Pressure Relief Device Inspection

Review of NBIC Part 2, par. 2.5

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THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

Purpose of Pressure Relief Devices

- Last line of defense against overpressure condition
- Overpressure could lead to failure of the boiler or pressure vessel (PRI)
- Protection for both persons and property
- PRDs are *not* designed as pressure control devices!

Keys to In-service Inspection

- Safety considerations
- Pressure relief device and PRI data
- Device condition
- Installation condition
- Testing and Operational Inspection

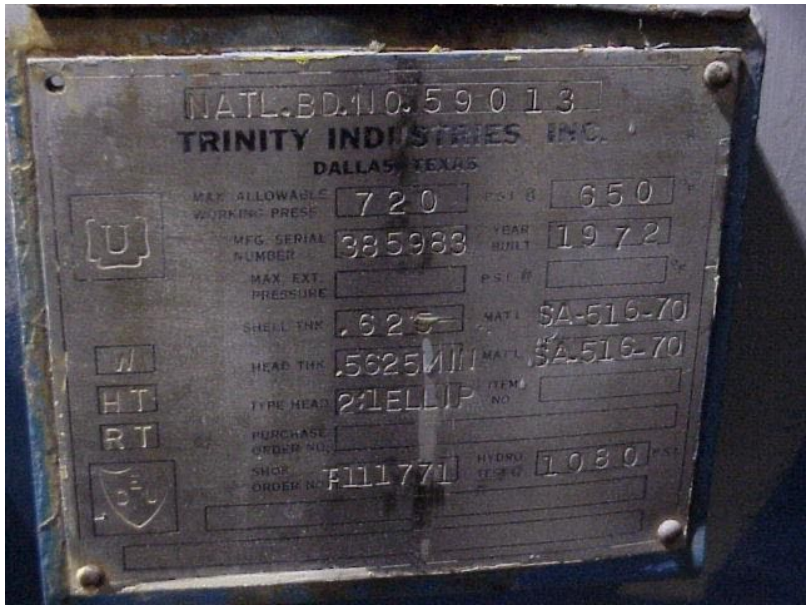
Safety Considerations

- High pressure discharge may have considerable energy released
- High temperatures may be involved (steam)
- High levels of noise encountered during testing

PRI Data

First look at application and PRI nameplate

- Determine MAWP and design temperature
- Determine steaming capacity or heating surface for boilers
- What is the service fluid?



Device Data

Correct Code Stamp for application

- Power and heating boilers

- Low pressure steam heating boilers, hot water heating boilers, hot water heaters

- Unfired pressure vessel service

ASME Certification Mark with Designator

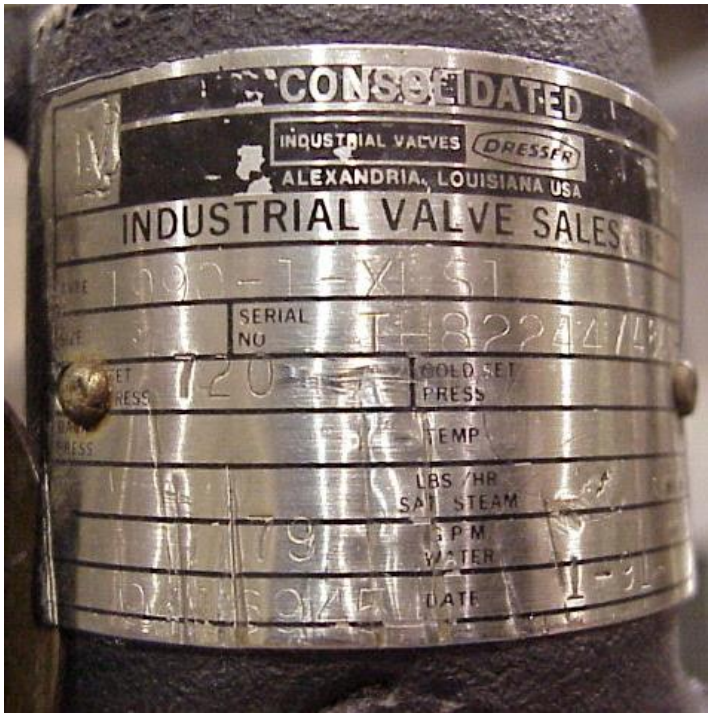
X

- New ASME Certification Mark
- Replaced previous Code stamps after 2013
- “Designator” gives service
- V, HV, UV, or UD for pressure relief devices

