

Contributing to a sustainable future mobility society

## Introduction of e-Mobility-related products



## The NOK Group contributes to an electrified society

NOK is Japan's first oil seal manufacturer.

NOK's advanced technology

The functional parts of NOK produced are:  
used in automobiles, housing equipment,  
and other equipment to support society.

Backed by NOK's technology

We provide products based on  
sealing technology and polymer blend  
processing technology.

We will also develop technologies  
in a timely manner.

We will contribute to higher functionality  
and performance by developing new items  
with a view to the future.

We aim to contribute to  
the future mobility society.



The automotive industry is undergoing major changes toward a carbon-neutral, electrified society.

**Environmental issues  
currently occurring on a global scale**

- Global warming due to CO<sub>2</sub> emissions and rising sea levels
- Air pollution
- Depletion of natural resources and energy issues etc.



- Sustainable development
- SDGs
- Carbon neutrality



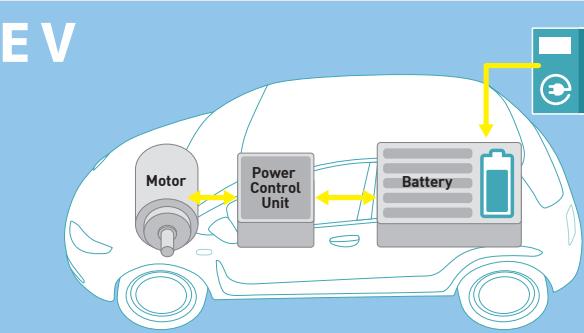
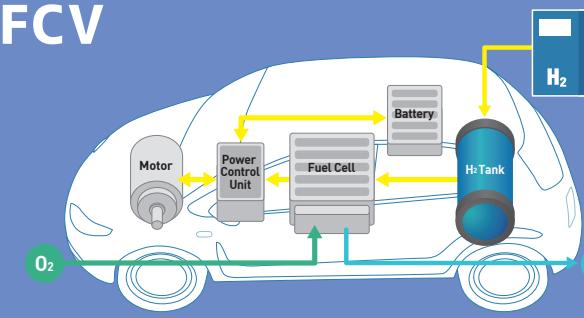
- Strengthening of regulations in various countries that are environmentally friendly
- Favorable treatment for EV vehicles
- Utilization of next-generation energy



- Technological innovation
- CASE

► 100 year period of major change

# Challenges in electrification

	Issues in electrification	NOK solutions
<b>EV</b> 	<ul style="list-style-type: none"><li>■ Support for high-speed motor rotation</li><li>■ Smaller and lighter batteries</li><li>■ Battery safety</li><li>■ Thermal management</li><li>■ Corresponding to shaft voltage</li><li>■ Further quietness</li></ul>	<ul style="list-style-type: none"><li>⇒ <b>High-speed rotary oil seal</b></li><li>⇒ <b>FPC for voltage monitoring system</b></li><li>⇒ <b>Flame-retardant rubber, explosion-proof valve</b></li><li>⇒ <b>Heat conduction member</b></li><li>⇒ <b>Conductive seal</b></li><li>⇒ <b>Vibration and sound isolation technologies</b></li></ul>
<b>FCV</b> 	<ul style="list-style-type: none"><li>■ Can be used in hydrogen environments</li><li>■ Improved durability</li><li>■ Improved power generation efficiency</li><li>■ Improved productivity</li></ul>	<ul style="list-style-type: none"><li>⇒ <b>Hydrogen-resistant rubber and grease</b></li><li>⇒ <b>Low-elution materials</b></li><li>⇒ <b>Humidification membrane module</b></li><li>⇒ <b>Fuel cell gasket</b></li></ul>

