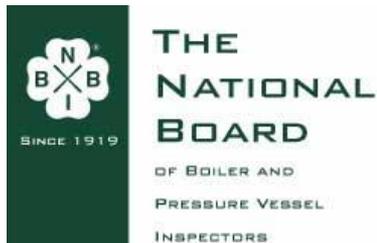

Applicability of National Board Testing Data to Reliability for Industry

**2012 National Board/ ASME General Meeting
Nashville, TN**



**Presented by: Joseph F. Ball, P. E.
Director, Pressure Relief Department**

Overview of National Board Capacity Certification Program

- **2 samples pressure relief devices (PRD's) tested every six years**
- **Test requirements come from ASME Boiler and Pressure Vessel Code**
- **National Board Inspector witnesses manufacturing/assembly to assure samples are done to normal procedures**
 - May include devices selected from stock
- **Not intended to be statistical in nature**



Overview of National Board Capacity Certification Program (cont.)

- **“Penalty” test of 2 for 1 required upon test failure**
- **Corrective action is then required**
- **Tests performed at ASME/NB accepted test lab**

- **What does collected test data show for PRD Users?**



Some Numbers...

Data on large number of tests was reviewed to look for trends, patterns etc.

Total number of tests included in the review: 21825



How Data was Analyzed

- 1. Included data from National Board and other accepted test labs**
- 2. Started from the year 2000**
 - Includes rupture disks as certified devices
- 3. Includes VR verification tests**
- 4. Does not include “provisional”, R&D or informational tests**
- 5. Does not include “investigation” tests (more on this later)**



Limitations of the Review

Represents lower pressures/ smaller sizes

- Economic reality of testing

“Cleanliness” of the data



Some Numbers...

Breakdown by ASME Code Section

- Section I 13.6%
- Section III 12 tests
- Section IV 3.4%
- Section VIII 83.0%



Some Numbers...

