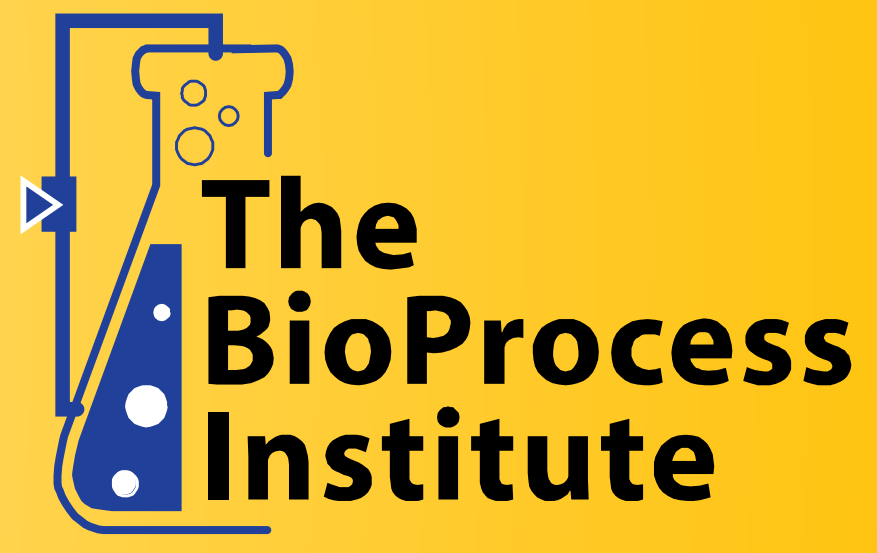


A Comparative Assessment of BioProcess Gasket Service Life

James Dean Vogel, P.E., Kristen Riley, Jeffrey Moore, and Maureen Eustis



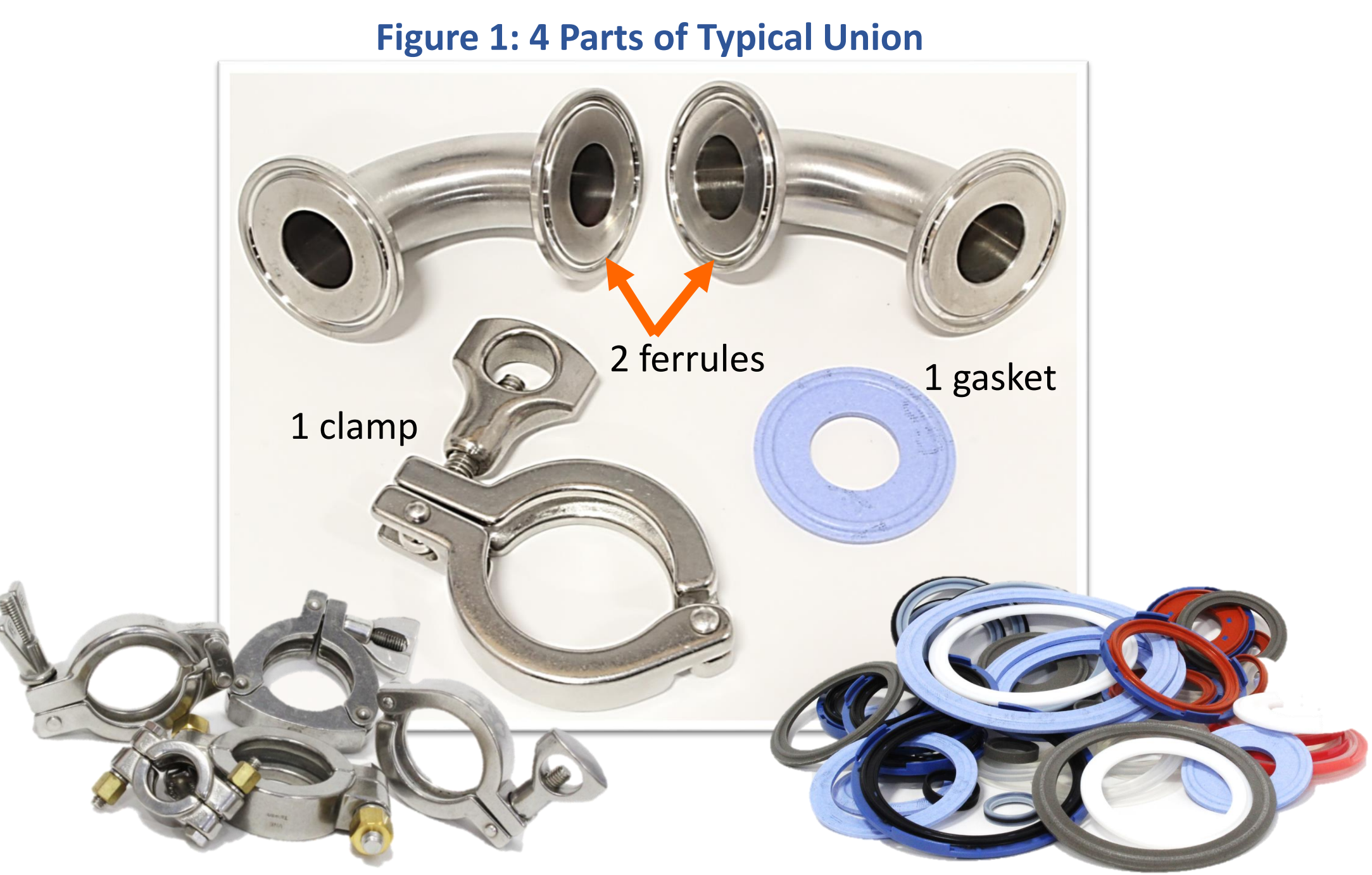
1 THE SITUATION

All gaskets are not created equal. There is no “perfect” gasket for every application, or for *all* applications. So how are biopharmaceutical suppliers and end users supposed to operate with process, economic, and regulatory conditions that require a high level of demand for consistent quality in the bioprocessing components they sell and use?

- End users need components which satisfy at least three criteria: (1) they must **meet the requirements of their process application**; (2) they must **comply with industry standards**; and (3) they must provide for **a long service life**.
- Suppliers need to gather as much critical information as possible to **create components which satisfy these requirements**.
- Both must obtain scientific test results to help them **make an informed decision when choosing the right component for each application**.

Before end users select a bioprocess gasket for an application, they must consider how all commercially-available components compare to each other in terms of service life. This includes categories such as **sealability, entrapment risk/cleanability, intrusion/recess, visual condition, and chemical compatibility**. Supply chain and compliance with industry-accepted performance tests (e.g., *ASME BPE-2014 Appendix J*) must also be examined closely. End users must weigh all performance results and then decide which criteria/criterion is most vital to their production process and the safety of the final product. To do this, they must consider each and every union in each of their process lines.

A typical union consists of four parts: **upstream ferrule, gasket, clamp, and downstream ferrule** (Figure 1). Each of these parts contributes to the successful performance of the union. History has assumed the gasket to be the ‘*Number One Suspect*’ when there is a failure. However, detailed studies found in The BioProcess Institute’s *BioProcess Performance Reports®* (BPPRs®) determined that the other components’ limitations may affect the union’s performance as much, **if not more**, than the gasket.