To solve various electrification issues

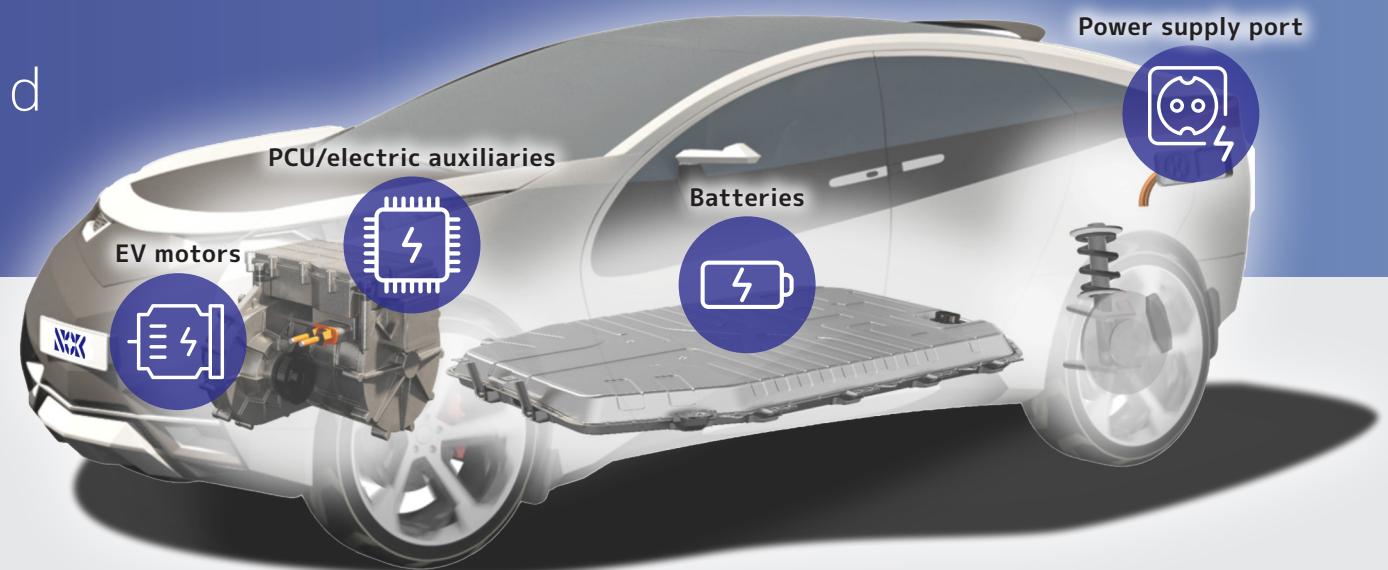
**NOK's advanced technology will provide the best solution**

# In the e-Mobility field

## Main products

**PLAY MOVIE ►**

"The NOK for e-Mobility"



Support for low friction and high peripheral speed

► [Low-friction oil seal](#)  
 ► [self-lubricating rubber](#)  
 ► [High-speed rotary oil seal](#)

Anti-Vibration/ Soundproofing

► [High-Performance Anti-Vibration Rubber](#)

Space saving and weight reduction

► [Space-saving rubber-bonded gaskets](#)  
 ► [Multichannel switching valve seal](#)  
 ► [Automotive FPC](#)

Heat Insulation/ Flame Retardation

► [flame retardant rubber](#)  
 ► [Flame Retardant Insulating Rubber](#)

Displacement Absorption

► [cushion rubber](#)  
 ► [Pipe fitting seal \(pipe connector seal\)](#)

Measures Against Electromagnetic Noise and Electrocorrosion

► [Conductive Ring](#)

Thermal Conduction

► [Thermally conductive material](#)

Salt compatible

► [Aluminum anti-corrosion seal and grease](#)  
 ► [Aluminum anti-corrosion coated seal](#)

Pressure adjustment and explosion proof

► [Pressure control valve series](#)

High voltage compatible

► [Tracking Resistant Rubber](#)

**Low Friction**

# Low Friction Technology

- ▶ Reduces friction and sliding heat, resulting in low fuel consumption and electricity costs



EV Motor

Contributes to the global environment with low friction technology

## Four friction reduction technologies

**Shape design technology****Material design technology****Surface function design technology****Grease technology****Oil seal**

For rotating parts such as motors  
Reduces friction loss while maintaining sealing performance!

**Thin film surface treated O-ring**

Achieves smooth insertion during O-ring assembly!  
In addition, reduces machine downtime!

**CNT-added Oval ring**

Sealing performance is maintained under high-pressure reciprocating environments in hydraulic circuits. Friction loss is reduced!

