Original Rubber Vulcanization System (Patent Pending)
Innovation

• Focus on developing technologies that will make a difference. Innovation is about more than solving problems, it is about realizing possibilities, leading us to a better way of doing things.

• Is there better way of making rubber lining repairs? Yes.

• Introducing the ORVS™ (Original Rubber Vulcanization System). It is a Permanent repair system that will change how our industry makes repairs.
Repair Concerns

- Is there an increased awareness of repairs made to Rail cars and Storage Tanks?
- How do we know when a repair is fully cured?
- How long will it take for a repair to achieve full strength?
- How strong is the adhesion of the Rubber repair to base material?
- How soon can the rail car or storage tank be put back into service?
Vulcanization

Vulcanization is a chemical process that modifies the polymer (rubber) by the formation of cross links (3D network) and crosslink density between individual polymer chains.

Vulcanization sets the following physical properties of rubber,

- Tensile strength
- Resistance to swelling and abrasion
- Elastic over a greater range of temperatures.
Parameters Influencing Vulcanization

- Time
- Temperature
- Pressure
## Repair Methods

<table>
<thead>
<tr>
<th></th>
<th>ORVS™</th>
<th>Internal Pressure Steam</th>
<th>Chemical Cure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°F)</td>
<td>250</td>
<td>250</td>
<td>80 to 212</td>
</tr>
<tr>
<td>Pressure (Psia)</td>
<td>12</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Time</td>
<td>3 – 5 hrs</td>
<td>&gt; 6 hrs</td>
<td>&gt; 12 hrs</td>
</tr>
<tr>
<td>Localized Area</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Direct Temp Ctrl</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Original Material</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Pull Strength</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good</td>
</tr>
<tr>
<td>Repairs on In use Lining</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
</tbody>
</table>
Original Rubber Vulcanization System

• Touch Screen Interface
• PLC (closed loop feedback control)
  – Cure Temperature control
  – Vacuum monitoring
• Heating Blanket
• Vacuum Pump
• Thermocouples
Equipment
Rubber Layers

- Heat Blanket
- Original Rubber Overlay
- Original Rubber Inlay
- Original Rubber
Heating Blanket

Butyl Tape

Vacuum Blanket

Thermocouple wire

Vacuum Film

Heating Blanket
Repair Setup
Recipe Selection

Select Recipe to Run

1000
1048
1051
1054
1055
1099
Custom1
Custom2

Return
Edit Recipes
Operating Screen

- Active: 73.2
- Setpoint: 0
- Output: 0
- Vacuum: 0.2
- Active Recipe: 1099
- Start
- Stop
- Waiting
- Time Remaining: 0.0 Mins
- Trend
- Select Recipe
- Ramp/Soak Settings
Temperature Curing Plot
Cured repair
Benefits

• Original Rubber and Cements
• Vulcanization of Rubber, Fully cured, Permanent repair
• Repair strength equivalent to original rubber
• Beveled edges are created by the hot flow of rubber
• Repair under controlled Pressure (Vacuum) and Temperature
• Make permanent repairs in as little as 3 hours
• Localized curing, No need to steam entire rail car or storage tank
• 120 Volts / 240 Volts
• Portable for on site repairs
• Savings in Energy, Manpower, Down Time, Transportation, and Cost