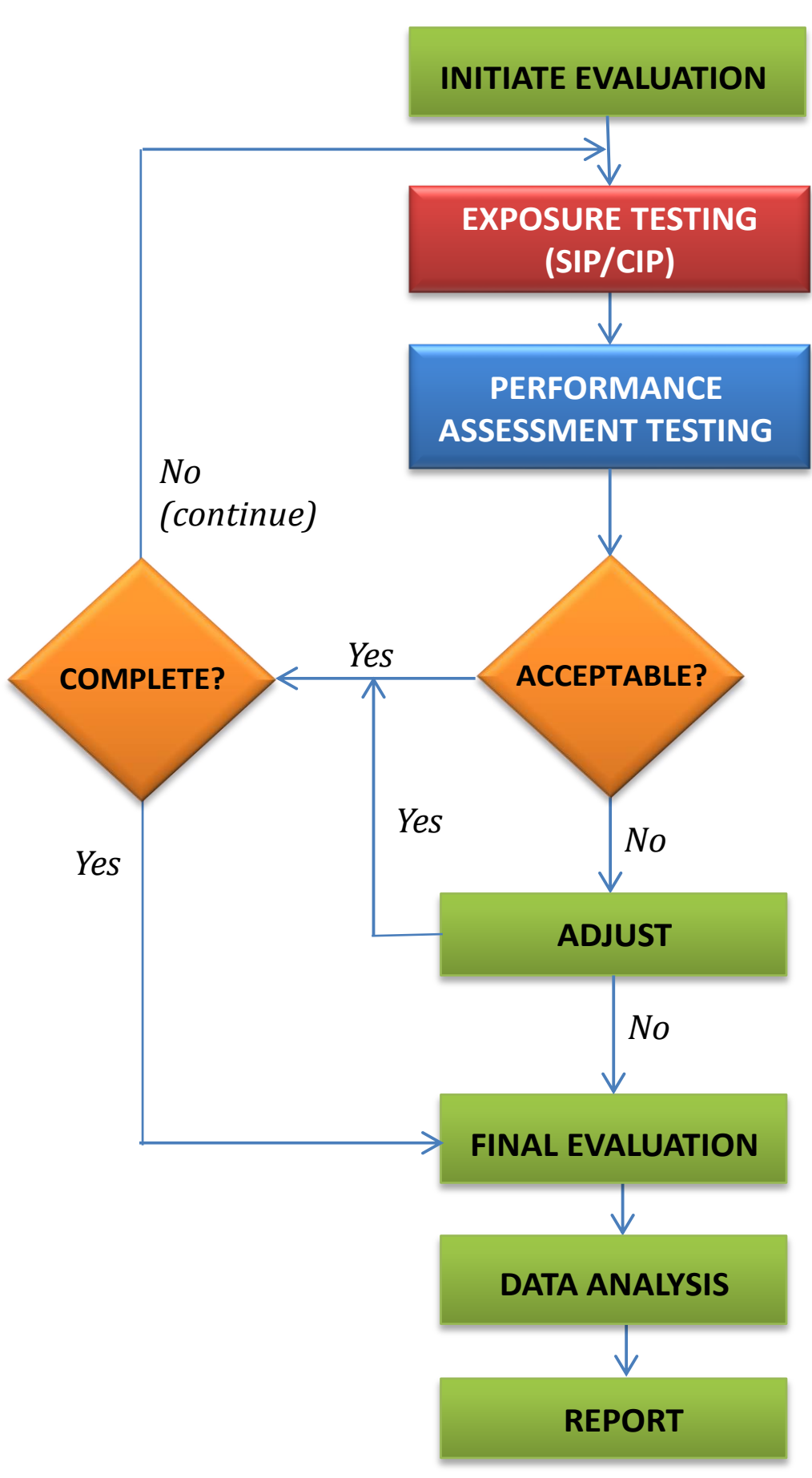
2 THE STUDY

BioProcess Performance Reports® were created to provide the bioprocessing community with independent, side-by-side comparisons of today’s commercially-available bioprocess components. Similar to *Consumer Reports Magazine®*, inside each BPPR® is objective foundational data compiled by assessing and comparing bioprocess components before, during and after subjecting them to simulated process test conditions and trade-secrected testing and evaluation methods. Think of EXPOSURE TESTING like a test track in car racing when the car is exposed to many laps around the track. PERFORMANCE TESTING is where parts of the car are then evaluated in the pit to see how well they withstood the EXPOSURE TESTING (Figure 2).

In those major studies, the performance of the most commonly used commercially-available Silicone, PTFE and EPDM hygienic gaskets were evaluated. The rigorous testing involved thousands of gaskets during the course of many months of exposure and evaluation time, using vast man-years of labor and combined technical experience.

The studies, conducted in a controlled environment, allow suppliers and end users to reference the findings when evaluating the wear and tear of their own components and find a solution.

Figure 2: BPPR® Process Flow for Gasket Service Life Testing



3 FINDINGS

The scientific data from this approach provided the information to choose the best gasket for an application as well as to help predict gasket service life (Figure 3). With the knowledge that this data was based on good, strong science, end users have used it to support their investigations, CAPAs and change controls. While suppliers can see how their component compares to others on the market right now and attain visibility to end users.

Some important findings from the BPPR® studies included:

FIT-UP

- Gasket material, gasket thickness and clamp type significantly affect fit-up.
- Elastomers have low tightening requirements.
- Thermoplastics have very high tightening requirements.
- Certain clamps and gaskets **do not** fit-up properly.
- Mismatched clamps and gaskets will affect fit-up.
- Tightening torques are not always what the manufacturer recommends. *[BPI used the manufacturer’s information, but always independently verified or determined the optimal torque themselves.]*
- Some gaskets were unable to reach 10 SIP cycles before failing.