Test medium used

- Steam 25.6%
- Air 48.6%
- Water 25.7%

Section VIII per medium

- Steam 10.6%
- Air 58.5%
- Water 31.0%

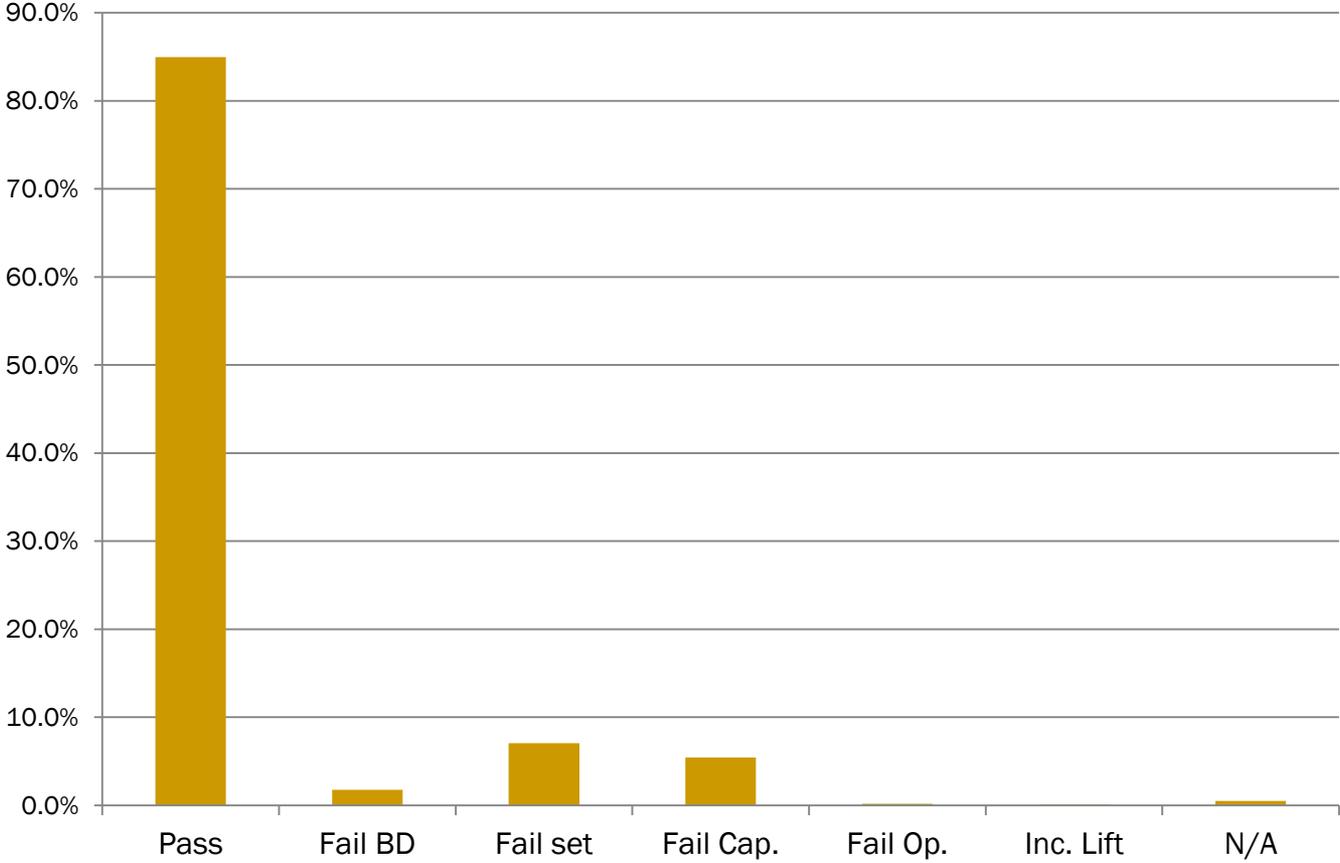


Raw Results

<u>Test outcomes</u>	<u>%</u>	<u>Amount</u>
■ Pass	84.9%	18538
■ Fail Set Pressure	7.1%	1541
■ Fail Blowdown	1.8%	383
■ Fail Capacity	5.4%	1186
■ Fail Operation	0.2%	43
■ Incorrect lift	0.1%	19
■ N/A	0.5%	113



