NewtonWorks

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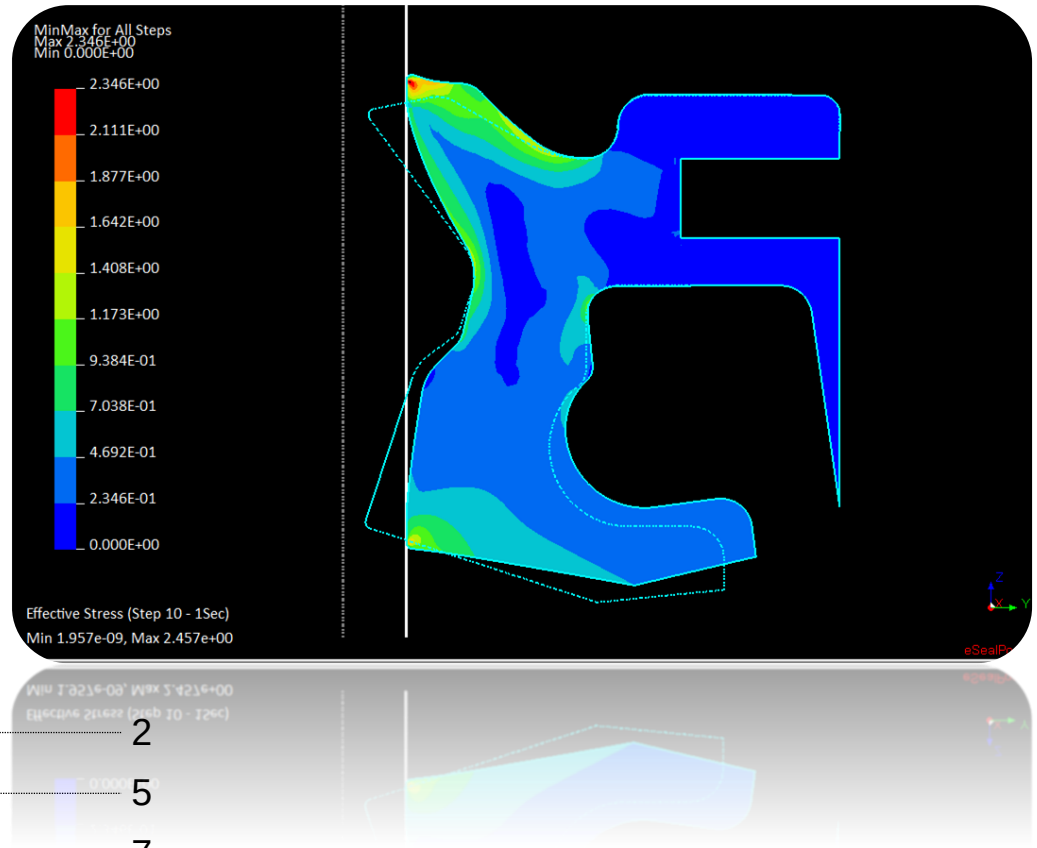
NewtonSuite eSeal Introduction Materials



- Contents -

Seal Design CAE Tool “NewtonSuite-eSeal”

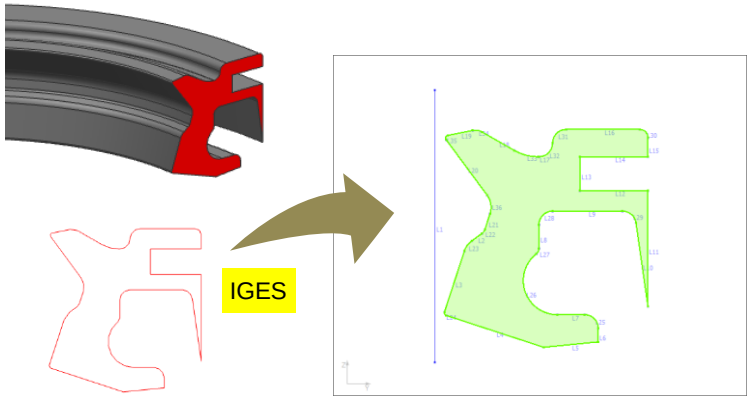
- Overview -

NewtonSuite-eSeal makes simulation as smooth to evaluate and design as a calculator.
It enables simple simulation for complex non-linear analysis involving contact, large deformations, and rubber, even for those who are not specialized in these analysis, and provides quick feedback.