Device Data – Set Pressure

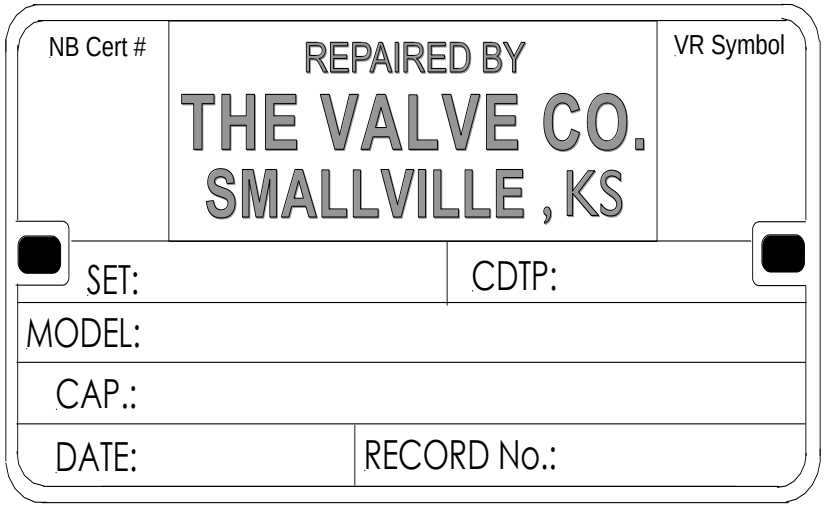
Inspect pressure relief device nameplate data

- Set pressure for single device cannot exceed MAWP
- Set pressure of *high set device* where multiple devices are installed may exceed MAWP
  - +3% for Section I boilers
  - +5% for heating boilers
  - +5% for pressure vessels
  - +10% for pressure vessel fire case
- Section I valves must have spread less than 10%



Device Data

Repair plate could change data on original plate



Device Data

Valve may also have “test only” nameplate

- Will show date of test
- Responsible party
- Gives traceability if valve reset

Missing Nameplates

2013 ASME Code, Section I, Appendix III included "CRITERIA FOR REAPPLICATION OF A CERTIFICATION MARK"

- Not practically written for pressure relief valves
- NBIC Part 3, par. 5.12.5 includes provisions for duplicate nameplates (must be done along with VR repair)
- Includes "Sec.I" instead of Code stamp

Device Data - Capacity

- For boilers, combined valve capacity must exceed maximum designed steaming capacity
- NBIC Part 1, Table 2.9.1.3 gives calculation method when heating area is used (need to know boiler fuel)

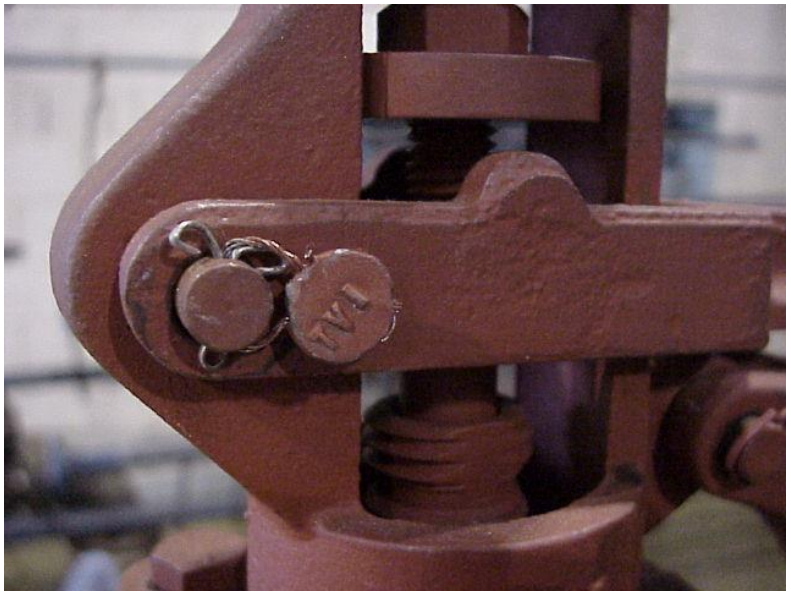
Device Data - capacity

Compare valve capacity in BTU/Hr to burner input for heating boilers

- Has burner or fuel been changed?