**Low torque seal ring for rotation**

Maintains hydraulic pressure at the rotating part in the hydraulic circuit  
Reduces friction loss!

**Rotating and rocking rod seals**

Friction loss is reduced while sealing performance is maintained in rotating and swinging parts under high pressure!

Low Friction

# Self-lubricating rubber

- ▶ Reduces friction in harsh lubrication environments, contributing to energy conservation, low fuel consumption, and low electricity costs

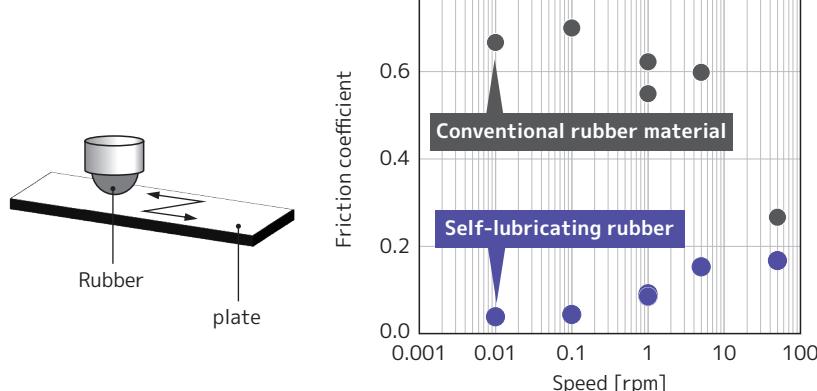


EV Motor

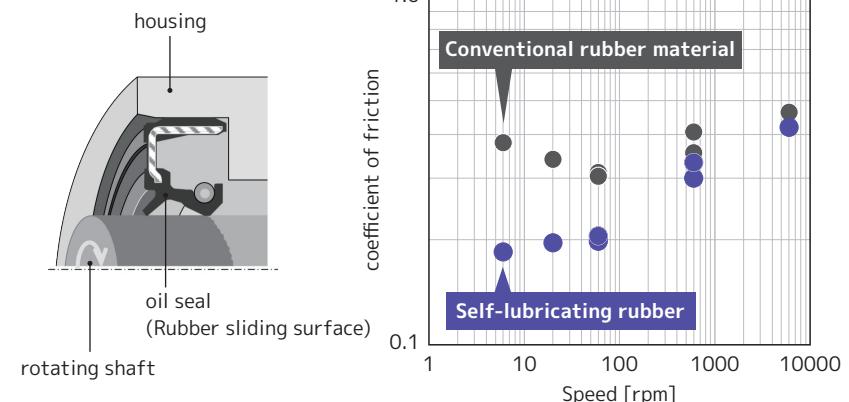
Lubricating oil is maintained at the sliding surface by incorporating rubber.

According to the results of each friction test of conventional rubber material and self-lubricating rubber, self-lubricating rubber suppresses the rise of friction

Pin-on-plate test (reciprocating motion)



Oil seal shape test (rotation)