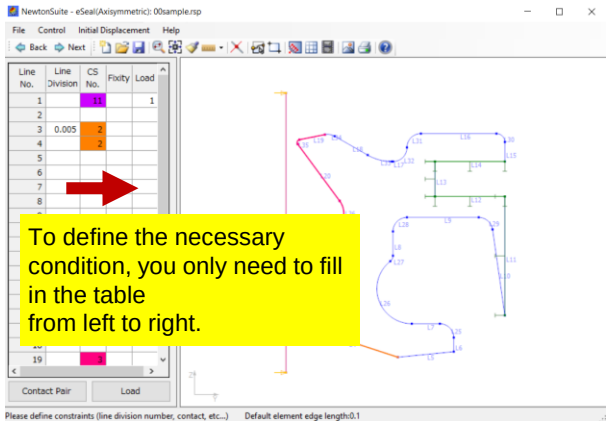
- Smooth simulation -

You can easily create the simulation in three steps

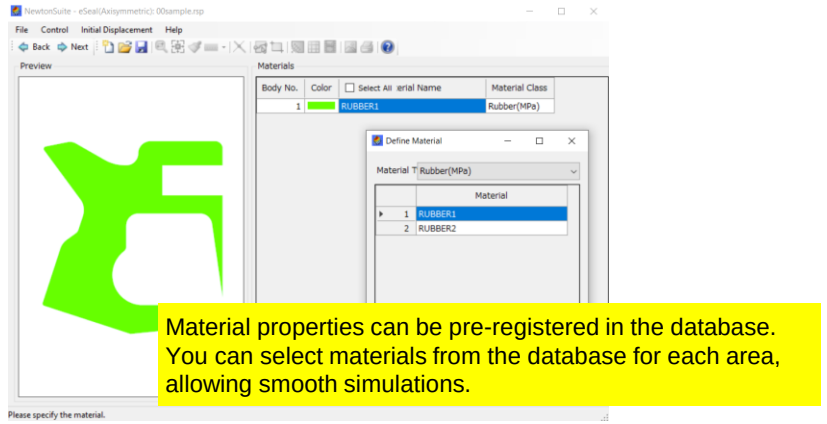
1. Specifying the analysis area
2. Defining conditions
3. Selecting materials



1.Specifying the analysis area



2.Defining conditions



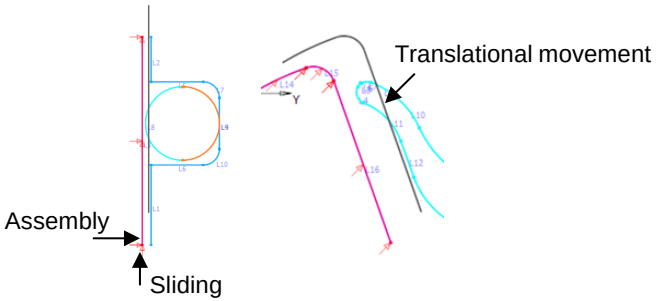
3.Selecting materials

Seal Design CAE Tool “NewtonSuite-eSeal”

- Functions for seal simulations -

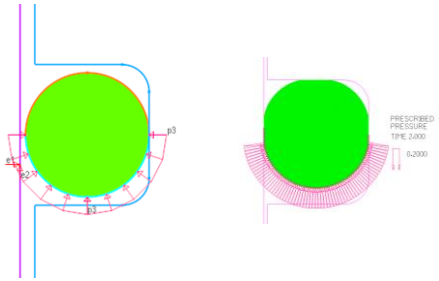
● Displaying via animation

- Represent the assembly process and operating conditions by increasing the load gradually.
- Enables you to confirm the conditions set before the analysis By displaying the load amounts.



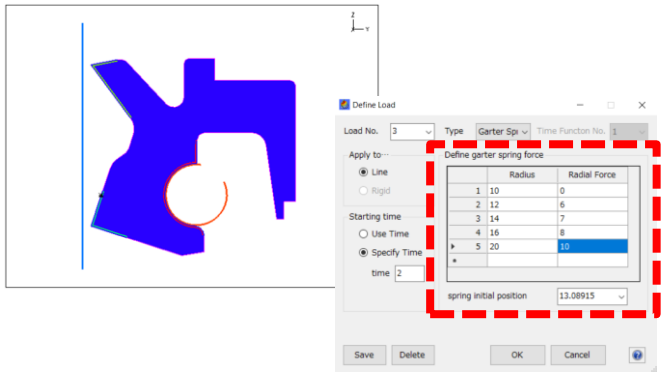
● Pressure condition

- Whether or not to apply pressure to the contact areas can be selected.
- Intuitively specify the area where pressure is expected to act.



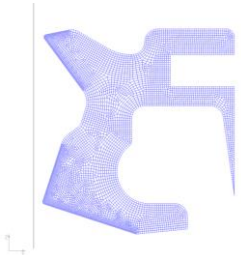
● Garter spring force

- Define the spring tension to ensure that the jacket part of the seal adheres closely to the mating surface, providing effective sealing.



● Auto meshing

- Automatically generates mesh suitable for the analysis of rubber seals.
- Allows specification of element length by default or by region.



