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Ensuring that your sealing devices work properly and deliver the service life you expect from them begins with where and how you plan to use them.

Sealing devices, such as gaskets, O-rings, oil seals, bearing isolators, valve packing, expansion joints and hydraulic components, are all items to consider when it comes to achieving optimal plant performance. Without them, pumps would leak, valves would release chemicals into the air, flanges would spray process fluids and oil would drip from gearboxes, among other things. Unfortunately, sealing devices also have something in common with everyday consumer items like cars and household appliances-*their owner/operators seem to care most about them when they fail to function properly.*

Where and how you apply a sealing device is crucial to its ability to deliver for you. Following the seven steps outlined here can help you make sure that you are selecting the right solution for a particular application.

Step 1. Identify the problem
Ask yourself several questions.

First, what's your facility's definition of a leak? If you are a chemical or hydrocarbon processor subject to the EPA volatile organic compound (VOC) regulations, the rule of thumb that "if it's not dripping, it's not leaking," is certainly not your world. You think in terms of parts per million, "fugitive emissions." If you work in a distribution center with hundreds of gear motors running materials-handling equipment, visible oil leaks from gearboxes is your standard. If you come from a pulp and paper mill living up to the standards of ISO 14000, you think of leaks in terms of thousands of gallons of un-conserved water poured down the drain after it flushes or drips from a pump seal.

Second, what is the desired area of improvement? The focus for many is "improved efficiency." Specifically, this can mean reducing fugitive emissions, water conservation or reduced downtime. The concept is very simple: optimize resources and raw materials to improve profitability. Perhaps a more specific end is the target of improvement-such as reducing work orders to repair equipment seals, increasing the time between replacements or reducing the amount of time required to replace a seal component.

Third, what do you think the problem is? It's helpful for end-users to be able to express themselves in this regard. A good supplier of sealing solutions will know how to listen, interpret the need, evaluate, define the root of the problem and offer viable/value-tested solutions.

Step 2. Identify cause(s) of the problem application

This step is probably one of the more difficult areas to address. The reason it is that the problem could be as simple as an equipment-related issue-such as a worn shaft in a pump, a scarred stem in a valve, a rotating shaft with high run-out or a warped face on a flange. Conversely, the cause could be external to the equipment, including:

- System temperature increases or decreases
- Pressure upsets
- Environmental conditions (inside facilities and/or outside weather conditions)
- Wrong product chosen for the service conditions
- Improper handling and installation of the seal produc

Get to the causes: failure analysis and troubleshooting…

Elementary my Dear Watson! There is a certain element of detective work required when identifying root causes of a sealing device failure.

A used sealing device creates a "fingerprint" of the equipment in which it was used. A trained person can tell how the sealing component was installed and its exposure to thermal, chemical and equipment conditions. For example, by inspecting the thickness of a used gasket, one can determine if it was properly compressed and in what condition the flange was, or if the previous gasket was properly removed. Inspecting the dimensions and wear patterns on the lip of an oil seal will tell if the lip was subjected to harsh chemicals, a rough shaft surface or a shaft with high runout or misalignment.

Once the causes are understood, the necessary characteristics of the sealing solution can be identified. For instance, a seal with the ability to handle temperature cycling in addition to imperfect equipment conditions may be needed. Perhaps there is no seal that will be able to handle the problem and last an acceptable length of time. Equipment overhaul may be necessary.

Step 3. Identify sealing needs and expectations

It would be an understatement to say that there are many needs and requirements to be considered and satisfied when selecting the proper sealing solution. It might be a little surprising to learn that not all of the needs will be completely obvious-*and that these can be can be just as important as the more apparent ones.*

Table I. Needs and Implied Needs Critical To Expected Seal Performance

NEED	IMPLIED NEED
The sealing solution must withstand the service conditions. [See Step 4 for discussion of T-A-M-P-S-S]	■ I need a product that seals; I don't want to think about this again.
Low cost	■ I need a solution that saves money above and beyond the price of the solution. I have budget constraints and it's not all for sealing solutions.
No color contamination	■ Will the sealing solution affect the color of my product?
No contamination/adulteration of the process fluid	■ Will the seal materials leach into or extract from my process?
Must comply with FDA, EPA, USP, 3A or other regulations and standards	■ I don't want issues with regulatory inspectors. ■ I want the manufacturer to supply certifications of conformance to regulations and standards that I must adhere to.
Easy to use, install and remove	■ I don't want to expend a huge amount of labor hours on seal installation and removal. ■ There areas, in which the seal is located, are difficult to access due to space or safety constraints. ■ How foolproof is the seal solution? Will the parts be confused with other products in my store room?
Seal must be tight to part per million levels	■ I have toxic and hazardous substances and am concerned about the health and safety of my people and neighbors. ■ I need to comply with regulations.
Service life needs to correspond with my maintenance cycles	■ I cannot afford unplanned process shutdowns.
No or minimal wear on machine components	■ I need to minimize the need for replacement parts on my equipment.
Fire safe-fire resistant seal solution for flammable fluid service	■ If there is a fire the seal must maintain its integrity and not further fuel the fire.
I need the fewest number of sealing solutions; I need products that cover a wide variety of applications	■ I don't want to stock and inventory a large variety of seal types.

