Pressure Systems For Contractors

or

How to Check the PVS Box with Minimal Effort, Expense, Surprises, or Delays

December 17, 2014

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Glenn Research Center
Why we do it:

- NASA regulations require each center to have a Pressure Vessel and Pressurized Systems (PVS) compliance program
  - NPD 8710.5 - Policy for PVS
  - STD 8719.17 – NASA Requirements for PVS
Why we do it:

- State and federal regulations (e.g. OSHA, CFRs, State of Ohio Law) require PVS be constructed (and repaired) to National Consensus Codes and Standards (NCS)
  - Ohio is a code State (ASME and NBIC codes apply)
  - NASA policy is to NOT exercise Federal Exclusion (i.e. act like a commercial entity)
    - Follow state law with boilers (ASME Section I, Section IV)
    - Follow ASME Section VIII for pressure vessels
    - Follow ASME B31 series piping codes for piping systems
    - Follow NBIC for repairs
    - Follow others reg’s as applicable for operations (NFPA, API, etc.)
Why it’s important:

- Bad things can (and do) happen when NCS are not followed. Some Examples:
Bldg 64 explosion – lack of adequate relief
Implosion of Foster-Wheeler Cooler, Bldg 38 (west wing ERB). Lack of certification/inspection was determined to be a significant contributing factor in the incident.
Bldg 60 steam line rupture. Cast iron components, not recommended by code, contributed to piping system failure that did considerable damage to library materials. Fortunately, the event occurred off-hours and staff was not in the vicinity. This could have been a truly horrible incident.
These cumbersome couplings were used solely to avoid hassles of code compliant welding. For the prepared shop, welding would be considerably cheaper, easier, and quicker construction method.

Results of a Victaulic Coupling Failure
What it entails:

Simply, all new construction and repairs must comply with applicable NCS:

- Piping must comply with ASME B31 series piping code (typically B31.3 or 31.9) – Note: per code, owner, not contractor, determines applicable code
- All vessels must comply with ASME Section VIII
- Fabrication, installation, examination, and testing must comply with applicable codes
- Pressure Systems Office (PSO) certifies system as code compliant when job is done (some exceptions)
- Pressure Systems Manager (PSM) is responsible for assuring all construction is code compliant, all PVS is certified, and is the Authority Having Jurisdiction (AHJ) for all code interpretation matters
Requirements – general:

- Pressure Vessel fabricators must have current code stamp(s)
- Piping Fabricators should have a Quality Program consistent with ASME piping code
- Assure staff have correct credentials and qualifications – especially welders (more on this later)
- Know basic OSHA safety rules and requirements
- Know basic requirements of Glenn Safety Manual (especially chapter 7, others as applicable)
- Know basic piping code requirements and scopes (esp. ASME B31.3)
Requirements – pre-construction:

- Confirm PSO has verified design as code compliant
- If design-build, assure design is code compliant – ask to have PSO verify
- Assure P&ID drawing exists and is code compliant (or confirm P&ID is not required for the job)
- Collect key component cut sheets/specifications
Requirements – pre-construction:

- Compile a weld map if job involves more than a few welds; assure weld procedures exist, the procedures are qualified, and welders are qualified to do it.
- Draft Health and Safety Plan (HASP); address Hot Work and Confined Space permit needs if applicable.
- Determine Owners Inspector for PVS portion of job (may not be QA).
Requirements – construction:

- Collect data sheets for major/critical components (e.g. relief valves, gauges, regulators, insulation, etc.)
- Verify fitting specifications/stampings (elbows, tees, weldolets, flanges, etc.)
- Collect mfgr certification sheets for critical components (e.g. relief valve cert’s, vessel U-1 form, piping Material Test Reports (MTR), Vessel MTR, bellows/expansion joint specifications, etc.)
- Assure piping support and vessel installations are code compliant
- Follow weld requirements and pressure test requirements detailed below
Requirements – welding:

There are two approaches to assuring welds are code compliant and certified:

1. Quality Program:
   - Contractor hires an independent third party (i.e. Team or comparable entity) to examine welds, verify welder credentials, and validate process. Results are provided to Government Owner Inspector (OI) for PVS
   - This approach can be used for any job, but is essential for larger jobs involving many welds

2. Weld Request Form (GRC 4025):
   - Form is filled out and submitted to PSO per form instructions
   - Examination is negotiated (typically 3\textsuperscript{rd} party, but can be PSO examiner if QA concurs and provides funds)
   - This approach is usually used only for jobs with very few welds
Requirements – welding:

Detail requirements are common to both approaches (see ASME B31.3, ASME Section IX, etc.):

- Verify and collect welding documentation to be provided to Owners Inspector:
  - Weld Procedure Specification (WPS)
  - Procedure Qualification Record (PQR)
  - Welding Operator Performance Qualification (WPQ)
  - Welder continuity logs
  - Weld pre-heat and post weld heat treat records
  - Welding rod MTRs and specification records
  - Weld map
Requirements – welding:

- Weld procure must be followed for any piping system regardless if the system is certified or excluded (i.e. code welding procedures would be required on an excluded water system)

- Welding on any **pressure vessel** or **code-stamped component** must be accomplished by a shop holding a current R-stamp credential – Only PSM has authority to waive this rule

- R-1 form signed by Authorized Inspector (AI) can be used to certify welds (no need to produce weld procedure and qualification documents in this instance because AI verifies)
Requirements – pressure test:

- Piping/vessel code compliance requires a pressure test.