Support for high peripheral speeds

# High-speed rotary oil seal

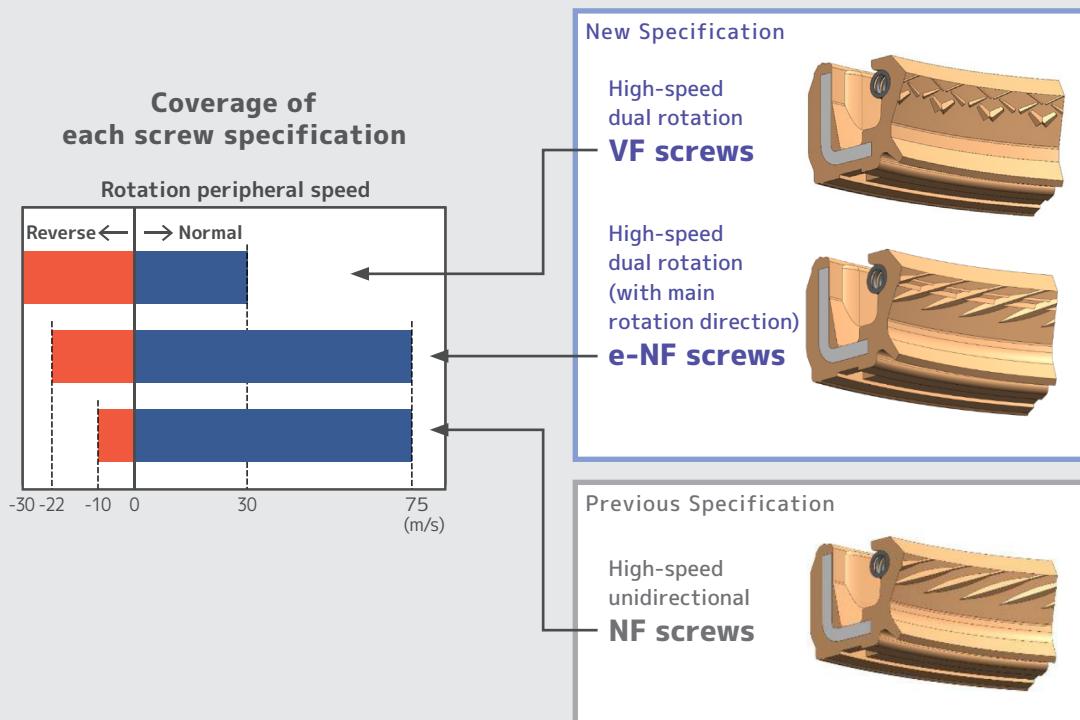
- Support for high speed, normal/reverse rotation Contributes to low fuel consumption and cost



EV Motor

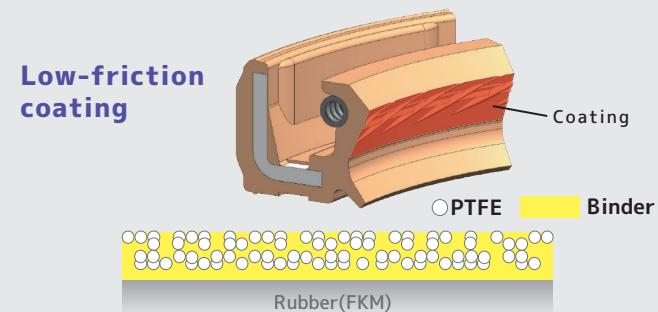
## Supports high-speed forward and reverse rotation

New specification VF screws and e-NF screws ensure peripheral speed even in reverse rotation

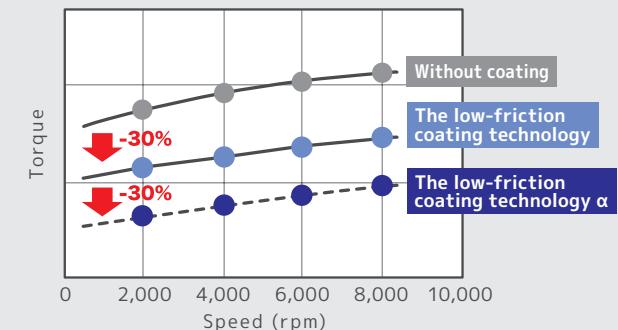


## Supports low fuel consumption and electricity costs

Reduces friction and sliding heat by adding low-friction coating



## Torque test with and without coating



## Measures against electromagnetic noise and electric corrosion

# Conductive ring

- Space saving and cost reduction  
(compared to conventional structure)