To select the best sealing solution(s) for an application, the end-user needs to define the expectation of performance. When determining what performance is expected from the sealing device, two categories must be addressed-*the Needs and the Implied Needs*. The *Needs* are typically immediate, urgent and factual in nature.
The Implied Needs
, while not always verbalized in the initial conversation with the seal
supplier, are very important to the end-user. It is vital that you identify both types of "needs" in order to determine the correct solution (see Table I).

Fortunately, the majority of fluid sealing applications can be handled with consideration of just a few of the requirements in Table I. It is helpful to keep many of these in mind when seeking sealing solutions for difficult problems. The list of the critical requirements, though, may change depending on the services, equipment and industry.

Step 4. Identify service conditions: T-A-M-P-S-S
TAMPSS is a simple way to make sure that nothing is missed when gathering information on the application. It stands for: *Temperature – Application – Media – Pressure - Size – Speed.*

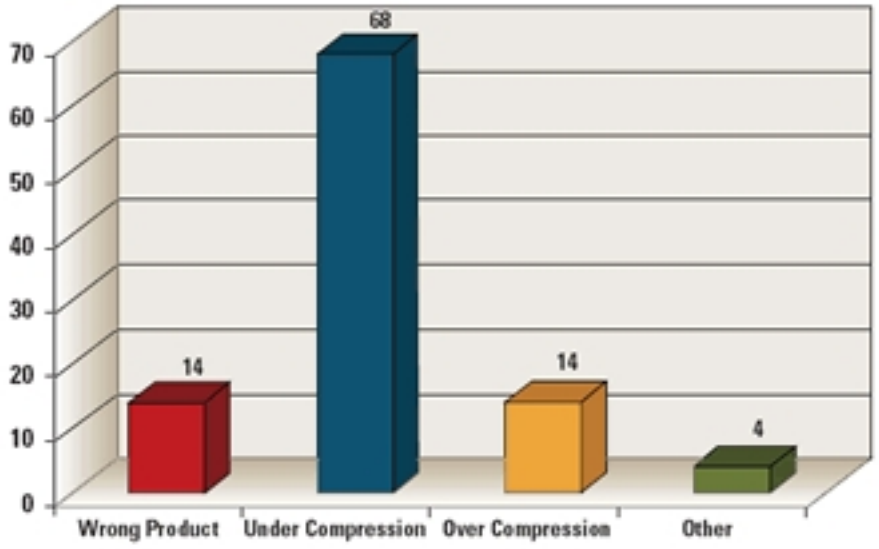
While many of these variables may seem obvious, it is important for users to understand what information is required and why. Refer to Table II for a description of each.

Table II. T-A-M-P-S-S Defined

TEMPERATURE	In most selection processes, the temperature of the fluid contacting the seal should be considered first. For rotating equipment this temperature will be increased to account for frictional heat. Knowing the temperature will quickly reduce the number of possible product materials.
APPLICATION	This category requires a level of detail that, at times, can be difficult to obtain. It basically demands information on the equipment in which the seal will be placed. This information also helps to determine installation procedures that will optimize seal performance. ■ For gaskets – flange type, flange material and bolting information is needed to determine how much compressive force will be available. ■ For oil seals – what type of equipment will the seal be used in–a gearbox, machine spindle, steel or paper mill calendar roll, etc.? ■ For valve stem packing – is it a reciprocating, helical or constantly-moving stem motion? ■ For expansion joints – what is the joint's function? Is it vibration isolation, linear or angular expansion contraction or all? What type equipment will it be attached to?
MEDIA	Common or chemical names of the gas, solid or liquid media that will come in contact with the seal are used to determine the chemical's compatibility with the seal material. Secondary media that are not part of the primary process, but part of a cleaning process need to be considered. These are usually fluids that are present intermittently, such as chemical cleaners or steam/hot water flushing processes.
PRESSURE	While most systems operate at a fairly consistent pressure, it is very important to recognize and factor in any severe pressure spikes or surges that may occur.
SIZE	For flanges, there are ASME standards such as B16.1, B16.5, B16.20, B16.21 or B16.47 that give standard dimensions for flanges and gaskets. Telling your seal source the nominal pipe size and flange class conveys the necessary information. Pumps and valves have some standardization expressed in API and ANSI standards. Otherwise, they must be field measured. Other equipment will require field measurements or manufacturer's drawings.
SPEED	When dealing with pump packing, mechanical seals, oil seals or bearing isolators, surface speed (in feet per minute, FPM) at the seal shaft interface is crucial. For example, if a customer has two pumps running at the same revolutions per minute (RPM), but the pump shaft diameters are different, the actual FPM will differ. Knowing the surface speed indicates the amount of frictional heat which will be created. High surface speeds demand material which can stand up to and effectively dissipate heat.

[illegible]

Fig. 1. Review of 100 failed gaskets returned for analysis. Of the 100 gaskets analyzed, 82 showed signs of improper compression. This type of failure is a direct result of not following proper installation procedures.



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