Valve Enhancement Program
Improved Valve Sealing Performance and Reliability

Global Fugitive Emission Reduction

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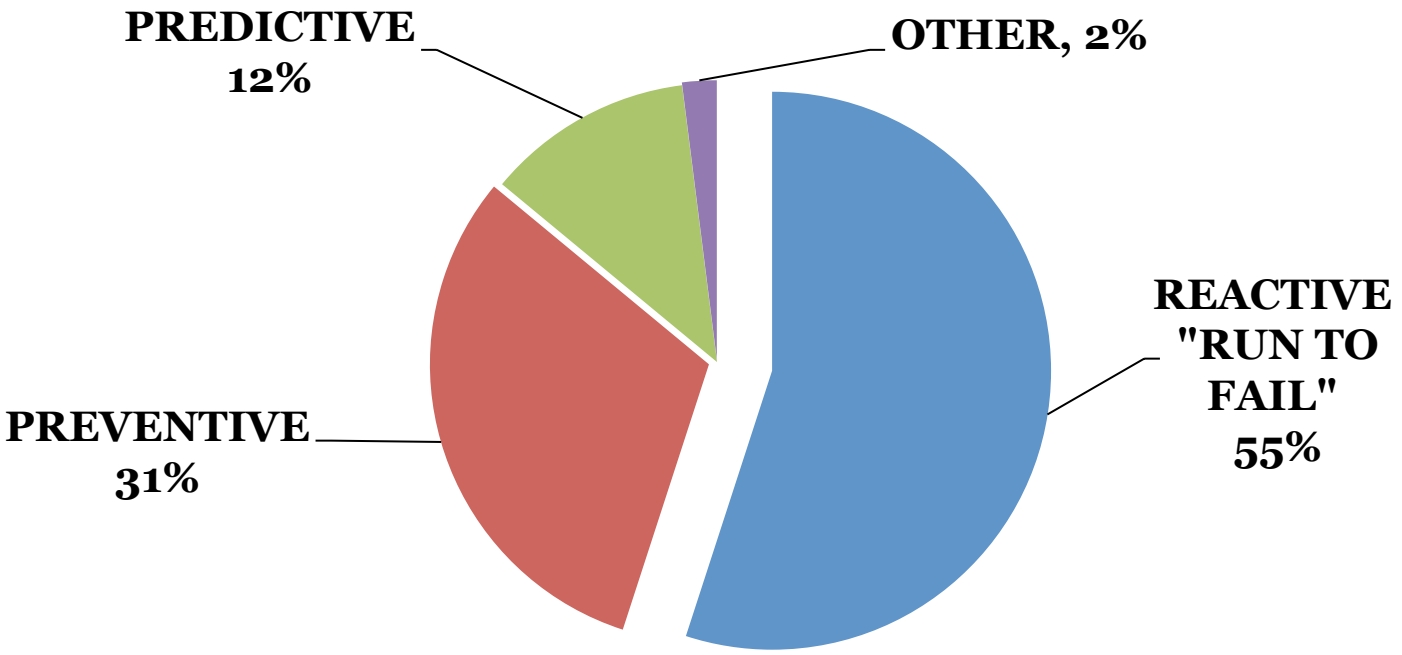
Maintenance Methodology



US Department of Energy, Energy Efficiency and Renewable Energy, Federal Energy Management Program, Release 3.0,. Operations and Maintenance Best Practices, *A Guide to Achieving Operational Efficiency, August 2010, Ch. 5, www1.eere.energy.gov/femp/pdfs/omguide_complete.pdf*

Maintenance methodology is adjusting to industry, and regulatory demands for reduced valve leakage with improved valve performance.

Improved valve programs and next generation materials are changing the approach to valve maintenance methodology.