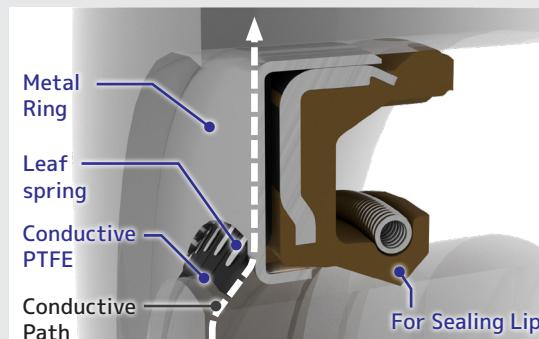


EV Motor

## Noise and electric corrosion suppression

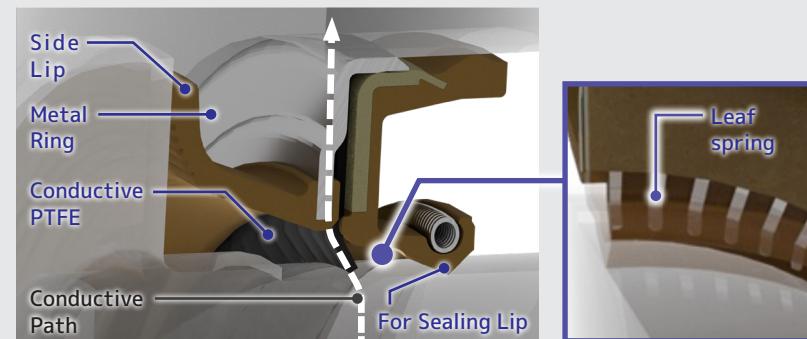
Conducting the shaft and housing to suppress electromagnetic noise and electric corrosion of the bearing due to electrification of the motor drive shaft

### Oil Seal + Conductive PTFE



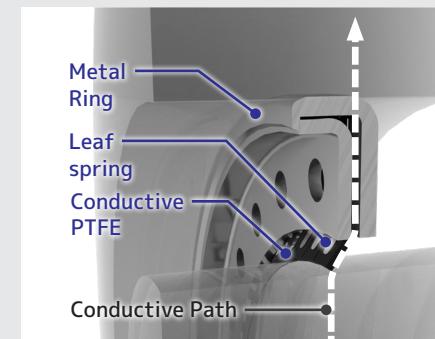
- Integrated oil seal
- Low resistance

### Differential Side Oil Seal + Conductive PTFE



- Integrated oil seal
- Space saving
- Low resistance

### Conductive PTFE



- Can be used in oil environment
- Low resistance

**Can be used in both oil and dry environments**

## Countermeasures against salt damage

Gasket grease that enhances salt water corrosion resistance of aluminum casing seal surface

# Aluminum anti-corrosion seal and grease

► Reduces cost and man-hours compared to existing rust prevention treatments

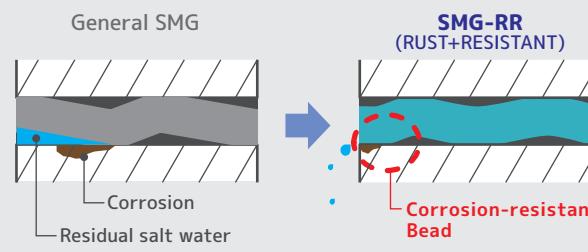
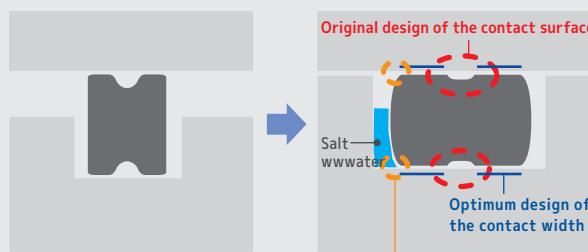


EV Motor

PCU/  
Electric Auxiliary  
Devices

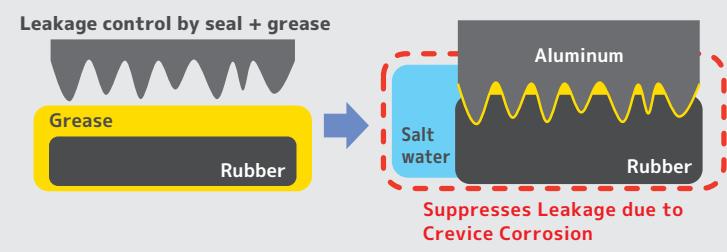
Batteries

## Seal for Anti-corrosive seal & grease for aluminum parts

Anti-corrosive seal & grease  
for aluminum parts rubber gasketAnti-corrosive seal & grease  
for aluminum parts Rubber-coated metal gaskets

Longer life of the unit is achieved by a shape design that extends corrosion life

## Grease for Anti-corrosive seal & grease for aluminum parts

KLÜBERGREASE LFT 71-402  
For NBR/HNBR/ACMNOXLUB AU 0710  
For EPDM/VMQ/FKM

Anti-corrosive seal & grease for aluminum parts  
can be used in combination with various gaskets  
to further suppress crevice corrosion of aluminum

