THE ADVANTAGES OF THE SMART-FLOW™ PRESSURE RELIEF VALVE
The Intelligent Solution for Relieving Rail Tank-Car Pressure

Optimized Flow is the Difference
Flow rate plays a key role in helping achieve the right balance between minimizing the loss of product and tank car integrity. The Smart-Flow PRV optimizes the flow rate to deliver superior performance and safety.

Proof-Positive Performance
To validate the Smart-Flow’s performance:

- Midland employed the AFFTAC model, worked closely with our tank car industry contacts and followed the latest simulation parameters
- Ran simulations using the pressure/flow parameters of the 10,730 SCFM Smart-Flow PRV and numerous alternatives
- The Smart-Flow PRV showed critical and specific performance advantages over the competition
- We focused our comparison on two critical performance parameters. The first was time before tank failure. The recently passed Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains regulation (HM-251) stipulates tank cars meet or exceed 100-minutes in a pool fire. For each valve, we compared how long the simulated tank car lasted before a failure or breach in the tank-car sidewall occurred.
- The second element was the amount of lading at failure. At the time of a simulated tank-car failure, the amount remaining in the tank is important. In simple terms, the more lading - the “fuel” to feed a high-energy event - the larger and more destructive the explosion.

Smart-Flow PRV Delivers Superior Results
- Increases Time before Failure – More time for First Responders / Enhanced Evacuation time
- Keeps Tank-Car Cooler – Lowers risk of rupture
- Lower Flow – Minimizes the scale of potential fires and catastrophic events
- Minimizes Product Loss – Lower environmental impact and cleanup costs
- Minimizes Remaining Lading – Less “fuel” to burn, decreases source of thermal energy

<table>
<thead>
<tr>
<th>Smart-Flow PRV vs. Competition</th>
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<tbody>
<tr>
<td><strong>Flow rate (SCFM) @ 75 PSIG</strong></td>
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<tr>
<td>Time before Tank Failure (minutes)</td>
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<tr>
<td>Lading Remaining</td>
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Did You Know?
At the 2-hour mark....The 27,000 SCFM relief valve would have discharged 2X the amount of crude oil, potentially fueling a larger event or spreading dangerous flames!
(Note pg. 2 data - Fraction Tank Filled vs. Time)

Time to Tank Failure

**Smart-Flow**

<table>
<thead>
<tr>
<th>Comp PRV (27,000 SCFM)</th>
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<tbody>
<tr>
<td><strong>367 minutes</strong></td>
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<tr>
<td><strong>55 Minutes</strong></td>
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<tr>
<td><strong>17% Longer</strong></td>
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*Smart-Flow provides the best combination of time before failure and percent of lading remaining.*
SMART-FLOW™ PRV ADVANTAGES

AFFTAC Simulation Parameters

<table>
<thead>
<tr>
<th>Temperature Protection</th>
<th>Shell Thickness</th>
<th>Jacket Thickness</th>
<th>Commodity</th>
<th>Rollover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Blanket</td>
<td>9/16”</td>
<td>1/8”</td>
<td>Bakken Crude</td>
<td>120°</td>
</tr>
</tbody>
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Performance Results – Smart-Flow PRV vs. Comp PRV

Tank Burst and WB Vapor Pressure vs. Time

- Internal Vapor Pressure (Smart-Flow)
- Tank Burst Pressure (Smart-Flow)
- Internal Vapor Pressure (1800)
- Tank Burst Pressure (1800)
- Internal Vapor Pressure (27000)
- Tank Burst Pressure (27000)

Comp PRV 27,000 SCFM
32% loading remaining
32 minutes duration

Comp PRV 1,800 SCFM
32% loading remaining
10,730 SCFM
可控，优化的排放不到1%

Comp PRV 27,000 SCFM
32% loading remaining
32 minutes duration

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