TRELLEBORG

Do's & Don'ts

SEAL & POLYMER BEARING VALIDATION RECOMMENDATIONS

TRELLEBORG SEALING SOLUTIONS

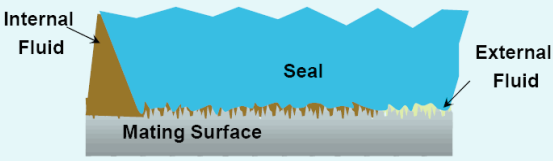
How do I validate a seal or bearing?

Trelleborg Sealing Solutions has over 60 years of experience in the development and manufacturing of seals and bearings. We'd like to share with you a few do's and don'ts to help you optimize seal and bearing performance when validating seals for a specific application.

Critical Elements

When specifying seals and bearings, there are a number of critical elements that need to be focused on. For seals, this is related to pressure, and for bearings, it is the load.

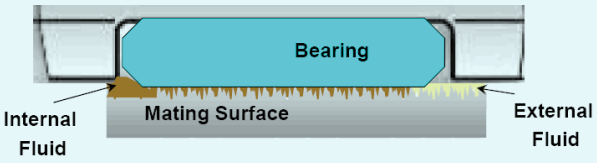
Seals



Factors Affecting Critical Elements:

Design Factors	**Environmental Factors**	
Material	Pressure	Dynamics
Shape	Temperature	Assembly
Process	Time	Media

Bearings



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Material

Trelleborg Sealing Solutions supplies a broad range of materials specially developed for specific applications. Specifying the right material for your application can help optimize its performance.

DO

+ Understand that **materials have a significant effect on component output** even when seals and bearings have the same geometry
+ Recognize that **specific materials** may provide additional performance benefits

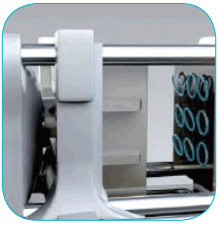
DON'T

- Undervalue the effect of **seal and bearing materials on an application**. Material specifications cannot fully describe a material
- Underestimate the **influence of materials** on the seal, bearing, fluid or dynamic sealing surface

General

DO

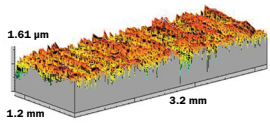
+ Carefully consider how any substitutions or **changes to any design, process or material** will effect your application and decide if the change is worth making
+ Respect that when working in a global team, **language and culture** may have an affect on the validation process



DON'T

- **Misapply static FEA results** in dynamic applications
- Use minimal data points or **extremely small sample sizes**

Mating Surfaces



The sealing and bearing interface is made up of the mating materials. This and the surface finish of the mating surface are important factors in seal validation.

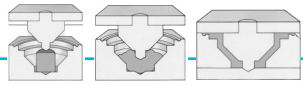
DO

+ Recognize that **surfaces** have different material properties that affect fluid retention beneath the seal and thus wear and friction
+ Consider that changes to **finishing processes** can affect the surface finish of the mating surface and thus sealing and bearing performance

DON'T

- Undervalue **surface finish** recommendations from sealing suppliers
- Underestimate any change to the **mating surfaces**

Process



Process includes the manufacturing, assembly, inspection, and other steps to produce seal and bearing components.

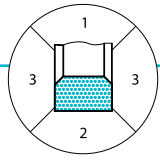
DO

+ Realize that there are **process and material limitations** in producing some geometries due to size or complexity of the part
+ Understand that the process itself can create significant differences in performance depending on **how sealing or bearing geometries are produced**

DON'T

- Make significant **process changes** between creation of prototypes and end production
- Ignore the **process steps** involved in production and handling of an acceptable production part

Design



Design is the particular geometry of seals and bearings.

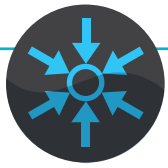
DO

+ Involve a professional **sealing supplier** in the development of sealing systems
+ Understand the **design limits** of seal and bearing geometries and how these should be measured

DON'T

- Assume that **scaling** (linear change in dimensions) of geometry will equate to the same factor change in the outputs of the sealing system (friction, life and leakage)
- **Change layout** (location, spacing, orientation, etc. of and between elements) without first considering possible effects of such changes

Pressure



Pressure produces the energy required for the seal function to be carried out. Additionally, it can deform the seal, changing the fluid film in which the seal rides.