## Response to salt damage

# Aluminum anti-corrosion coated seal

- Additional coating for unique cross section further improves salt water corrosion resistance



EV Motor

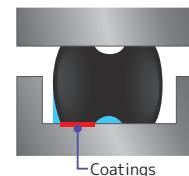
PCU/  
Electric Auxiliary  
Devices

Batteries

Rubber gasket  
for aluminum corrosion protection

## Comparison of saltwater corrosion resistance

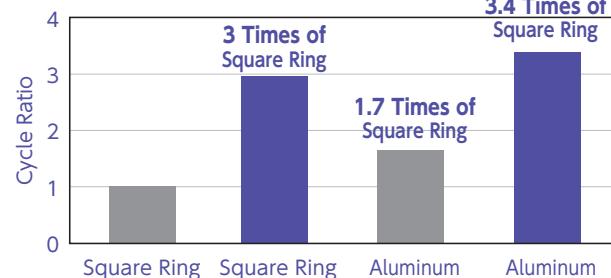
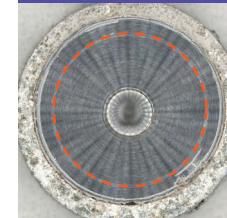
By coating  
Achieves about 3.4 times  
saltwater corrosion resistance



## No coating



## With coating



--- Seal Line

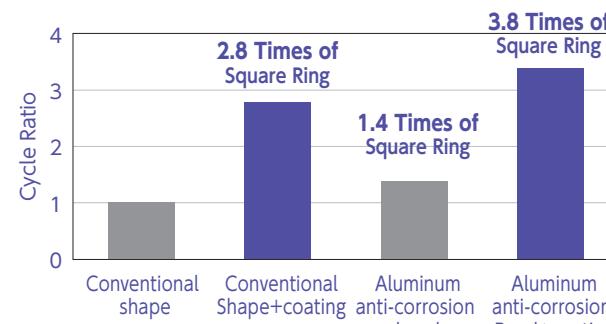
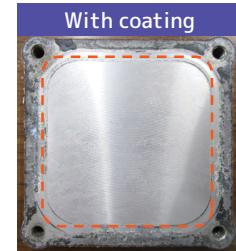
Rubber-coated metal gaskets  
for Aluminum Corrosion Protection

