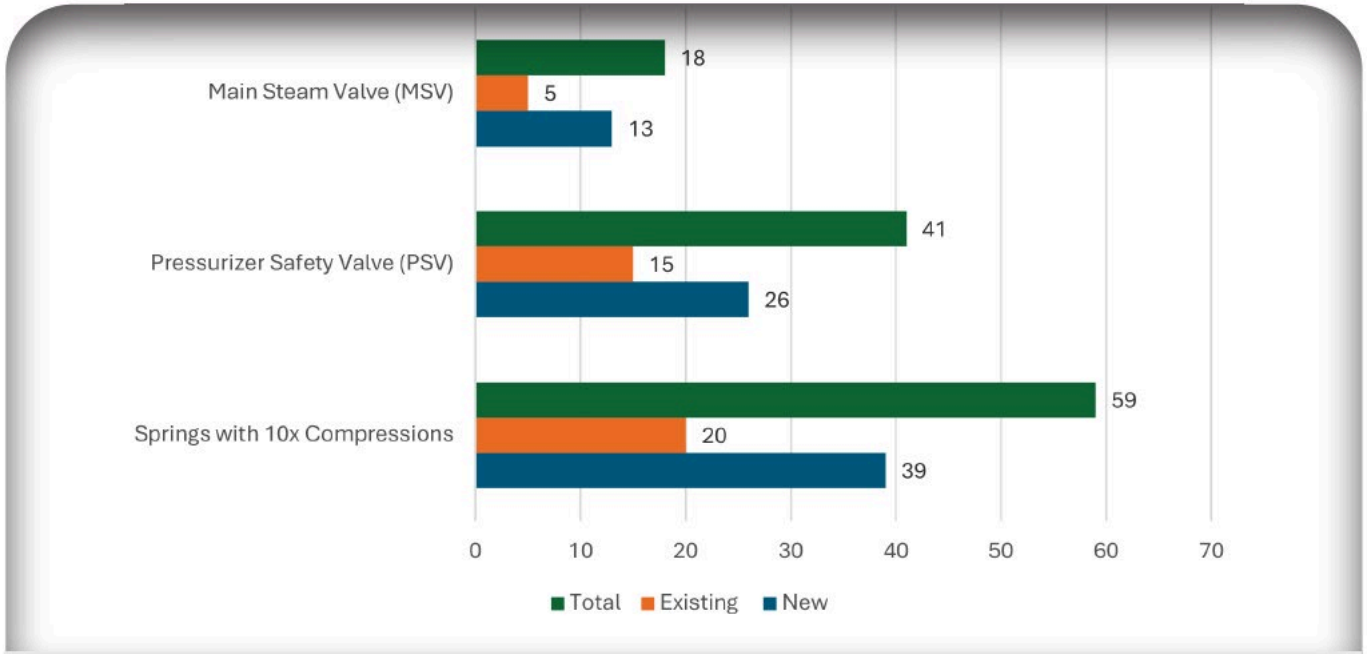


Figure 2. *10x Spring compressions, by valve type*

Results – Std Deviation – All Springs

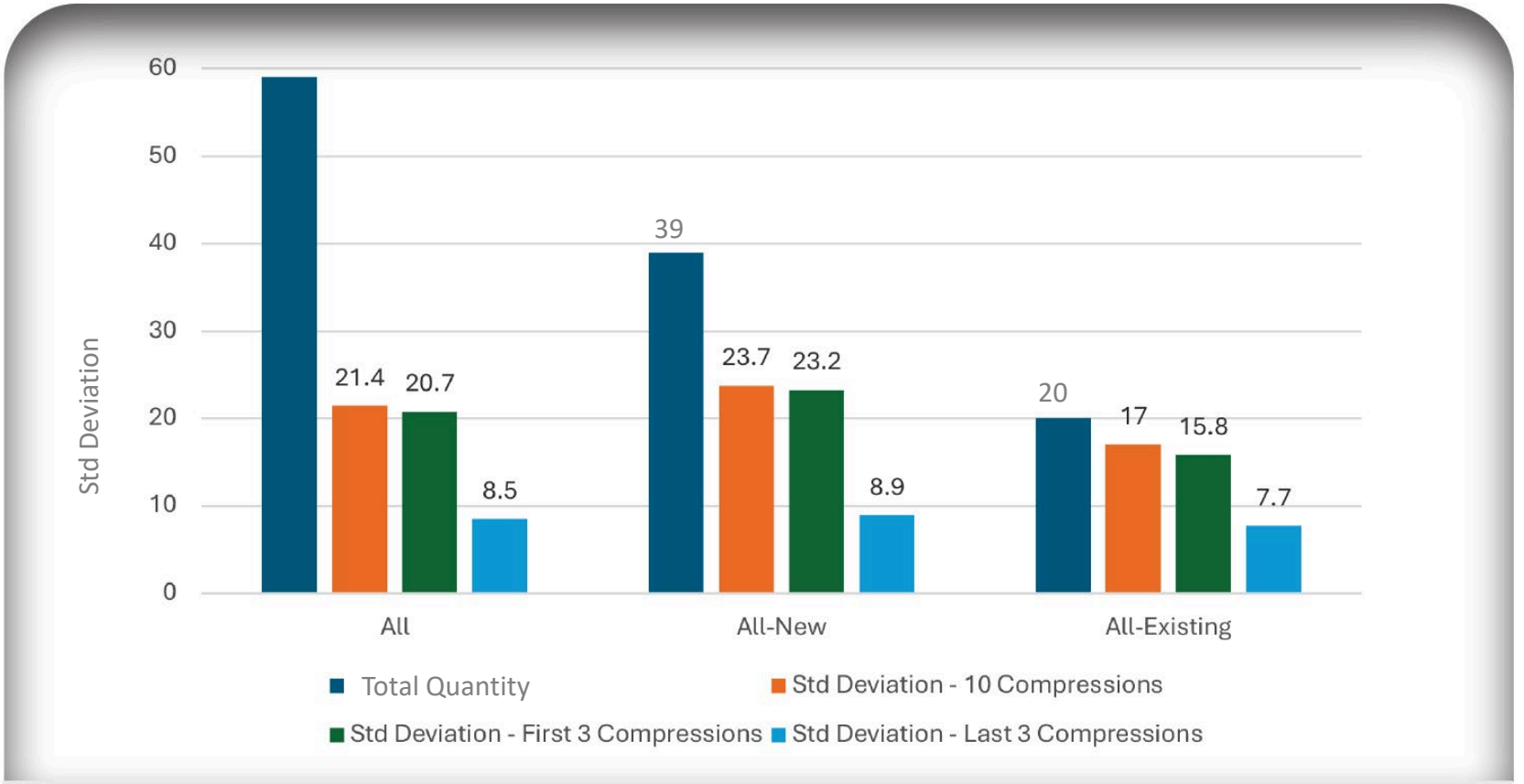


Figure 3. *Standard deviation across 10x compressions—all springs*