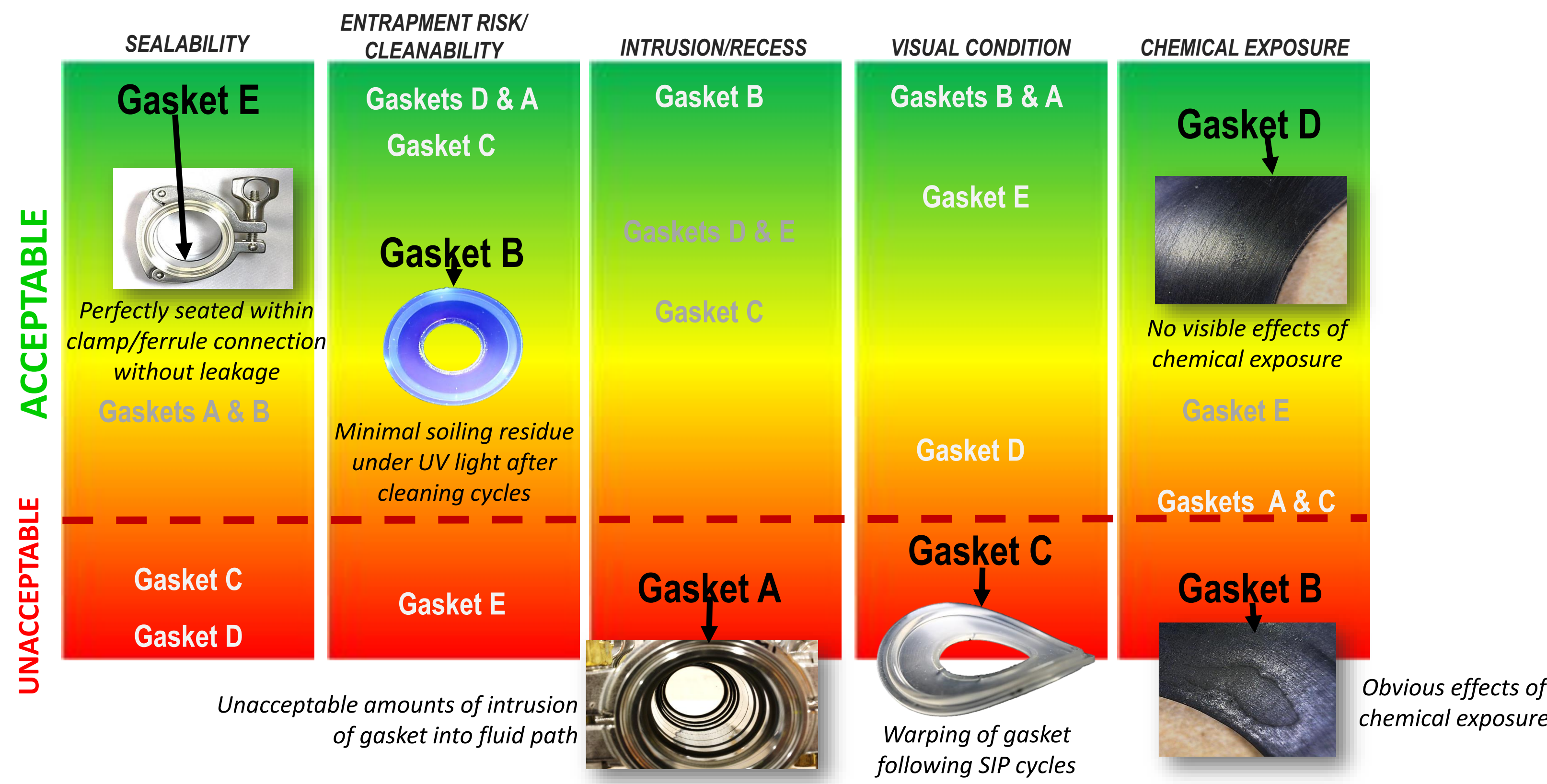
SUPPLY CHAIN

- The Supply Chain is not always robust or sufficient enough to meet the requirements of the industry.
- All manufacturers do not have equivalence across lots. Significant lot-to-lot variability from a single manufacturer was discovered during BPPR® testing.
- Change control was not always in place for the suppliers/manufacturers.
- You don’t always get what you pay for. Some lower priced gaskets were solid performers while some high-end gaskets had substandard performance.
- Some lesser known gaskets displayed superior performance.