Valve Enhancement Program Overview

- Industries served
  - Oil & Gas
  - Chemical
  - Petrochemical
  - Fossil Power
  - Pharmaceutical

- Current Regulatory Requirements
  - U.S Clean Air Act / BACT – U.S Clean Water Act/ BAT
  - API 622 / API 624
  - Other standards and criteria – ISO 15848-1, VDI2440, TA Luft, CHEVRON, self Imposed

Valve Enhancement Program Overview

Valve enhancement programs (VEP) are designed to meet the regulatory requirements set forth with respect to valve leakage to atmosphere. It is a program developed for OEM's and End-Users that:

- Offers the solution through quality sealing materials and technology
- Incorporates a reduced leakage warranty related to components
- Monitors and tracks valve performance and history
- Develops engineered solutions for valve leakage and efficiency
- Provides valve evaluation and on-site repair when required

Valve Enhancement Program
Components of the VEP

- Sealing Products
  - Valve stem packing
  - Body to bonnet gasket
  - Flange gasket (optional)
  - Valve body pressure seal

- Live load springs
  - Each valve will incorporate a “live-load” system of springs
    - This configuration will maintain a constant predetermined load value on stem packing
    - Assures sealing through thermal and pressure swings (system)
    - Maintains seal during periods of in-service consolidation
    - Designed to optimize performance at recommended load values

Valve Enhancement Program (VEP)
Components

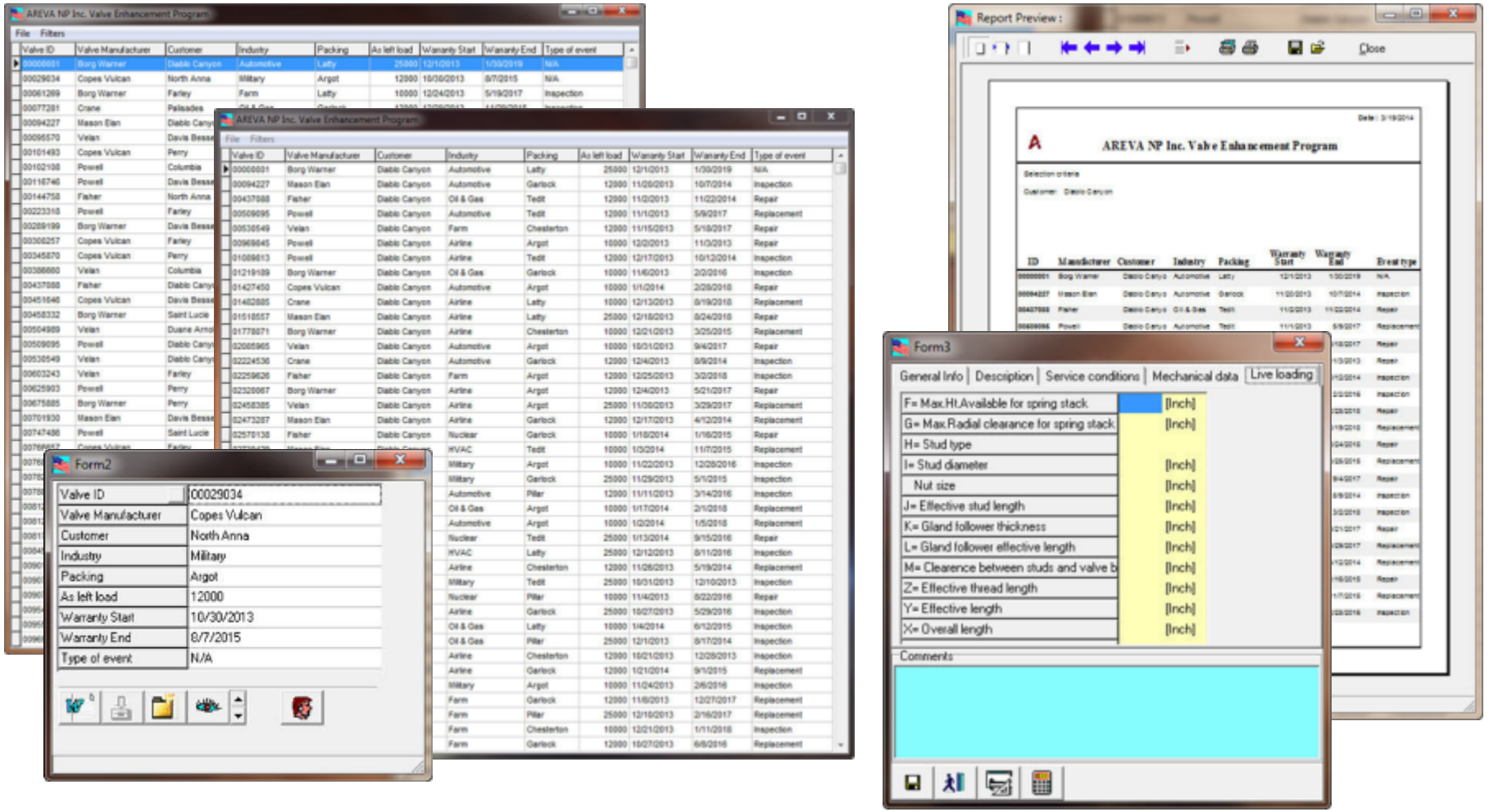
- Valve Packing Monitoring Device (VPMD - optional)
  - Designed to provide a method of monitoring volume loss of sealing material within the stuffing box and provide advance notice of possible valve stem leakage prior to the actual leak arising. Responds to in-service consolidation and loss of packing load.
  - Remote monitoring capability under development