Results – Std Deviation

Standard deviation across 10x compressions—PSV springs

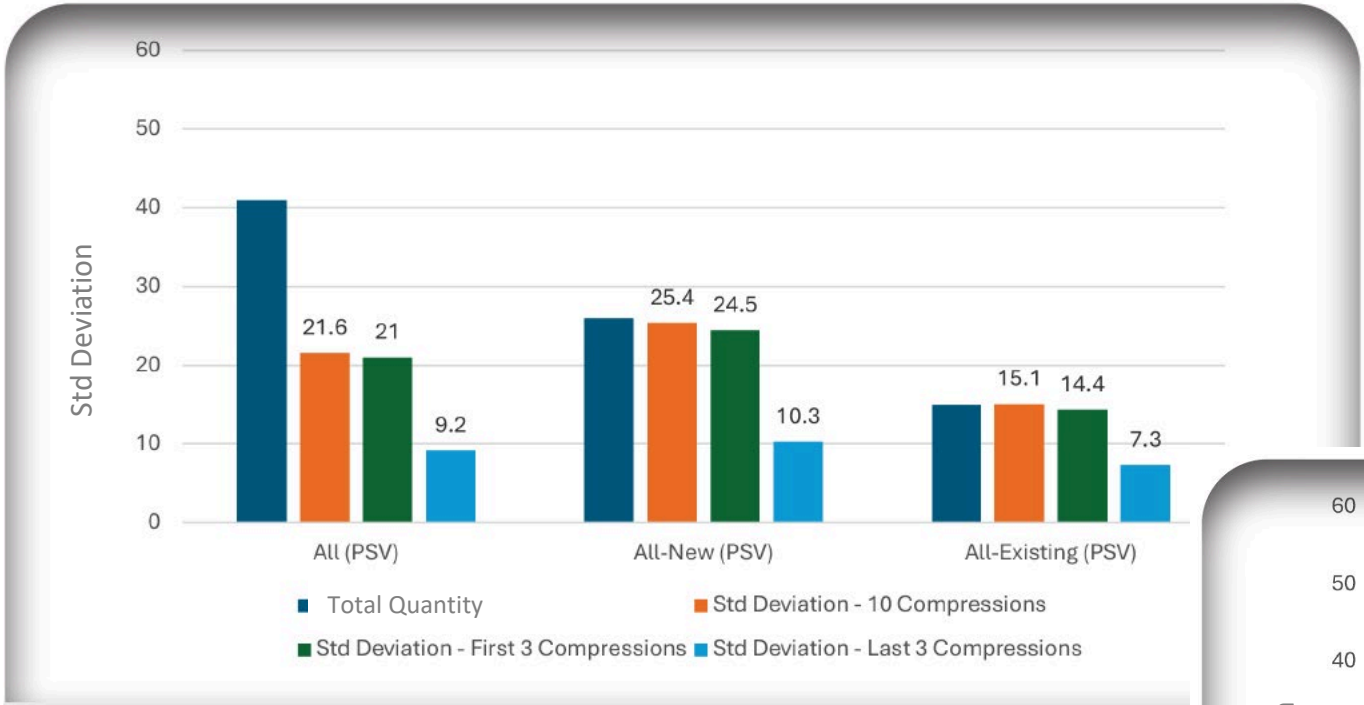


Figure 4. Standard deviation across 10x compressions—PSV springs

Notice any trends?

