Introduction Swagelok

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Agenda

• History and Objectives of API 682
• Piping or Tubing?
• Designing Seal Support Systems for Reliability
  – Reducing Leak Points
  – Utilizing panels to enhance reliability
  – Simplifying Operation and Maintenance
• Designing Seal Support System for Safety
  – Seal Pot Filling Systems
  – Standardization
• Seal Support Evaluation and Advisory Services
API 682 – 4th Edition

- API 682 is a standard for the sharing of best practices and not a Code like ASME B31.3
- API 682 is often employed as a design reference for ANSI systems
- Two sections are important for Seal Support Systems
  - Section 8 Accessories
  - Annex G – Standard Piping Plans and Auxiliary Hardware
- Seal Support Systems Designed for Reliability, Safety and Ease of Maintenance
“More recently, however, American Petroleum Institute Standard 682 (API 682) began to endorse the use of tubing for some seal piping plans….Consider now as the right time to more widely use tubing for mechanical seals and their support systems”
## Piping or Tubing?

### Table 5 — Minimum Pipe Wall Thickness

<table>
<thead>
<tr>
<th>Materials</th>
<th>Nominal Pipe Size Minimum</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DN 15 to DN 40</td>
<td>1/2 to 1 1/2</td>
</tr>
<tr>
<td>Carbon steel</td>
<td>DN 50 to DN 200</td>
<td>2 to 8</td>
</tr>
<tr>
<td></td>
<td>&gt;DN 200</td>
<td>&gt;8</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>DN 15 to DN 40</td>
<td>1/2 to 1 1/2</td>
</tr>
<tr>
<td></td>
<td>DN 40 to DN 75</td>
<td>1 1/2 to 3</td>
</tr>
<tr>
<td></td>
<td>DN 100</td>
<td>4</td>
</tr>
</tbody>
</table>

### Table 6 — Minimum Tubing Wall Thickness

<table>
<thead>
<tr>
<th>Nominal Tubing Size</th>
<th>Minimum Wall Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>in.</td>
</tr>
<tr>
<td>12</td>
<td>1/2</td>
</tr>
<tr>
<td>20</td>
<td>3/4</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
</tr>
</tbody>
</table>

*The tubing size is the outside diameter.*
Bearing lubrication and seal flush system
Easier to build, service and maintain
Designing for Reliability

- Annex G of API 682 defines standard piping plans and auxiliary hardware
- Wherever a seal support system has not been proven to have a 3-year successful operating life, it is noted in the standard
- Items such as strainer on Plan 12 can be a reliability concern
Designing for Reliability – Reducing Leak points

• “Piping shall be fabricated by bending and welding to minimize the use of flanges and fittings where practical… Threaded connections shall be held to a minimum. Pipe bushings shall not be used (8.2.11).”

• View all connections as potential leak points and points where a system’s reliability is compromised

• However sometimes additional instruments need to be added
Even new installs need help
Even new installs need help
Even new installs need help
Eliminate potential leak points
Eliminate potential leak points
Eliminate potential leak points
Designing for Reliability – Instrumentation

• “Pressure gauges shall have block-bleed valves. (9.4.2).”

• Instruments should be easy to isolate and replace when needed
“If specified, switches shall be provided in place of transmitters. (9.5.1.2).”
Designing for Reliability – Instrumentation

“If specified, switches shall be provided in place of transmitters. (9.5.1.2).”
Designing for Reliability – Vents and Drains

• “All seal auxiliary systems shall incorporate vents as necessary to remove air and vapor and drains to allow safe removal of liquids (8.1.11).”

• While API 682 provides the guidance, designers should consider how the system will be constructed by the installer and interpreted by the operator.
Designing for Safety

• “All controls and instruments shall be located and arranged to permit easy visibility by the operators, as well as accessibility for tests, adjustments, and maintenance (9.1.5).”

Image is of a Plan 32 as installed in a refinery
Designing for Safety

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Designing for Safety – using panels

• “All controls and instruments shall be located and arranged to permit easy visibility by the operators, as well as accessibility for tests, adjustments, and maintenance (9.1.5).”