● Detach/merge at body boundary

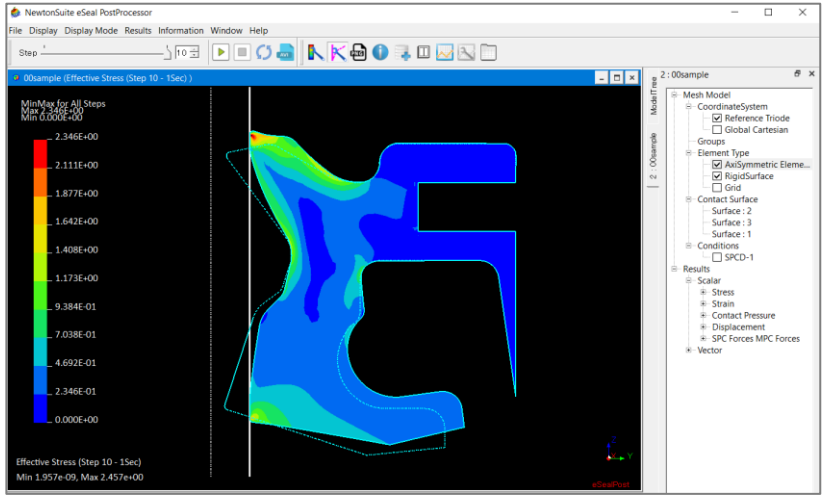
- Manage either adhesion or contact at the body boundary where multiple kind of materials meet.
- Set the coefficient of friction for each pair of contacting surfaces.

Seal Design CAE Tool “NewtonSuite-eSeal”

- Visualizing results with simple operations -

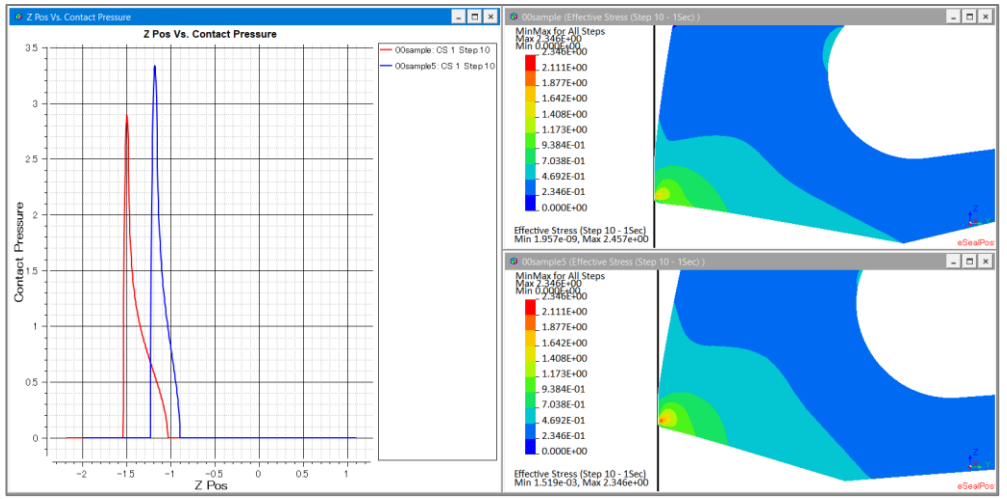
- **With the post tool**

  Effortlessly view results like deformed shapes, animation displays, contour views, and graph views with just a few clicks.



- **Viewing the results**

  Easily compare results from two different designs by showing them side by side.



Evaluation of Sealing Performance by Press-Fit and Hydraulic Pressure

- Overview -

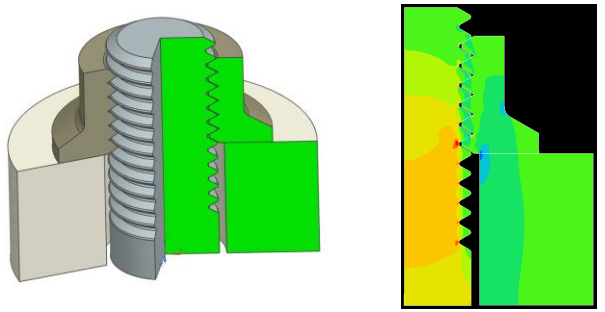
eSeal can simulate the assembly and working state of static seals for dust and waterproofing.
You can evaluate the necessary load for press-fitting, deformation and sealing contact pressure, and sealing performance under high pressure.
This technique can also be applied to other parts, allowing numerical analysis of bolt and cap tightening.

Wire connector seals

- Examples of use -

Wire connector seals
Bolts
Caps (evaluate tightening and sealing of caps)

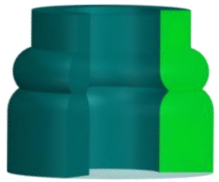
Bolts



Caps

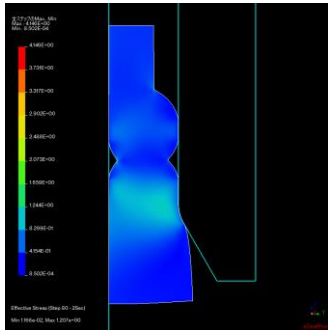
Evaluation of Sealing Performance by Press-Fit and Hydraulic Pressure

- Packing assembly -



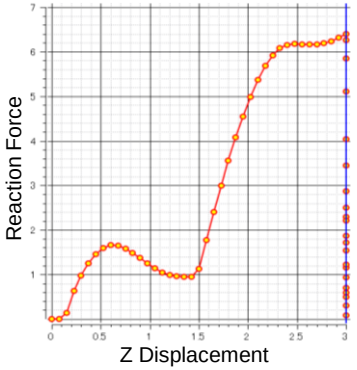
● Deformation and stress distribution

- Aanalyze the deformation and stress distribution during the process of press-fitting the packing.
- Evaluate if the reasonableness of shape and risk of fracture after press-fitting.