Standard deviation across 10x compressions—MSSV springs

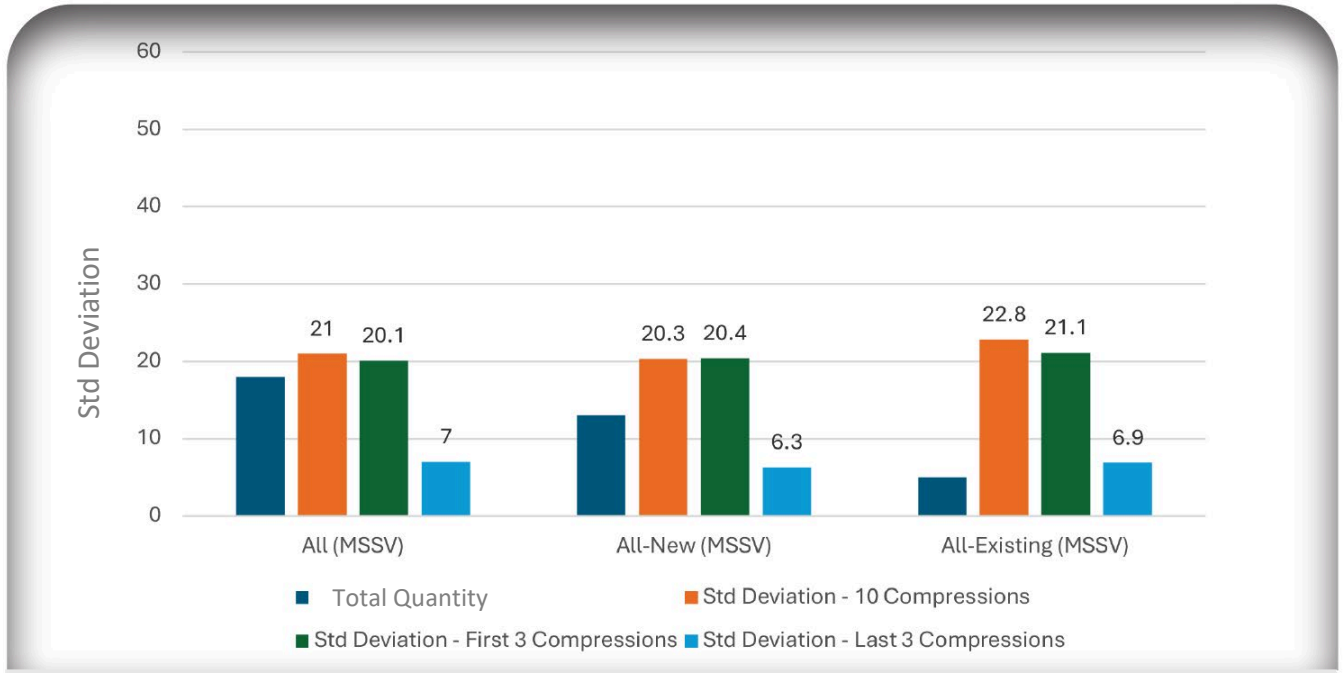
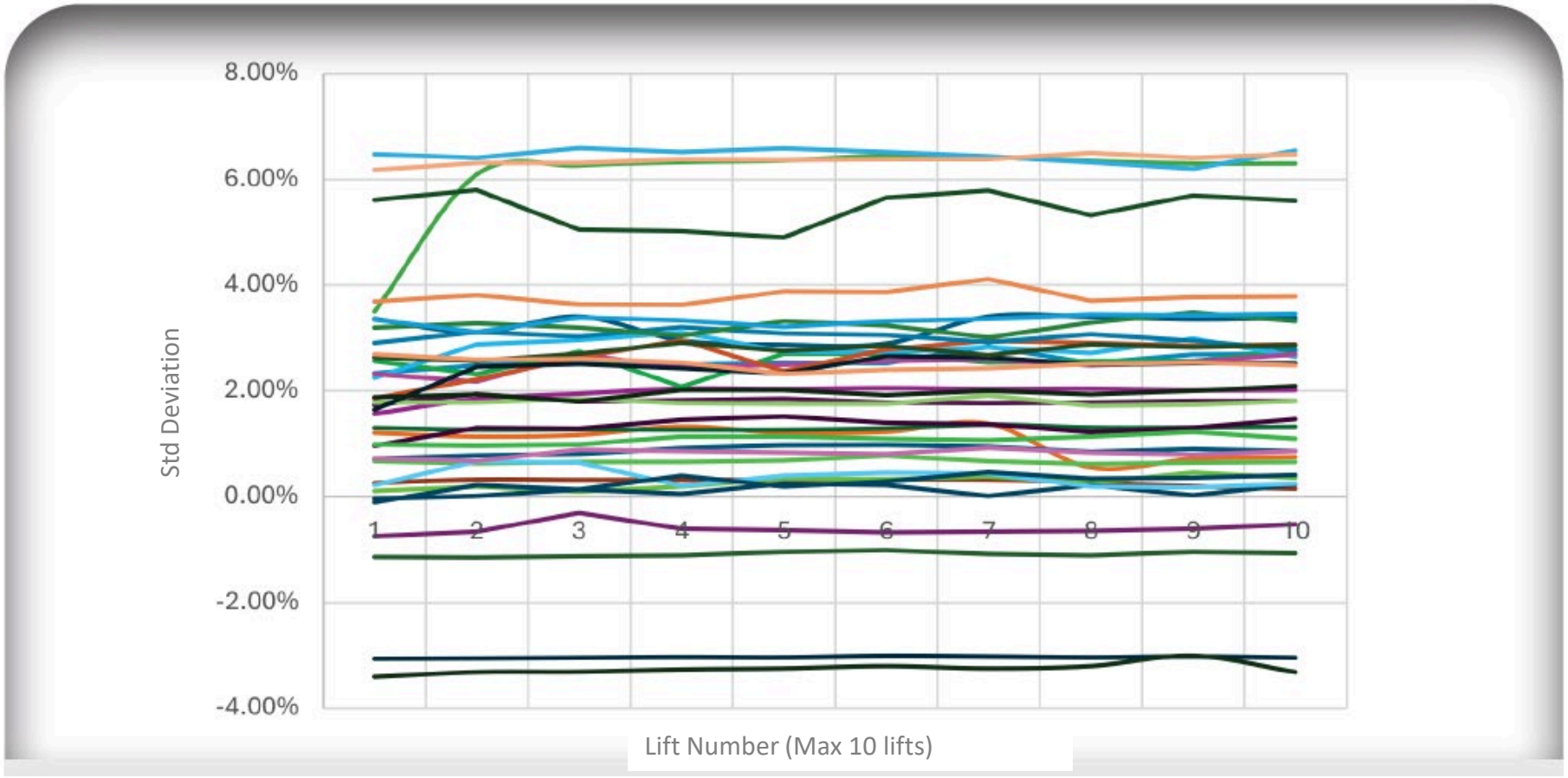