## Comparison of saltwater corrosion resistance

By coating  
Achieved about 3.8 times  
saltwater corrosion resistance



Coatings

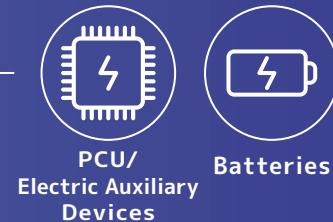


--- Seal Line

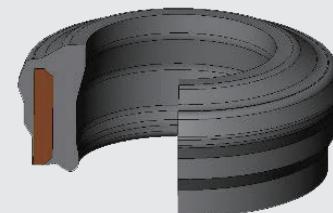
Space-saving and lightweight

# Space-saving rubber-bonded gaskets

- Space saving compared to conventional design

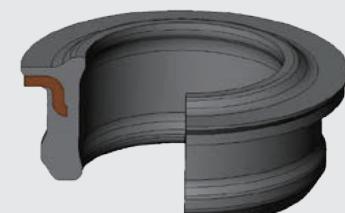


Bonded gasket capable of reducing size and weight of unit



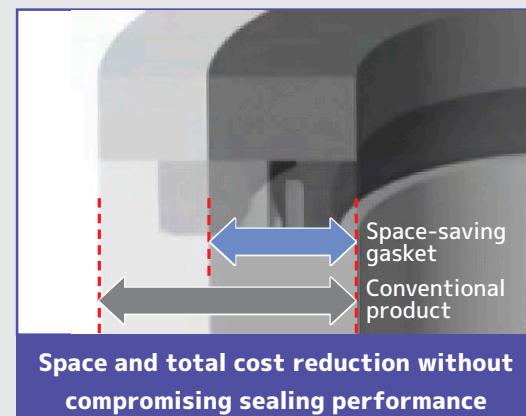
Cylindrical type

Patent No. 6502318

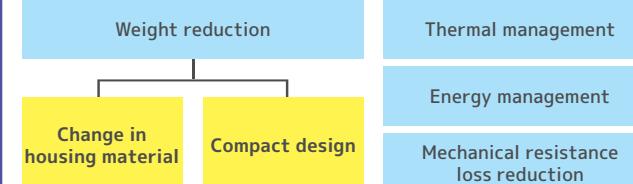


Flange type

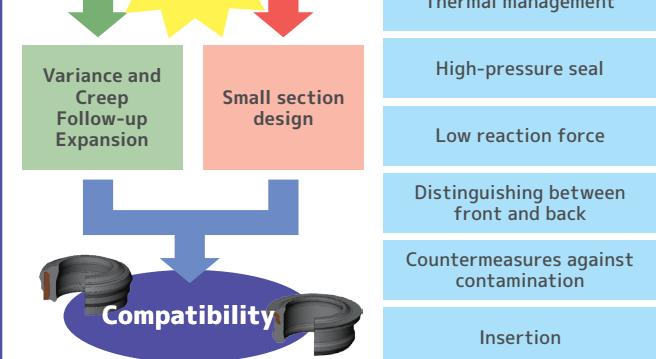
Patent No. 6591569



## Realization of low fuel consumption



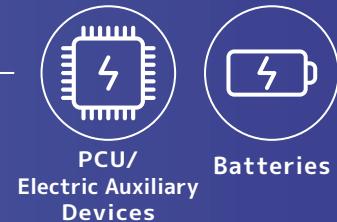
Conflicting



Space-saving and lightweight

# Multichannel switching valve seal

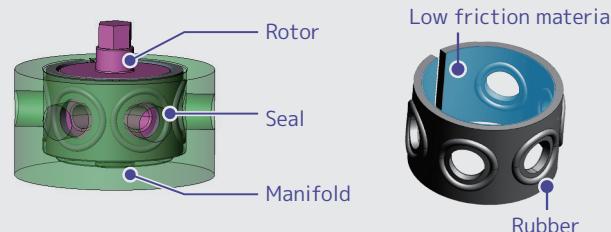
- Miniaturization of unit by combining sealing performance and low torque



## Proposed optimal seal products for multi-channel switching valves

- PTFE (Fluororesin) and rubber molded integrally  
Offered products tailored to cooling modules
- NOK's proprietary analysis technology provides optimum seal structure

### Roller Type



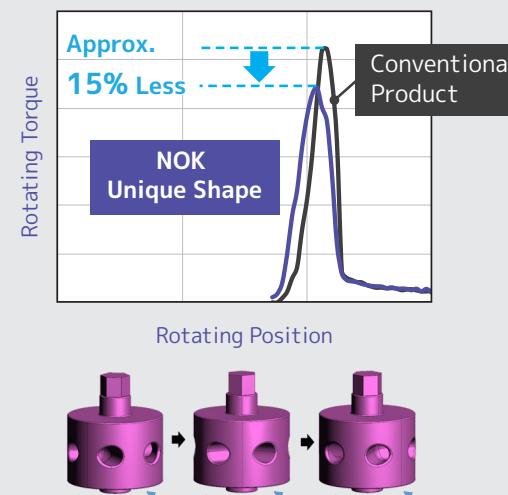
### Disk Type



## Unique shape achieves high seal performance and low torque, contributing to unit miniaturization

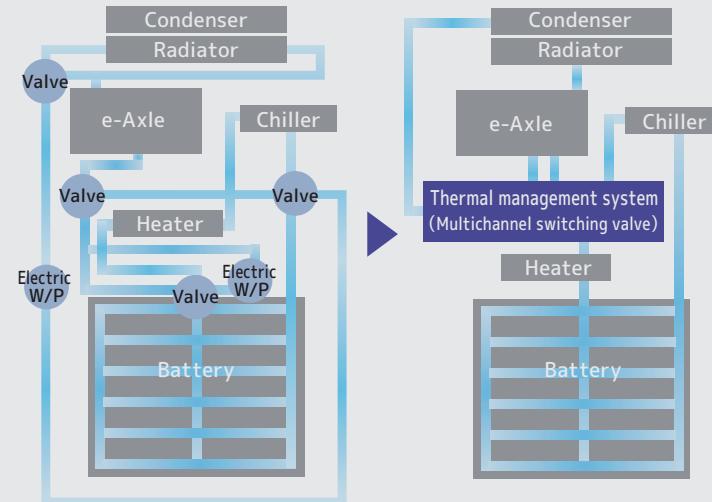
### Torque performance

- Approximately 10% reduction in torque compared to conventional products Contributes to unit miniaturization