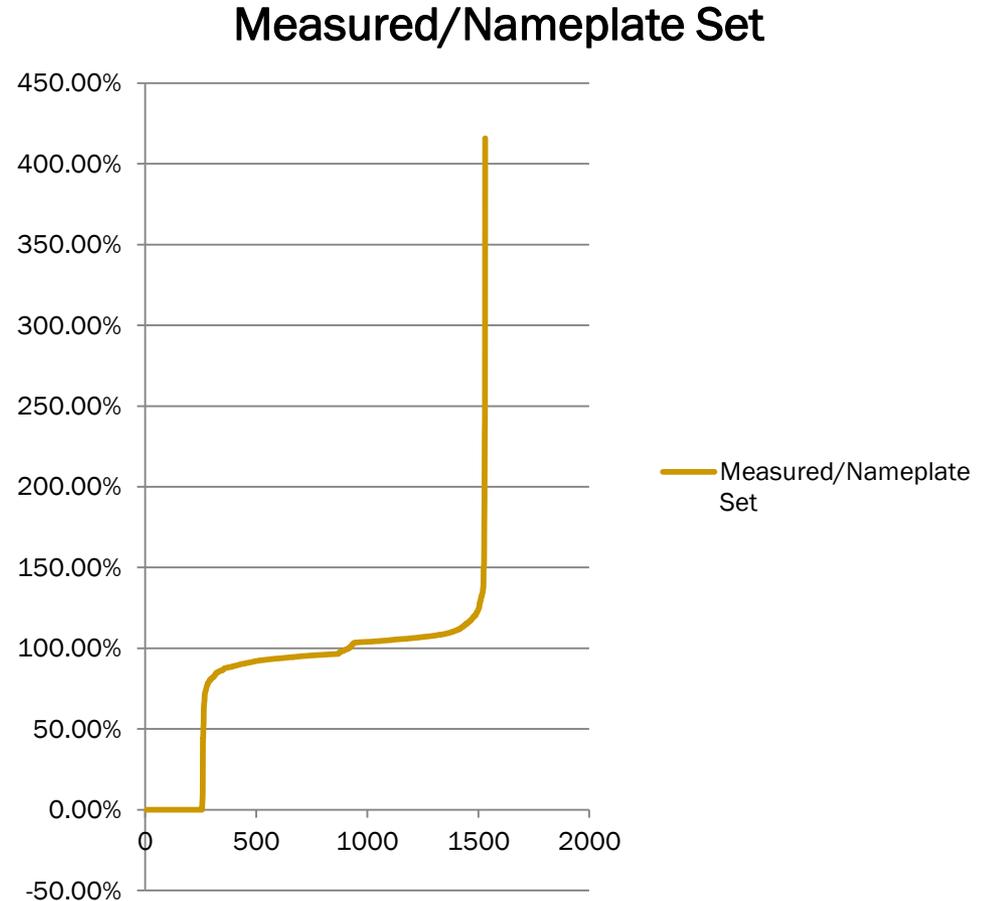
Raw Results



Analysis of Failures

Set pressure

- Failures represent valves out of Code tolerance