Device Data – Valve Seals

- Valve seals must have correct identification
- Valve seal identification must match other information on the valve
  - OEM seal
  - Repair company seal should match repair nameplate
  - Seal may match “test only” nameplate



Device Condition

- Seals intact
- Bolting tight and no bolts missing
- Deposits or material buildup
- Damaged or missing parts

Device Condition

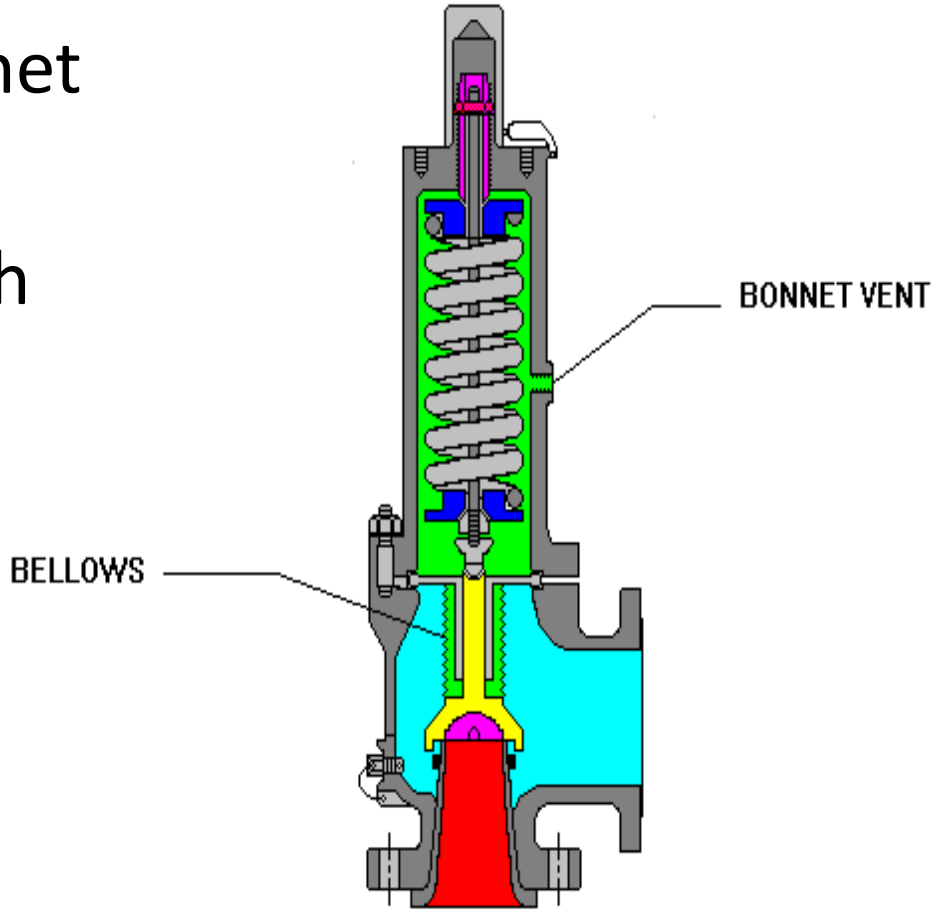
Small valves may be permanently sealed (what's wrong here?)