• Placing system on a panel places all key instruments at eye level

• Design is intuitive, function apparent

Fig. 18 API Plan 32 Panel
Designing for Safety – using panels
API Plan 72/76 – intuitive design, apparent function

- Vinyl wrap on panel allows for multiple types of information to be displayed
API Plan 72/76 – intuitive design, apparent function

- Vinyl wrap on panel allows for multiple types of information to be displayed
- Background color denotes both a system difference and material change
API Plan 72/76 – intuitive design, apparent function

• Vinyl wrap on panel allows for multiple types of information to be displayed

• Instrument set points are indicated at multiple points
API Plan 72/76 – intuitive design, apparent function

- Vinyl wrap on panel allows for multiple types of information to be displayed
- Commissioning and operator instructions listed on panel
Designing for Safety – Fill from Grade

• “Local operation, venting, filling, and draining [of seal pots] shall be accomplished from grade. Unless otherwise specified systems that require the use of a ladder or step or that require climbing on the baseplate or piping are not acceptable (9.1.5).”

• Refill procedure is unsafe and inefficient
“Local operation, venting, filling, and draining [of seal pots] shall be accomplished from grade. Unless otherwise specified systems that require the use of a ladder or step or that require climbing on the baseplate or piping are not acceptable (9.1.5).”

- Refill procedure is unsafe and inefficient
- Use of ladder or climb on equipment to fill seal pots
- Shut down and cool equipment
- Health and safety issues
- Exposure to hot / hazardous vapors (up to 300 psi & 350F)
Designing for Safety – Fill from Grade

New method to refill seal pot:
• Each seal pot has a fill tube
• Check valve provides online refill
  • Reduced cost / no downtime
• Standardized design
  • Single method to fill all seal pots on site
• Safe operation
  • Operator works from ground level
  • Gauge indicates pressure in line
• No exposure to vapors
Designing for Safety – Fill from Grade
Swagelok Seal Support
Evaluation & Advisory Services

API Plan 53A continued

Field Installation Kit (SPK 53A)

Seal Pot Assembly (SPA 53A)

From External Pressure Source

To Seal

Coolant In

Coolant Out

Buffer Fluid Drain

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Swagelok Seal Support Evaluation & Advisory Services

- Asset realization – Do you know exactly what you have in the field?
- Identifies deficiencies in systems and gaps in standardization
- Provides a road map for seal support reliability initiatives
- Comprehensive report allows for easy project planning and execution
- Built around API 682 and industry best practices
- Flexible programming allows incorporation of specific company MET
- Each system is individually identified, recorded, and reported
- Findings are provided with corresponding solutions linked directly into the report
# Swagelok Seal Support Evaluation & Advisory Services

## Pump Number
- **MP-39YA**

## General Information
- **Tubing Material**: Stainless steel
- **Tubing Size**: 1/2" NPT
- **Tubing Inside Threaded**: 1/2"
- **Pump NPT Connection**: Tubing inside thread 1/2"
- **Seal Pot Connection**: 1/2" NPT
- **Seal Pot Connection Size**: 1/2"
- **Barrier Fluid**: aqueous
- **Temperature**: 50°C
- **Pressure**: 25 psig
- **Flow**: 2.54 GPH
- **Port Material**: stainless steel, flat seat caps
- **Height of Pump Column**: 25"
- **Height of Seal Pot Supply Port**: 31"
- **Height of Seal Pot Return Port**: 44"
- **Height of 5% MAF Port**: 43"
- **Height of 100% MAF Port**: 59"

### Customer Specified Minimum Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Existing (Y/N)</th>
<th>Functioning (Y/N)</th>
<th>Deficiency (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Shared Pressure Regulator</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Level Sensing Port Below Recirculation Port</td>
<td>T</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>No port available for quick Krench</td>
<td>T</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>No Local Level Indication</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>AR Minimum Components</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pot Drain Valve</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Added Pressure Source w/ orifice, check valve, and shutoff valve</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Pot Gauge 33 (T)</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Long Radius Tubing (60&quot;)</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Minimum 1/2&quot; tubing (34&quot;) recommended</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

### Recommended Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Existing (Y/N)</th>
<th>Functioning (Y/N)</th>
<th>Recommendation (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Gauge</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Pressure Transmitter 33</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Temperature Gauge</td>
<td>T</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Level Sensor M &amp; L</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>dP Level Transmitter</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Local Level Indication</td>
<td>T</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Inter Low Flow Drain</td>
<td>T</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Cooling Oil</td>
<td>T</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

### System Rating

- **Customer Specified Deficiencies**: 3
- **AP Delinquency**: 2
- **Recommendations**: 5

### Other Considerations

- Do not use TFE tape on seal systems
- Eliminate unnecessary fittings
- Improve maintainability
- Release excess pressure

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*Typical API Schematic (Optional Features in Red)*
Swagelok Seal Support Evaluation & Advisory Services

Olin Facility Team Comments:
- Bad actor (frequent maintenance required) pumps concentrated on end of cascading coupling reactor chain - Possibly linked to changes in process composition. 6-8 months between repair.
- Leading cause of seal failure due to loss of nitrogen flow or pressure.