Valve Enhancement Program Database

The VEP database will track each valve that is part of the program including any service performed. Customized reports can be generated for each customer demonstrating valve and material performance during the warranty period. The database will track specific details for each valve such as:

- Valve and component information
- Component materials
- Gland loading/Load and Friction Calculations
- Application information
- Installed location
- Service history
- Capability to calculate load and friction values

Valve Enhancement Program Overview - Database



Valve Enhancement Program Benefits

- Designed to provide solutions in the form of a program and not just a product!
- Addresses valve stem leakage (**64% of the 68% total leakage value**)
- Limited warranty to cover all provided components
- Complete detailed software program to track the valve and/or valves for the customer
- Value added
  - Components compliant to ISO15848-1,TA-Luft, VDI2440,API622/624
  - Single point of contact for all components of the program

Next Generation Valve Packing Materials

The valve enhancement program has been developed to complement the next generation valve sealing materials to optimize overall valve performance.

Extensive Research and Development has been undertaken to better understand the mechanical behavior of sealing materials in an effort to extend life cycle.

Next generation materials and advancements in yarn development allow the industry to comply with newer regulatory requirements.

Tribology studies
(Friction – Wear – Lubrication)

These studies contribute to the development of new products that will:

- comply with the requirements in the industries impacted by global regulatory guidelines
- simplify valve maintenance while maintaining efficiency
- increase service life of valve stem packing materials
- increase sealing efficiency, valve performance, PREDICTABILITY and REPEATABILITY

The Benefit

New engineered yarn and packing provide the following characteristics and advantages:

- Reduce the applied stem friction level
- Improve thermal resistance properties
- Decrease the porosities
- Improve the calorific evacuation
- Preserve packing's chemical resistance
- Reduce stem leakage to atmosphere

Testing Results

More than 25 different types of rings sets have been tested by the manufacturer and the results have been compiled into a packing performance database (PPD).

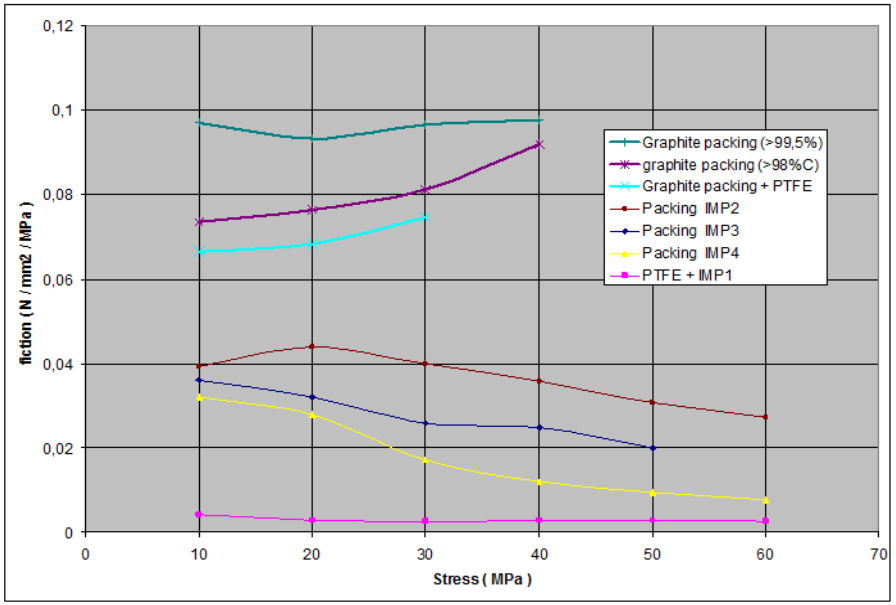
As a result of such tests, specific software was developed to select and calculate the packing configurations required for a wide range of valves and systems.