Device Condition

- Valve should not be leaking
- Drain hole not clogged or plugged

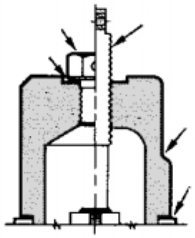
Device Condition

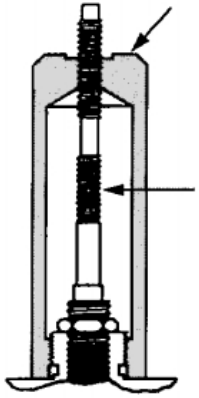
- Bellows valve bonnet vent not plugged
- No leakage through bonnet vent

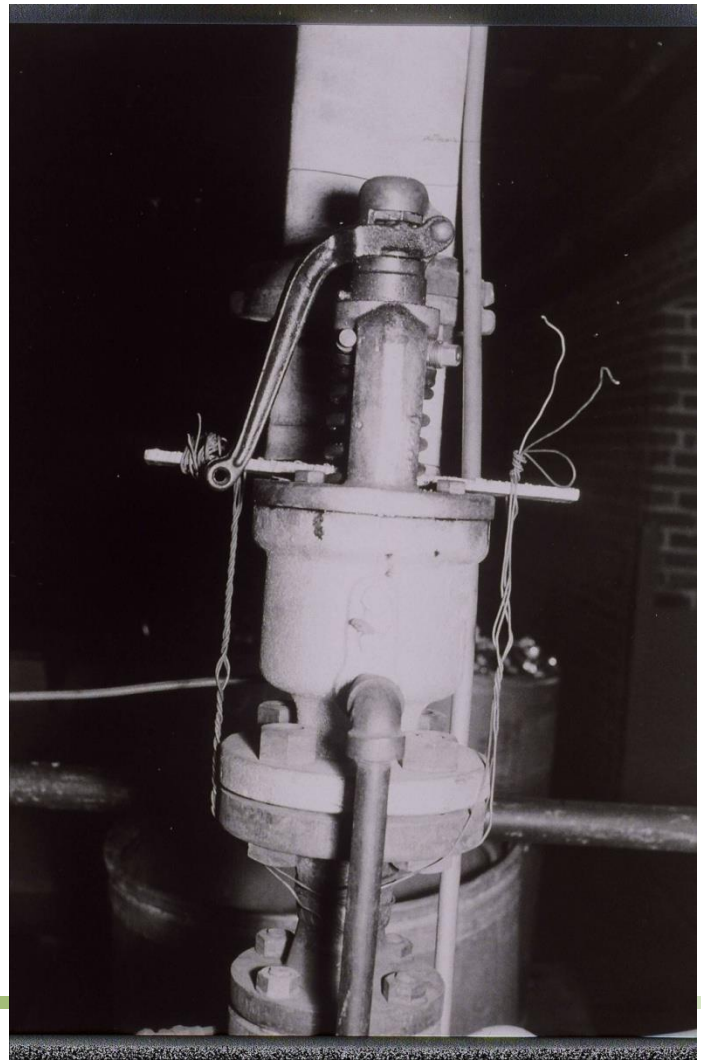


Device Condition

No test gag!