Swagelok Field Team Findings:
Table 1: Findings

<table>
<thead>
<tr>
<th>Finding</th>
<th>Evaluation</th>
<th>Recommendation</th>
<th>Solution Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many Plan 74s lack pressure gauges</td>
<td>There is no way to verify pressure in the field</td>
<td>Install/repair gauges on the regulator outlet</td>
<td>Appendix E page 81-84</td>
</tr>
<tr>
<td>Plan 74 components are not all centrally located within the enclosures. Regulators are upstream and valving is downstream of enclosure</td>
<td>Why were enclosures originally specified? System is difficult to maintain while components are spread out.</td>
<td>Move all plan 74 components to enclosure or mount to a central panel.</td>
<td>Appendix E page 81-84</td>
</tr>
<tr>
<td>Plan 74 check valves/block &amp; bleed valves are located directly off pump connection</td>
<td>Valves are exposed to vibrations from the pump and can lead to premature wear or failure.</td>
<td>Relocate away from pump with the remainder of the components.</td>
<td>Appendix E page 81-84</td>
</tr>
<tr>
<td>General lack of consistency in design/manufacturer/ distance from pump</td>
<td>Systems are difficult to operate and maintain</td>
<td>Systems should be located as close to the pump as possible. Systems should be standardized for ease of maintenance and operation.</td>
<td>Appendix E</td>
</tr>
</tbody>
</table>

| Replaced components are not “like for like” | Replaced components are potentially not suited for the application they are in e.g. liquid rotometer in gas service | Standardize on stocked components where possible and replace with “like for like” components | Appendix E, Google: “MS-02-346” |
| None of the seal pots have quick fill capability. | Technician must remove pipe cap to refill pot leading to potential exposure to process material. Ladder is needed to reach fill port. | API recommends filling from grade. Retrofit existing seal pots with a quickfill assembly. | See quickfill part number example |
| Most seal pots don’t have local level indication, only dp level transmitter | The only way to know if a pot is empty is a signal in the control room. What prompts a refilling of the pot? | Some transmitters have digital displays, is this a new trend? Standardize on a local level technology e.g. sight glass, magnetic gauge, etc. | Seal pot with sight glass example |
| Many seal pots have level sensing ports that are below the upper pump recirculation line | The return line from the seal may dry out before the transmitter reads zero level. | Retube pots when possible to ensure both level sensing ports are above the seal recirculation ports. Standardize on a seal pot design that prevent wrong installation. | Seal pot with correct porting example |
| Many seal pots and gas panels share a nitrogen regulator with another system or don’t have a regulator at all. | A nitrogen regulator failure impacts multiple systems. No regulation could lead to overpressuring a seal. | Each system should be fitted with an independent pressure regulator. | Regulator with check valve example |

Additional observations:
- Nitrogen blocked in on MP-247A seal pot while pump is still running
- MP-213A flow meter reading 5.5 SCFH
- MP-110A check valve inside of pump shroud
- Redundant bleed valves on plan 74 systems
- No nitrogen reg on MP-200C and MP-110A plan 74
- Nitrogen reg too high to access is this intentional?
- No relief valves on plan 74s
- Vacuum pump plan 32 flush fluid?
Statistical Findings

Figure 2: Percentage of Seal Systems by Unit Areas

Table 2: Percentage of Pumps with Different API Plans

<table>
<thead>
<tr>
<th>API Plan Types</th>
<th>Plans</th>
<th>Pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan 11</td>
<td>53</td>
<td>35%</td>
</tr>
<tr>
<td>Plan 13</td>
<td>7</td>
<td>5%</td>
</tr>
<tr>
<td>Plan 32</td>
<td>5</td>
<td>3%</td>
</tr>
<tr>
<td>Plan 53A</td>
<td>59</td>
<td>39%</td>
</tr>
<tr>
<td>Plan 62</td>
<td>12</td>
<td>8%</td>
</tr>
<tr>
<td>Plan 74</td>
<td>34</td>
<td>22%</td>
</tr>
<tr>
<td>Multiple Plans</td>
<td>18</td>
<td>12%</td>
</tr>
<tr>
<td>Pumps Surveyed</td>
<td>152</td>
<td></td>
</tr>
<tr>
<td>Total Seal Support Systems</td>
<td>170</td>
<td></td>
</tr>
</tbody>
</table>
Conclusion

Questions?
Contact Swagelok Nederland

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