● Insertion distance versus press-fit force

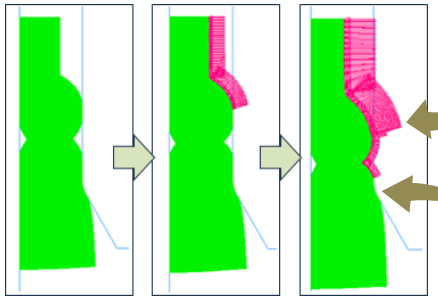
- Evaluate the force press-fit the packing.
- The force can be used to design the optimal shape that balances two factors: ease of press-fitting and sealing performance, which often have trade-off relationship, combining with the contact pressure distribution.



Z Displacement vs. Reaction Force

● Maintaining sealing performance

- Observe the state change when pressure is applied to a space.
- Evaluate the maintenance of sealing performance.

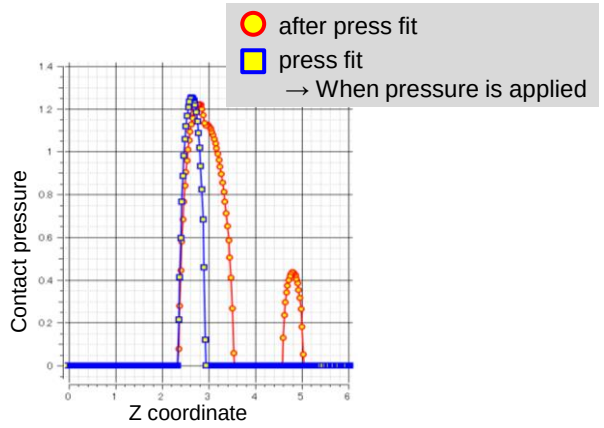


Space is created on the upper side, and sealing does not perform effectively.

The lower contact area remains contact with the packing and sealing performs effectively.

● Contact pressure distribution

- Evaluate sealing performance from the magnitude and distribution of the contact pressure.
- Output the contact pressure according to changes in status.



Z coordinate vs. Contact pressure

Evaluation of Dynamic Sealing Performance

- Overview -

eSeal can predict deformation of contact parts as well as changes in sliding resistance and contact pressure distribution during assembly and sliding.
It can be used for design to improve efficiency of rubber seals.
eSeal can express the seal made of several materials (e.g. resin coating and metal insert). These body boundaries can be represented as both the contact boundary and the assembly one. It is useful to review design when you need to consider replacing with other material properties because of factors such as electrification.
The result of analysis can also be seamlessly applied to lubrication calculation tools to evaluate the leakage amount.

- Examples of use -

Lip Seals, Stem Seals, and Piston Seals
You will receive feedback on design on the trade-off between efficiency and sealing performance (contact force) in sliding seals. CAE allows you to evaluate material selection and the suitability of shapes, even when you are required to change material due to environmental issues.