Figure 5. Standard deviation across 10x compressions—MSSV springs

Results – K-Rate Std Deviation



Example K-Rate Spring Inconsistencies

New Springs

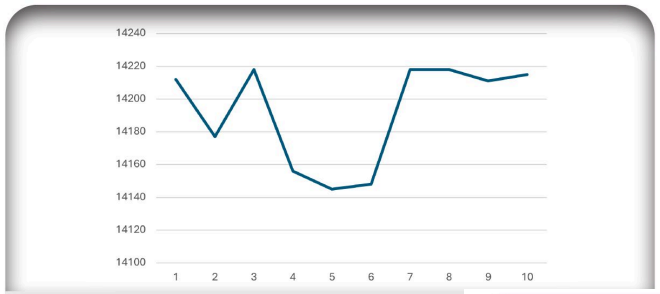


Figure 2-1. 10x compression plot—spring 1 (pressure safety valve, new spring)

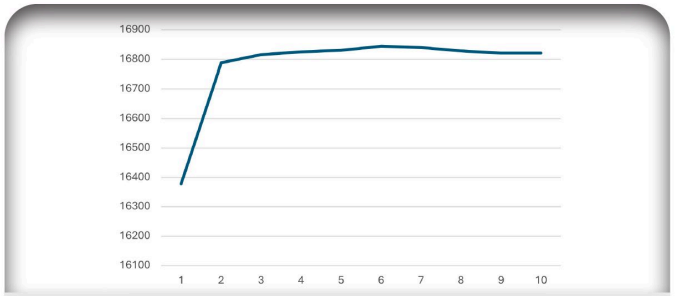


Figure 2-2. 10x compression plot—spring 6 (pressure safety valve, new spring)

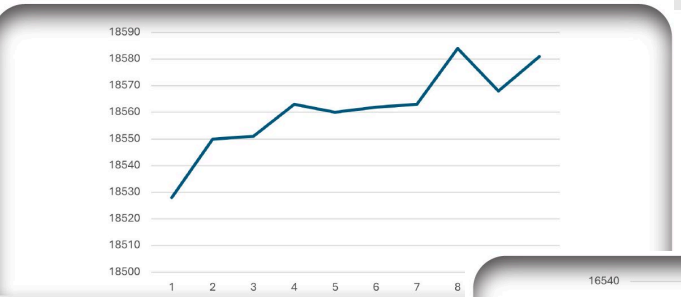


Figure 2-6. 10x compression plot—spring 26 (pressure safety valve, new spring)

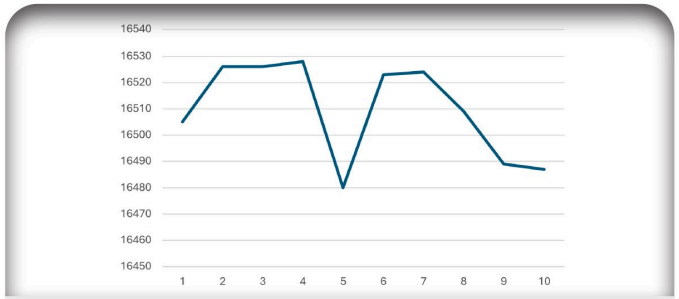


Figure 2-9. 10x compression plot—spring 40 (pressure safety valve, existing spring)