- What is “unsafe” level?
- 0.3% were above 116% of nameplate set pressure



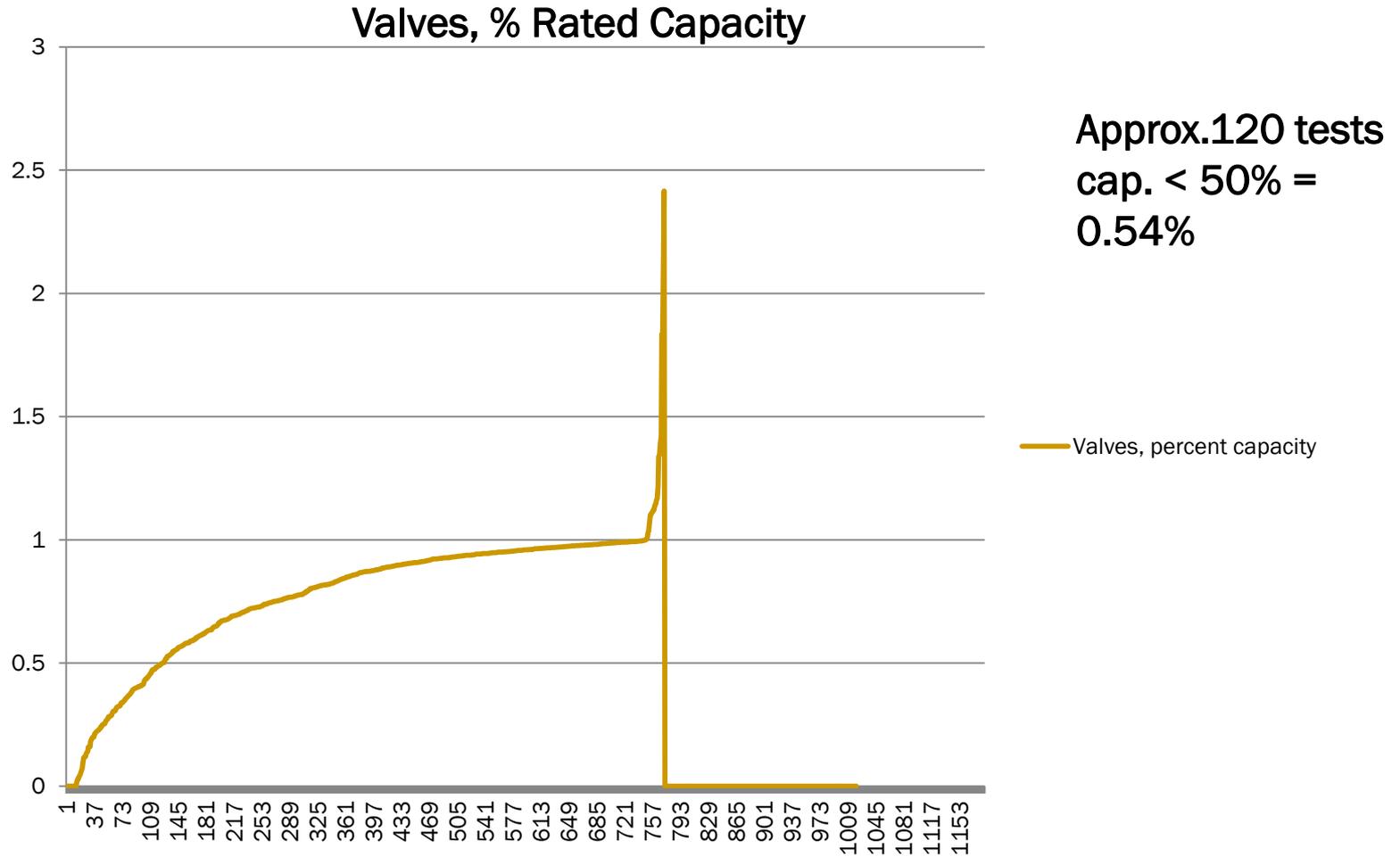
Analysis of Failures (cont.)