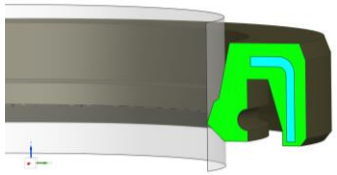
Lip Seals

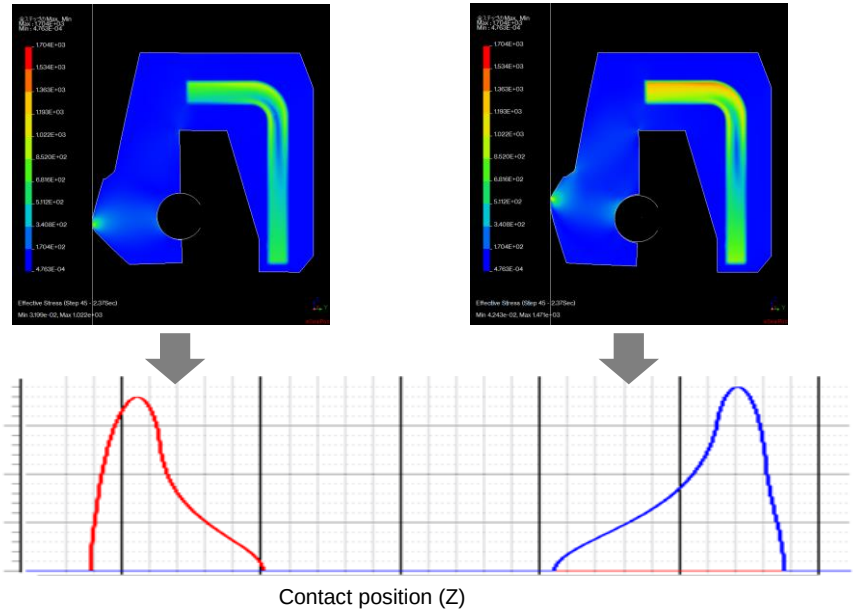
Stem Seals

Evaluation of Dynamic Sealing Performance

- Lip seals assembly and sliding -

- **Deformation shape and stress**
  - An example of changing the angle of the lip tip. (See the graph below)
  - Use maximum contact pressure and gradient to estimate the sealing performance of oil seal.

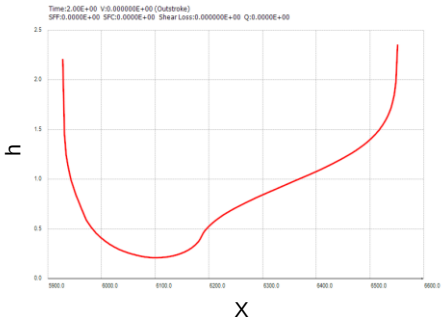




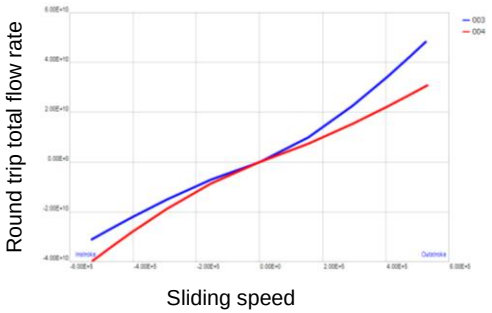
- **Contact pressure Distribution**
  - PostTool enables you to compare the quality of the shape immediately by displaying the results side by side.

- **Sliding resistance vs. reciprocating motion**
  - Estimate the history of sliding resistance against the movement of the shaft.
  - Also caluculate the force that pushes the shaft out by the lip section deformation when the direction of sliding changes.

- **Application to lubrication calculation** (NewtonSuite-RSCalc)
  - Use the data of contact pressure distribution and seal surface rigidity.
  - Calculate the fluid pressure generated by sliding, the corresponding changes in oil film thickness, leakage amount, and sliding resistance.



Oil film thickness variation



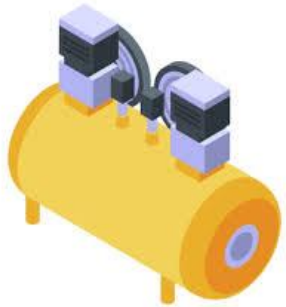
Sliding speed and leakage amount

Seal and Packing Evaluation Under Severe Operating Conditions

- Overview -

eSeal enables you to review the design of seals under conditions that are difficult to observe during testing.
It is possible to consider very high pressure and high/low temperature conditions, allowing to predict behavior of seal and evaluate the sealability under severe conditions.

Compressors

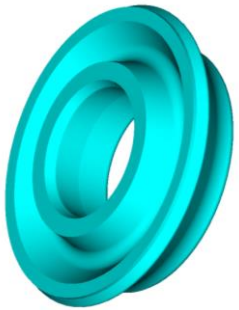



- Examples of Use -

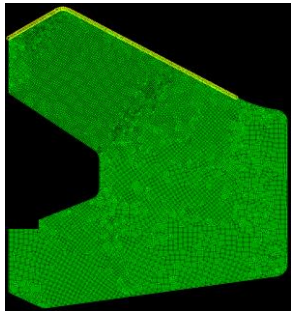
Packing for water-resistant elements
(Compressors)
Hydraulic piston seals
(Heavy machinery, CVT, Brakes)

Heavy machinery


CVT

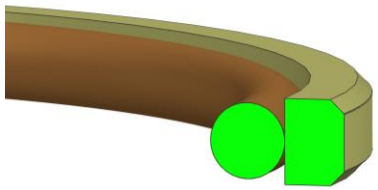


Brakes



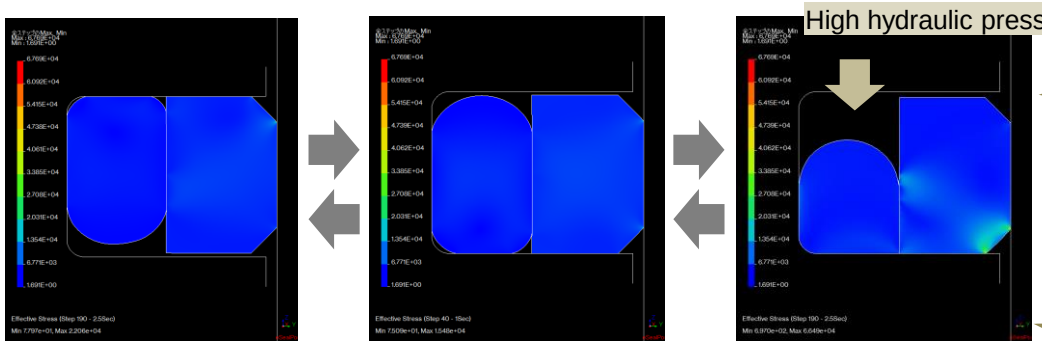
Seal and Packing Evaluation Under Severe Operating Conditions

- High pressure oil seal -



● Seal condition due to sliding cycles and changes in hydraulic pressure

Visualize the deformation of the oil seal and seal performance in each process by representing the pressure and shaft motion under analytical conditions.