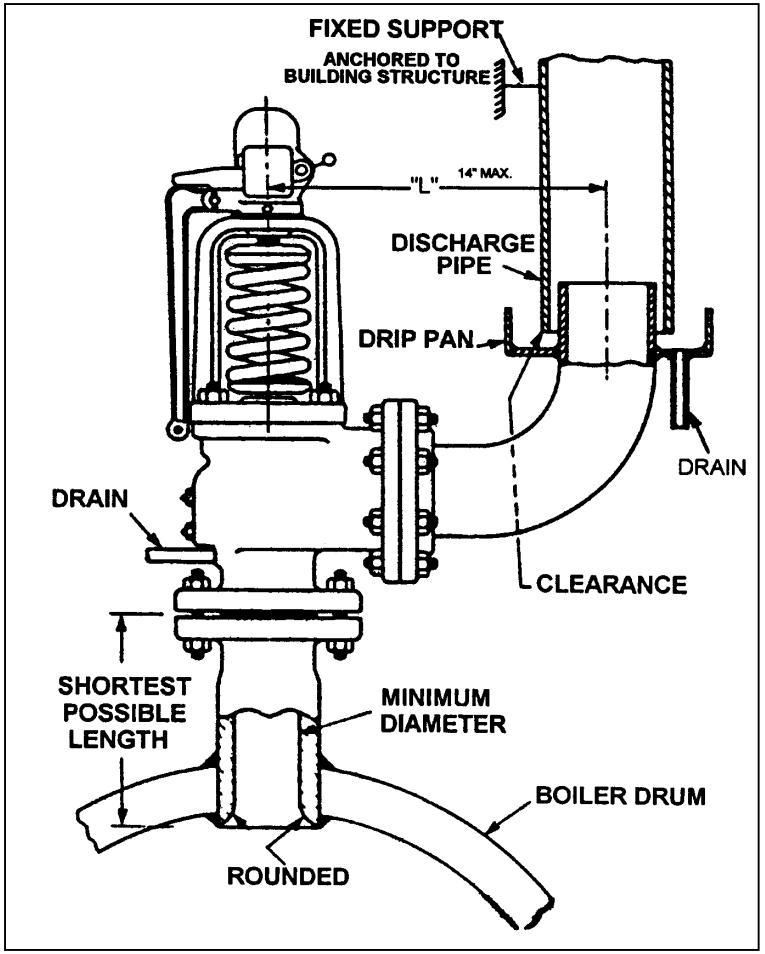




Installation Condition

- No reduced inlet or outlet pipe sizes
- Drain piping open
- Piping should not be binding on valve
- Piping should not be supported by valve
- Discharge hazards to personnel

Typical ASME Section I Safety Valve Installation



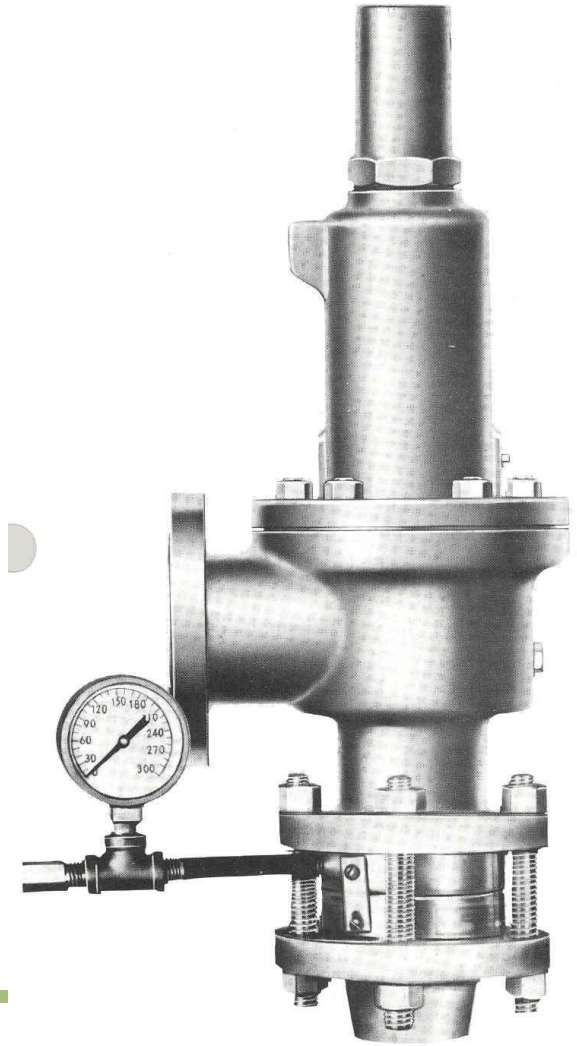
Installation Condition

What's wrong here?

Installation Condition

Installation Condition

- Rupture disk installation under PRV
- No pressure on gage



Installation Condition

Isolation valves

- Not permitted for boilers or hot water heaters
- May be permitted in some pressure vessel applications
  - ASME Code Appendix M requirements
  - *Jurisdiction must approve*

Installation Condition

Change-over valves

Testing and Operational Inspection

- Does the valve actually work?
- Lift lever test
  - At least it's not stuck shut…
  - Test at 75% of set pressure for boiler or pressure vessel valves
  - Section IV valves can be checked without pressure
  - Section VIII: Test lever required for valves for steam, air, and hot water over 140 deg. F.