- The type of pressure test can vary between in-service leak check, hydrotest, pneumatic test, or sensitive leak test depending on:
  - the specific code (e.g. ASME B31.3 vs B31.9 piping code)
  - type of service (e.g. Normal Fluid Service vs Category D Fluid Service)
  - circumstances (e.g. system may not be able to tolerate water for hydrotest).
Requirements – pressure test:

- The pressure test must be documented – standard code forms or GRC forms can be used for this purpose.
- **Hydrotest** can be accomplished without any special approvals; **Pneumatic** tests require a permit due to the potential stored energy.
- Pressure test requirements are detailed in Glenn Safety Manual (GSM), chapter 7.
Requirements – pneumatic test:

- As noted above, pneumatic tests require a permit due to potential stored energy associated with the test.
- Procedures and forms for pneumatic test permit are contained in GSM, Ch 7, and involve submitting request form GRC-802 with:
  - Basic description of test noting key pressures
  - Schematic detailing test configuration and key components (see sample below)
  - Relief Device flow capacity calculation (see PSO website) and certification documentation (from mfgr or valve shop)
  - Gauge calibration data (from mfgr or cal shop)
  - Exclusion Zone calculation (see GSM, Ch 7, App B)
## Pneumatic Test Request Form GRC-802

### To: Pressure Systems Office

<table>
<thead>
<tr>
<th>Name</th>
<th>Work Phone</th>
<th>Home Phone</th>
<th>Location of Activity</th>
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### Emergency Contacts

(Provide information below for an emergency contact and alternate knowledgeable of activity. The requester can be an Emergency Contact.)

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone</th>
<th>Email</th>
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### Activity Schedule

(Select all that apply)

- [ ] Workday
- [ ] Night
- [ ] Weekend

**Start:**

**Complete:**

**Test Run Length (Hours, days):**

### Check all supporting documentation attached:

- [ ] Pneumatic Test Plan
- [ ] Restricted Distance Calculation
- [ ] Relief Device Certification
- [ ] System MAWP (Max. Allowable Working Pressure)
- [ ] System Component MAWP
- [ ] Test Plan
- [ ] Schematic Plan
- [ ] Relief Device Calculation
- [ ] Relief Device Manufacturer’s Cut Sheet
- [ ] System Component Sheets (Cut Sheets)
- [ ] System MAWP (Max. Allowable Working Temp.)
- [ ] Test Procedure
- [ ] Other

### Pneumatic Permit Requester Signature

[Signature]

**Date**

**Work Phone**

### Supervisor of Requester (Print name)

[Signature]

**Date**

**Work Phone**

### NASA Technical pressure testing request (Print name)

[Signature]

**Date**

**Work Phone**

### James Hill, Safety Engineer

**Date**

- [ ] Approved
- [ ] Denied

### Senior Engineer, Pressure System Manager

**Date**

- [ ] Approved
- [ ] Denied

Instructions: Send this request and all supporting documentation to the Pressure Systems Manager. Refer to the Glenn Safety Manual, Chapter 7, for additional information.

PREVIOUS EDITIONS ARE OBSOLETE.
Pneumatic Test Schematic

Figure 3. – Typical piping schematic for pneumatic pressure test
Pneumatic test – tips and advice:

➢ Understand the need for relief – a low pressure test fed from a high pressure source (K-bottle, for example) can become dangerous without proper relief
  ▪ RV sizing calculations are available on PSO website and from standards such API-520
  ▪ Help/guidance is available from PSO or SHeD, yet as the saying goes: ‘God helps those who help themselves’

➢ It is sometimes possible to eliminate need for RV by choosing low pressure source; for example, a pancake compressor that dead-heads at 120 psig

➢ Be aware the need for calibrated gauges; assure resolution is appropriate for test – electronic pressure devices are often a good alternative
General survival tips and advice:

- Develop a basic understanding/familiarity with ASME codes; especially B31.3 piping code
- Verify basic design is Code Compliant and has been validated by PSO
- Know code welding requirements and strive to meet them – the best (and most profitable) contractors generally have this knocked
General survival tips and advice:

- Know requirements of pneumatic test and ways to simplify:
  - Use low pressure source if possible
  - Avoid pneumatic test via off-site hydrotest if possible
  - Understand RV and calibrated gauge requirements

- Use references and POC’s to largest extent possible – PSO strives to partner with contractors in mutual goal of meeting certification with minimal effort/expense
References:

- Glenn Safety Manual (GLM-QS-1700.1)
- GRC Weld Manual (GLM-QE-8730.2)
- PSO Website
- NASA STD 8719.17 – NASA Requirements for PVS
- ASME piping and vessel codes (B31 series piping codes and Section VIII Boiler and Pressure Vessel Code)
- NBIC NB-23
- PSO (general procedural info): Andrea Popiel, 3-3183
- PSO (technical info): Calogero DiRienzo, 3-8002
- SHeD (technical info): Jim Hritz, 3-3028
- PSM (technical info): Steve Wnuk, 3-5748