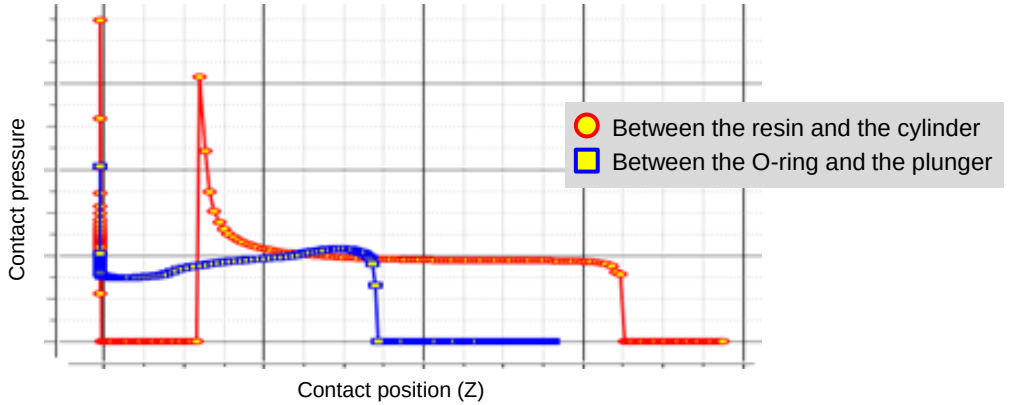


Pulling process *During assembly* *Pushing process*

● Durability and seal performance

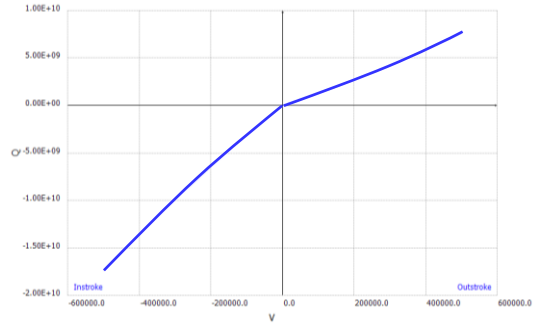
eSeal can model material properties that resists severe environments. In severe conditions where temperature and pressure fluctuate significantly, the durability of a sealing material directly affects its functionality. Even with an assembly that has passed a simple test, unpredictable problems can arise in the actual working environment.

● Contact pressure distribution



● Application to lubrication calculation（NewtonSuite-RSCalc）

- Can apply the contact pressure distribution and seal surface rigidity calculated by eSeal to the lubrication calculation tool.
- Estimate the varying oil film thickness, fluid pressure, and leakage depending on the sliding speed.



Sliding speed and leakage amount

Gasket Design Analysis Variation Resistance

- Overview -

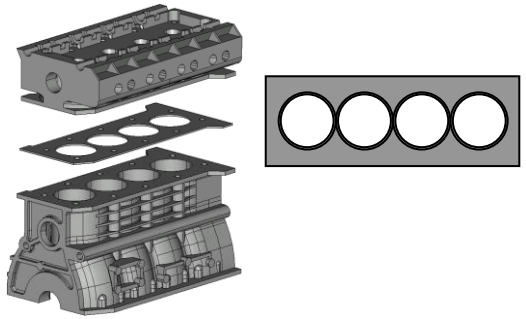
eSeal can evaluate variations in stress and seal performance under conditions of significant temperature changes. It makes sure the seal does not break with the thermal expansion and contraction of the material and it seals at the target position and force.
It makes it possible to review the shape and materials to ensure long-term seal performance reliability.

Rear seals

- Examples of use -

eSeal enables you to calculate materials with various properties such as iron, resin, and rubber.
For chemical plants and medical products, not only the shapes but also the materials that can be used differ depending on the usage environment and fillers.
It is useful in designing resin and rubber gaskets that meet your need.
In addition, you can evaluate metal gaskets used in heat exchangers such as engines and flanges, and single-piece rear seals made of steel and rubber.