Existing Springs

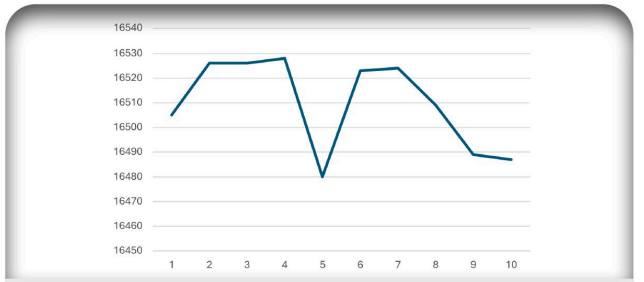


Figure 2-9. 10x compression plot—spring 40 (pressure safety valve, existing spring)

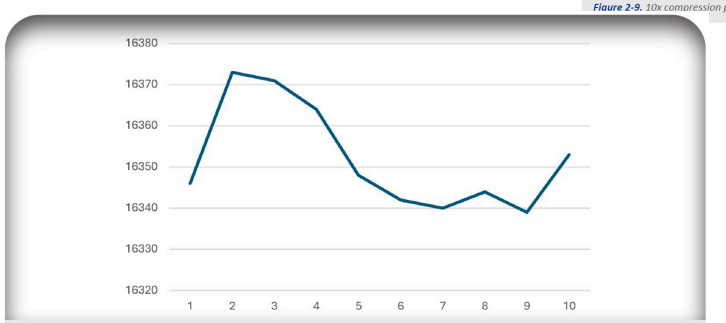
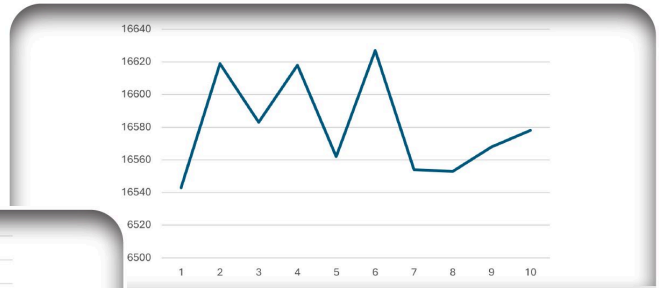


Figure 2-10. 10x compression plot—spring 45 (pressure safety valve, existing spring)



ession plot—spring 50 (pressure safety valve, existing spring)

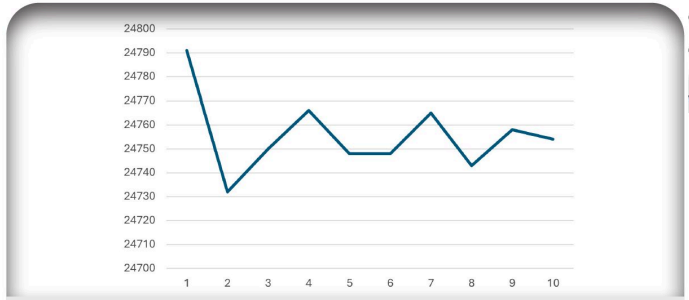


Figure 2-13. 10x compression plot—spring 59 (main steam safety valve, existing spring)

Results – Set-Pressure Testing (Inconclusive at this time)

Table 1. Set pressure certification with new 10x compression spring

SPRING TYPE/VALVE	QUANTITY	NUMBER OF LIFTS TO CERTIFY	NUMBER OF ADJUSTMENTS TO CERTIFY
All	34	8.8	2.1
PSV	23	10.2	2.7
MSSV	11	5.3	1.5

Most of these valves have <u>not</u> been returned for steam testing and refurbishment services

Conclusions

- Review of springs with 10x compressions suggests improved repeatability over the compressions.
  - Most apparent when the standard deviation for the first 3x compressions is compared with the last 3x compressions
- 10x compressions is just a “rule of thumb”. More or less compressions may be needed.
  - Goal is repeatable performance
- As more data becomes available, we will consider the impact on the set-pressure tests

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