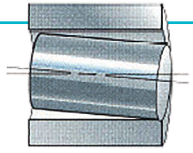
DO

+ Consider **pressure rise rate effects**
+ Recognize that a **change in pressure** affects fluid film
+ Account for the potential of **pressure spikes** from, for example, valving or plumbing
+ Bear in mind the **role of pressure in relationship to dynamic motion**

DON'T

- Underestimate hardware ballooning or **internal deformations** caused by pressure
- Misjudge the effect pressure has on **internal contamination**
- Concentrate testing on **pressure spike** portion or high-end system pressure only
- Assume that **system pressure** is exactly the same as the pressure conditions that the seal is exposed to in the application

Dynamics



Beyond the general operating parameters of the component, other factors may include:

- Vibration
- Deformation
- Alignment

DO

+ Be aware that **system vibration** can have a significant effect on sealing performance
+ Consider that offset or **misalignment** has a significant effect on sealing and bearing performance

DON'T

- Underestimate the effects of **pressure hold** on sealing components
- Ignore the issues associated with **impact, buckling** and other similar **dynamic events**

Speed

The speed of an application plays a significant role in seal performance. Duty cycle, motion and acceleration can significantly improve or degrade the sealing system.

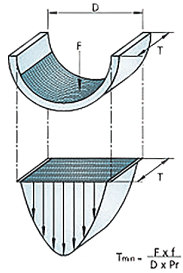
DO

+ Recognize that **changes in the operating cycle** can introduce different failure modes
+ Realize that **speed** plays a significant role in fluid film and thus affects leakage, friction and wear

DON'T

- Miss the significant impact of **fluid property** changes

Load



The sealing system must absorb load or force to ensure proper guidance of the piston or rod.

DO

+ Transform load to displacement in **isolated tests**
+ Prefer scarf cut wear rings on the **unloaded side of the bearing**

DON'T

- Neglect **impact**, which can exert extremely high loads on wear ring

Temperature

Temperature is a result of outside environmental conditions, frictional heat caused by the sealing system and fluid movements through valves and hoses.

DO

+ Take into account the **frictional heating** due to the sealing system
+ Keep in mind that **higher temperatures** weaken seal and bearing materials
+ Take into consideration that **temperature cycling** can affect temperature limits of materials

DON'T

- Test systems at a **temperature** greater than sealing component limitations
- Underestimate the temperature rise due to equipment **shut down**
- Exceed **fluid temperature** limitations

Time

Seals and bearings are highly stressed components that have a life span. Thus time has an effect on performance. Ideally the components will function the same after many hours of use compared to when they first start.

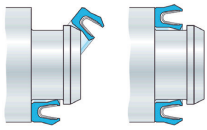
DO

+ Account for the fact that elastomers tend to **stress relax** over time. This results in a reduction of forces exerted by the seal to the sealing surface
+ Recognize that plastics tend to **creep or cold flow** over time. Creep is the increase in deformation or strain over time under a constant load/stress
+ Understand the **potential change in the working fluid's properties over time**

DON'T

- Misjudge the effect of **component fatigue**
- Undervalue that **contact surfaces** change over time and this has an affect on seals and bearing

Assembly



Proper assembly is needed from both a functional point of view and a practical standpoint.

DO

+ Take into consideration the recommended assembly dimensions/hardware for **installation** of seals & bearings
+ Take care with **installation over ports**
+ Take into account **field assembly** environments: these will differ from factory installation in many cases
+ Consider **assembly accessibility**
+ Take into consideration **assembly lubricant**
+ Keep in mind the media used for **preheating** hard seals for installation

DON'T

- Underestimate the effects **rapid stretch** has on sealing components
- Ignore the effect **scaling** of seals (moving up or down in size of seals) has on assembly
- Take too lightly the difference between: **"build & wait until usage"** versus **"build and operate immediately."** A "build and wait" situation can introduce additional failure modes:
  - Corrosion
  - Localized compression set
  - Erratic startup motion

Media

Media refers to the fluid retained within an application and the contamination the seal system keeps out.

DO

+ Understand **fluid properties**.
  - The effect that the fluid will have on sealing components
  - The heat transfer properties of the fluid
  - Viscosity and how it affects the fluid film which the seal rides on
+ Recognize all potential sources of **contamination**

DON'T

- Undervalue the **cleanliness** requirements of fluid
- Ignore the effect of **energy** density
- Misunderstand the **replacement and replenishment profile of fluid**, which could affect its properties

Trelleborg is a world leader in engineered polymer solutions that seal, damp and protect critical applications in demanding environments. Its innovative engineered solutions accelerate performance for customers in a sustainable way. The Trelleborg Group has local presence in over 40 countries around the world.

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