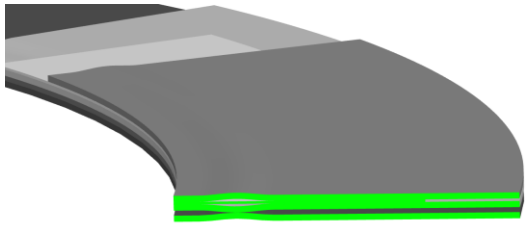
Gaskets (Engines)



Gaskets (Flanges)

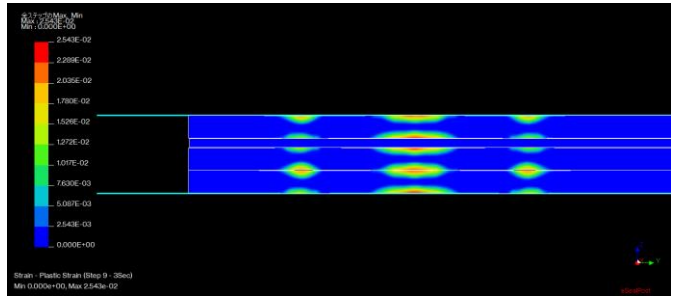
Gasket Design Analysis Variation Resistance

- Gasket deformation and recovery -

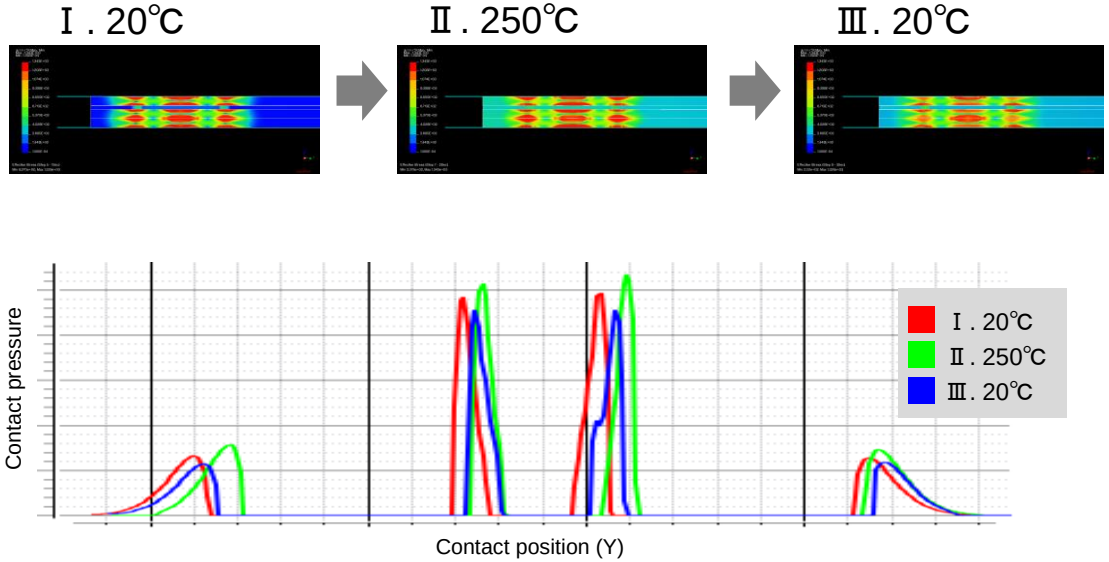


Inner sim type gasket

- **Plastic deformation of sealing materials**
  - Enables you to check the history of plastic deformation of elastoplastic materials.
  - Shows the durability of sealing materials under the cycles of expansion/contraction caused by assembly with heavy loads and significant temperature changes.



- **Temperature variation and Mises stress**
  - Represent temperature cycles in the calculation conditions.
  - Evaluate the variation of internal stress due to the thermal expansion and contraction of the sealing material.
  - Also evaluate the maintenance of sealing performance during thermal cycles based on changes in seal position due to sliding caused by that.



Changes in contact pressure distribution and seal position due to temperature change

Evaluation of Press-Fit Load, Assembly, and Closure Compression Feel

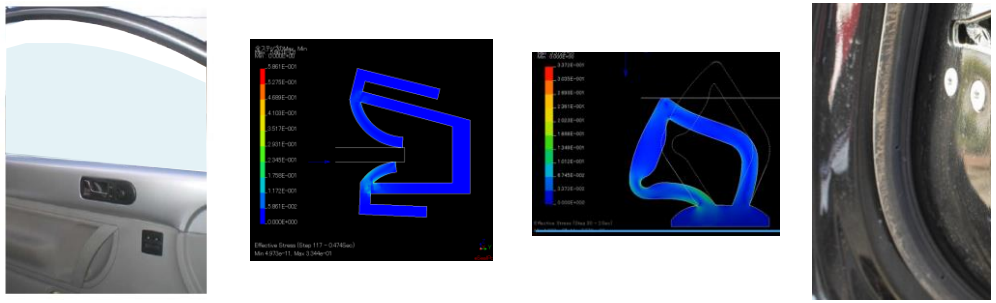
- Overview -

eSeal make it possible to evaluate the assembly by representing complex movements of assembling.
It can also analyze under the conditions where self-contact can occur, and predict sealing performance based on compression feel, closure feel, and contact pressure.