SERVICE LIFE

- Material fatigues over the service life of a gasket, affecting performance.
- Higher quality (not necessarily higher priced) gaskets showed longevity because they were able to withstand fatigue throughout rigorous simulated exposure and performance testing.
- PM can be extended with post-use testing; reducing the risk of opening the process too often.

Figure 3: Actual BPPR® Results

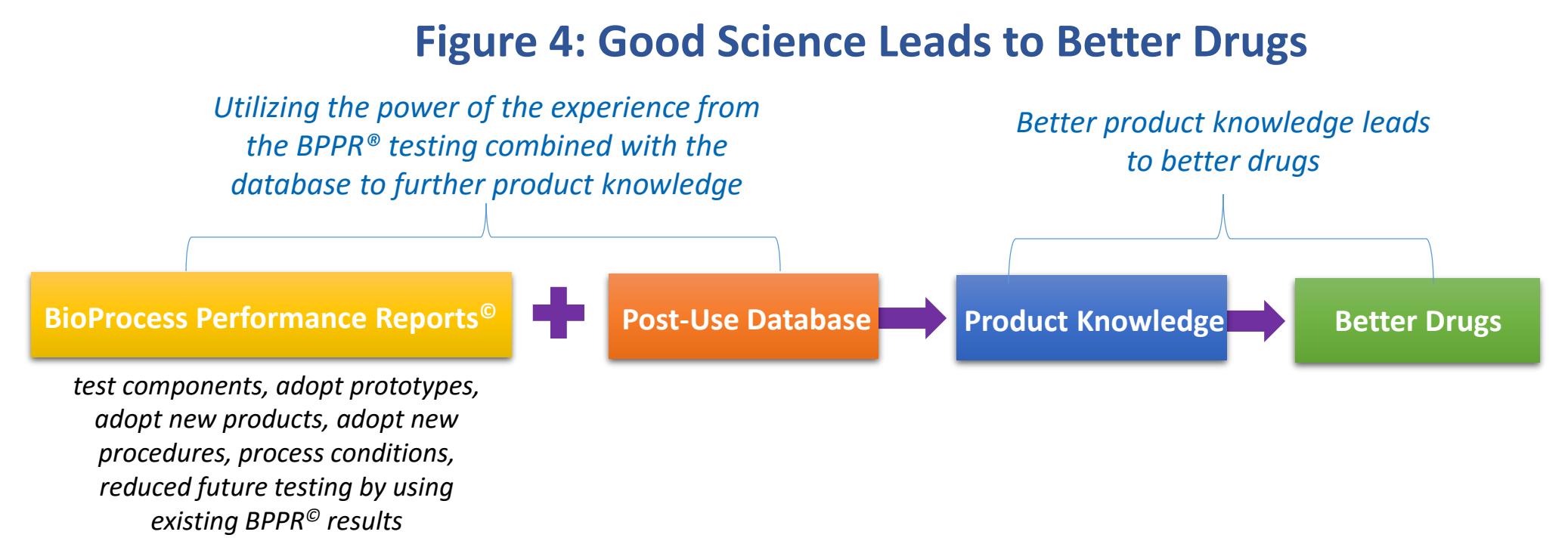


4 LOOKING AHEAD TO THE FUTURE

The BioProcess Institute LOVES gaskets. We test them every single day! In addition to the important results found in the *BioProcess Performance Reports®*, suppliers and end users share their process performance results from their actual applications by donating their post-use gaskets to BPI for evaluation. Scalable to expand to other gasket types and process conditions, BPI’ BPPRs® assesses the condition of the gasket and may also subject the gasket to further forensic diagnosis to determine the root cause of the failure or condition. BPI is developing a post-use testing rationale for reference in future BPPRs®. Gasket users are welcome to send their post-use gaskets to BPI for analysis and inclusion in upcoming *BioProcess Performance Reports®*.

Testing is currently underway on diaphragm valves and a *BioProcess Performance Report®* will be published in Spring of 2016. Hoses, single-use tubing, and other components are being planned now.

The power of information from the testing, combined with the value of gaskets from actual real life use, leads to product knowledge. This, in turn, leads to better drugs (Figure 4).



“Day in and day out at The BioProcess Institute, we help end users, suppliers, & organizations navigate the industry to make better drugs. Everybody wins.”

--JAMES DEAN VOGEL, DIRECTOR