Testing and Operational Inspection

- Rope can be tied to lever for personnel safety
- Assure rope does not affect valve
- Allow valve to “snap” shut

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Testing and Operational Inspection

- Set pressure test
  - Set pressure within Code tolerance
  - Valve should not be leaking
- Full pressure test on unit (not accumulation test)
- Remove valve and check on test stand

Testing and Operational Inspection

Lift assist devices sometimes used to check valve on-line without a full pop test

Testing and Operational Inspection

- Corrective Action
  - Remove system from service if valve is stuck shut! (+16%)
- Out of set pressure tolerance (NBIC Part 2, par. 2.5.7 g))
  - “Minor” adjustment = 2x set tolerance
  - Must be done by qualified organization
  - “Major” adjustment indicates a repair is needed

What is a Qualified Organization?

- NBIC defines a “qualified organization” as an “organization accredited by the National Board”
- Could be National Board VR or T/O certified organization
- Part 3, Supplement S7.10 gives outline of requirements for potential Jurisdictional acceptance

Recommended Test Frequencies

- Jurisdictional Rules
- NBIC recommendations
  - Boilers less than 400 psi – manual test every 6 months, annual pressure test
  - Boilers greater than 400 psi – Pressure test every three years
  - High temp. hot water boilers – annual pressure test
  - Low pressure boilers (15 psi) – manual test quarterly, annual pressure test before heating season

Recommended Test Frequencies

- Hot water heating boilers – manual test quarterly, annual pressure test before heating season
- Hot water heating boilers – manual test quarterly, annual pressure test before heating season
- Water heaters – manual test every 2 months (replace if defective)

Recommended Test Frequencies

Pressure Vessel and Piping Applications

- To determine inspection frequency, the vessel contents, system operation, and previous inspection history must be reviewed
- Steam – annually
- Air, clean dry gasses – every 3 years
- PRV with rupture disk – 5 years
- Propane, refrigerant – 5 years
- All others – Per Inspection History

Sample Inspection Checklist

Sample
Inspection Checklist for Pressure Relief Devices
(Based on NBIC Part 2, Section 2.5)

1. Valve Type _____
2. Set pressure _____
3. Object being protected _____ Code Section _____
4. Object MAWP _____
5. Set pressure LT or equal to MAWP: Yes _____ No _____

6. Set pressure seal intact Yes _____ No _____
7. Adjusting ring(s) seal intact Yes _____ No _____ N/A_____
8. Seals match mfg. / repair /test nameplate? Yes _____ No _____
9. Inspection done with valve: Installed _____ Removed_____
10. Evidence valve is leaking Yes _____ No _____

11. Connections (bolting) tight Yes _____ No _____
12. Evidence of rust or corrosion Yes _____ No _____
13. Body drain open Yes _____ No _____
14. Test gag Yes _____ No _____
15. Bonnet vented for bellows Yes _____ No _____ N/A_____

16. Inlet pipe GT or equal to valve inlet size Yes _____ No _____
17. Outlet pipe GT or equal to valve outlet size Yes _____ No _____ N/A_____
18. Drain pipe open Yes _____ No _____
19. Binding of inlet or outlet piping Yes _____ No _____
20. Discharge pipe support OK Yes _____ No _____

21. Discharge to safe location Yes _____ No _____
22. Isolation valve(s) used? Yes _____ No _____
23. Inlet pipe and valve inlet deposits? Yes _____ No _____ N/A_____
24. Outlet pipe and valve outlet deposits? Yes _____ No _____ N/A_____
25. Test method: Pop test __ lift lever check _____
26. Measured set pressure: _____ Acceptable: _____, Not acceptable ___
27. Seat leakage: Acceptable: _____, Not acceptable ___

Comments: _____
_____

Inspected by: _____ Date _____

Corrective actions required/ taken:
_____
_____

Corrective actions completed by: _____ Date _____

Final Exam (outlet piping)

Final Exam

Final Exam

What's wrong with this installation?

Conclusions

- Pressure relief devices are important to safe system operation
- Inspections must be done to assure devices are installed and *functioning properly*

THANK YOU!