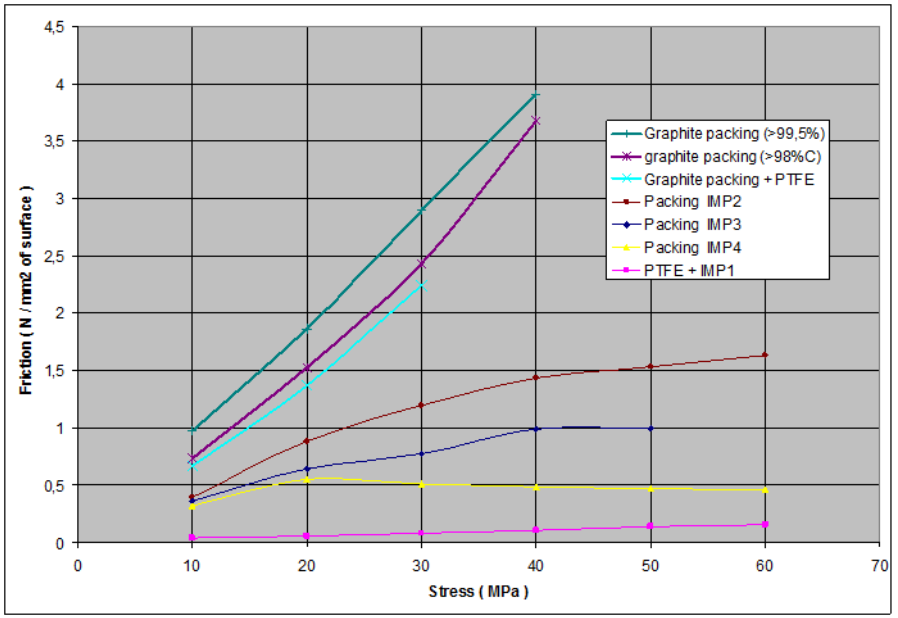
When applying this data at the OEM or end-user maintenance level we can expect:

- An improved and more efficient sealing solution for the valve design
- Accurate assessment of the mechanical behavior and loading characteristics of the components to determine if the materials and configurations provide the solution as required by the end-user or OEM

Determination and analysis of the friction load

- Graphite packing (>99,5%)
- graphite packing (>98%C)
- Graphite packing + PTFE
- Packing IMP2
- Packing IMP3
- Packing IMP4
- PTFE + IMP1





Summary

Valve enhancement programs provide value in the areas of engineered sealing solutions many with limited warranties that support all industries and valve OEM's. This is accomplished by providing a solution through a program and not a single sealing component.

This program is supported by the new technology and improved yarns and materials which provide:

- A better understanding of valve sealing & fluid sealing components
- Improved mechanical behavior
- lower friction coefficient
- improved life cycle with reduced emission levels
- Improved sealing characteristics which enhance valve safety, and dependability
- Interaction between supplier/vendor and customer

Conclusion

The positive impact of programs verses product.

Functional valve maintenance programs:

- Return on investment = 10 times
- Reductions in valve maintenance cost = 25-35%
- Reduction in valve related failures = 70-75%
- Reduction in downtime due to valve = 35-45%

Valve enhancement programs can decrease cost, and increase productivity leading to increased profitability.

Thank you for your time.

US Department of Energy, Energy Efficiency and Renewable Energy, Federal Energy Management Program, Release 3.0,. Operations and Maintenance Best Practices, *A Guide to Achieving Operational Efficiency, August 2010, Ch. 5, www1.eere.energy.gov/femp/pdfs/omguide_complete.pdf*