Capacity

- Includes valve capacities less than rated
 - Common cause: Valve fails to achieve “secondary lift”
- Includes liquid valves failing to open by specified overpressure
- Includes rupture disk flow resistance(K_R) / Minimum Net Flow Areas (MNFA) not to specification



Distribution Where Capacity was Measured



Analysis of Failures (cont.)

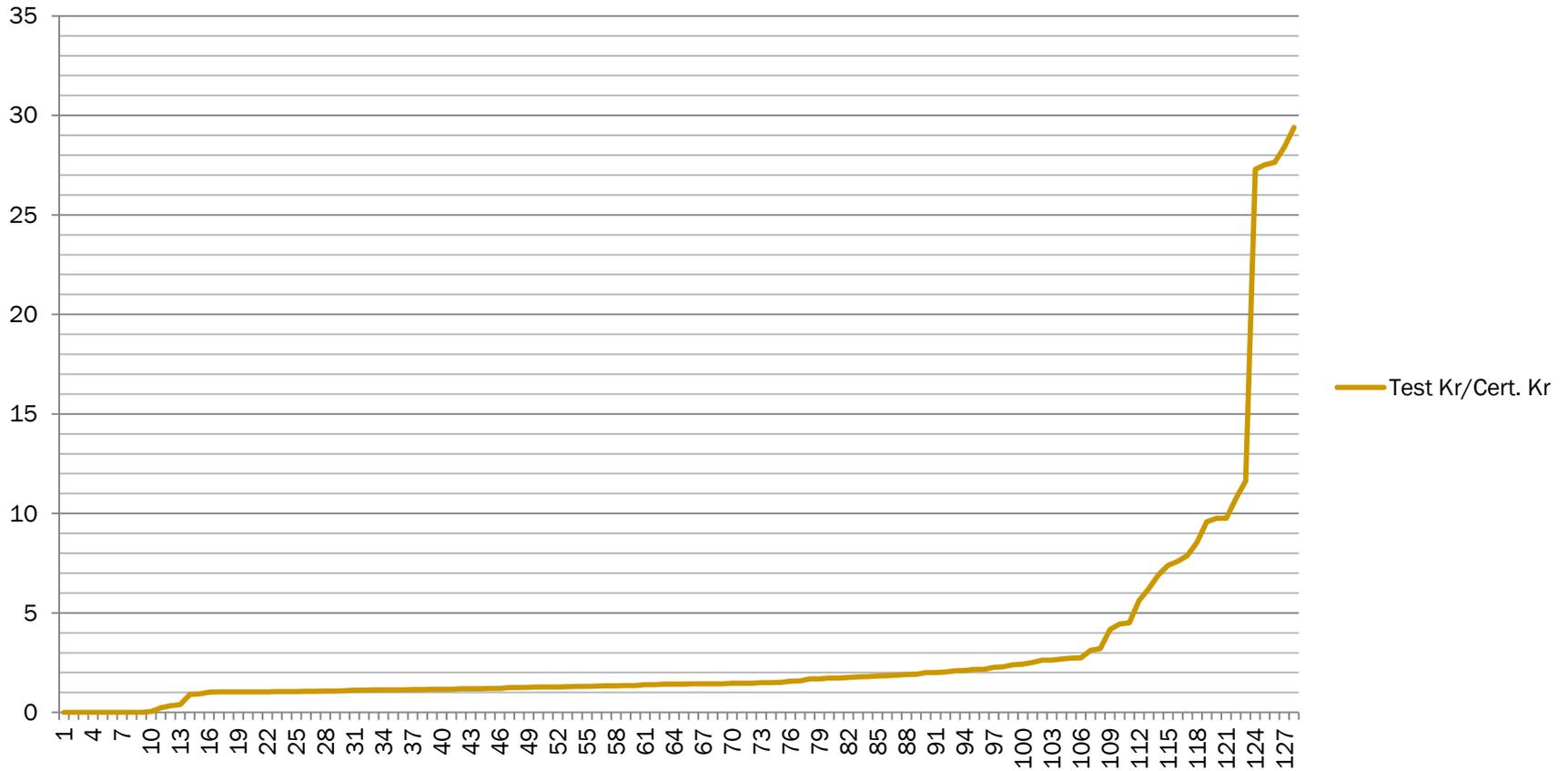
Other Capacity Issues

- 247 other failures where capacity was not measured (1.1%)
- Typical failure to open before 10% above set – mostly liquid valves
- Typical opening point in these cases is 12% to 15% above set



Rupture Disk K_R Problems

Test K_r /Cert. K_r



Rupture Disk Capacity Problems

Data includes 128 Kr failures (0.7%)

Disk opened where Kr measurement is reported: 20 samples more the 5X certified Kr (.09%)

Includes 18 failures to open (0.08%)

Some were reversal without opening

6 MNFA failures (insufficient disk opening)



Blowdown Problems

Represented 1.8% of test samples

Affect of blowdown on overpressure protection

- (More of an operational concern)

- Section I short blowdown
- Section VIII – adjustable design exceeding 7%



Other Problems...

Fail Operation 0.2% (43 valves)

Includes lift lever problems, valves “stuck open” etc.

Incorrect lift 0.1% (19 valves)

Restricted lift valves with lift not set properly (usually too high)



Summary

Estimates of PRD problems:

Set pressure problems: 0.3%

Valve Capacity problems: 0.54%

Rupture Disk Kr problems: .09%

Rupture Disk, failure to open: .08%

Total: 1.01%

Pressure Relief Device Availability Estimate: 98.99%



Investigation Testing

130 Investigation tests

37: Pass

70: N/A

11: Fail set

8: Fail capacity

4: Fail blowdown

Most problems noted were caused by lack of maintenance



Recommendations

- **Recognize value of Code/NB Certification**
 - Tight requirements provide extra margin for safety
 - Test issues cause suppliers to “tighten up”
 - NB Test capabilities to be expanded



Recommendations

- **Provide feedback**
 - PRD Suppliers
 - Regulatory Authorities
 - National Board when certification is suspect
- **Mandate In-Service Inspection at intervals *supported by Inspection History***