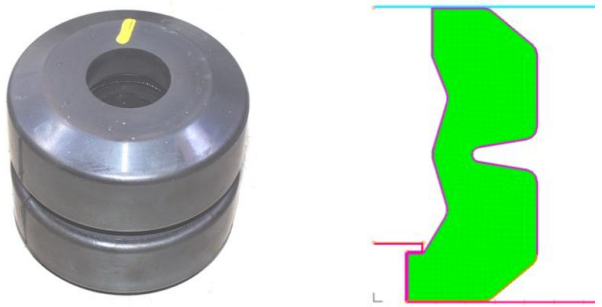
- Examples of use -

eSeal can simulate complex movements during assembly operations and perform analysis of rubber seal fitting into grooves.
You can evaluate the assembly of weather strips and glass runs by human hand and consider the shape design that meets your needs.
The analysis solver has strength on large deformation and contact and can analyze crushing even when self-contact occurs.
It can also be used for large compressions, such as in rubber springs.

Weather strips and Glass runs

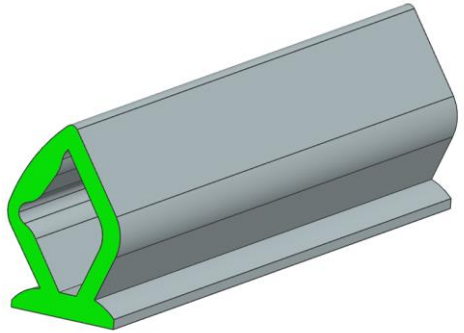


rubber springs



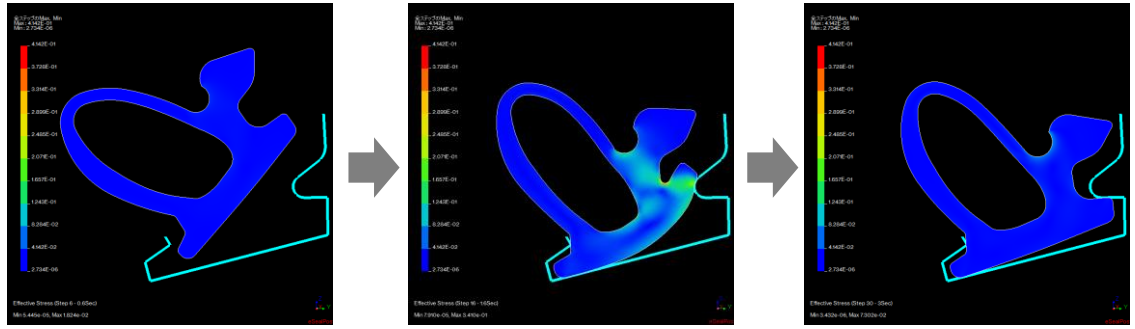
Evaluation of Press-Fit Load, Assembly, and Closure Compression Feel

- Weatherstrip compression -

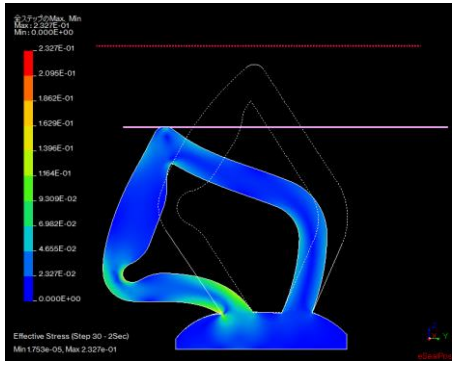


- **Predict seal performance**
  - Predict seal performance based on the compression feel, closure feel, and contact pressure.

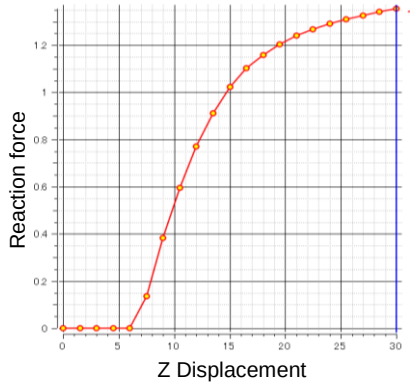
- **Analysis of assembly processes**
  - Express the assembly process by picking a specific part of the seal and moving it.
  - Predict the possibility of assembly of particular shape and design.



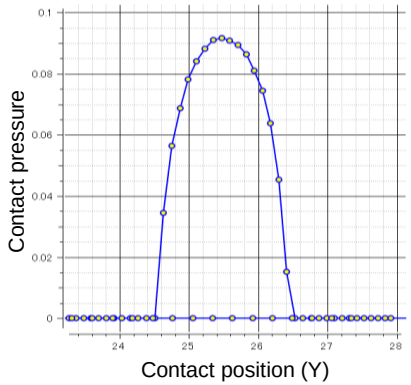
before assembly → after assembly



Deformations



Amount of compression versus Reaction force



Contact pressure distribution at assembled