## Example of thermal management system

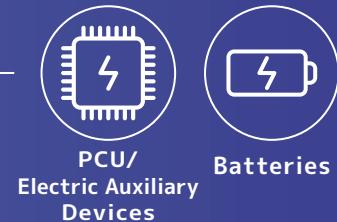
- Space saving and weight reduction by reducing piping, valves, and W/P
- Limited heat energy can be used without waste



Space-saving and lightweight

# Automotive FPC

- Space saving compared to conventional design, FPC connection contributes to miniaturization of case



Thin, light and durable flexible printed circuit boards (FPC)



INFOTAINMENT



For LCD connection



LIGHTING



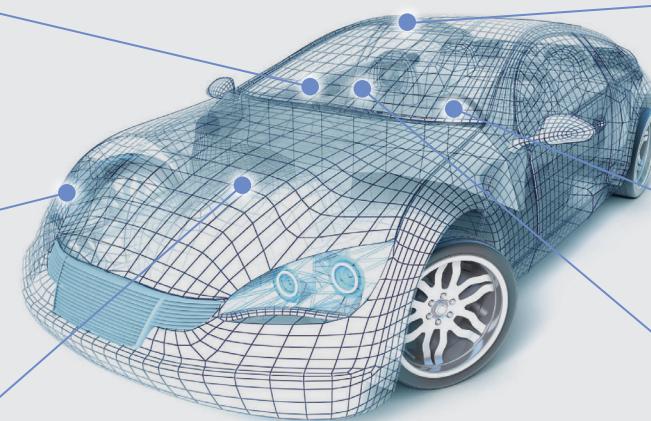
For daytime running lights



POWERTRAIN



For battery voltage monitoring



For image sensors



For column switches



For window connectors



SENSOR



SWITCHES



OTHERS

Total cost reduction  
Integrated board and wiring

Weight  
reduction

High heat  
resistance

Space saving

Three-dimensional  
wiring

Improved  
reliability

Component  
mounting

## Vibration and soundproofing

# High-performance vibration-proof rubber

## ► Reduction of sound and vibration caused by e-Mobility



PCU/  
Electric Auxiliary  
Devices



Batteries

Providing optimal NVH solutions to solve vibration and noise problems

## NOK's 3 proprietary technologies

### Optimal shape design technology

Designing and proposing optimal product shapes based on a wide range of vibration and soundproofing technologies

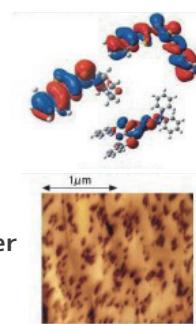


### High-performance rubber material technology

We offer a wide range of materials, including High damping rubber, which has excellent damping performance

Submicron range

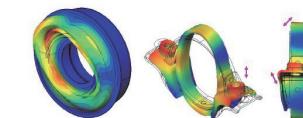
Design of rubber properties



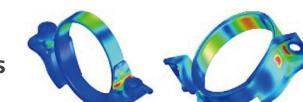
### Optimal shape design technology

Designing and proposing optimal product shapes based on a wide range of vibration and soundproofing technologies

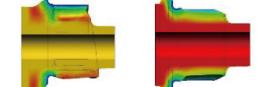
Eigenvalue analysis



Stress analysis

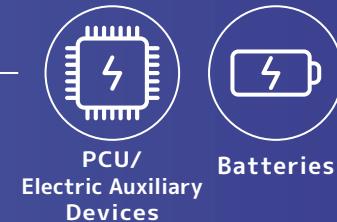


Prediction of spring characteristics

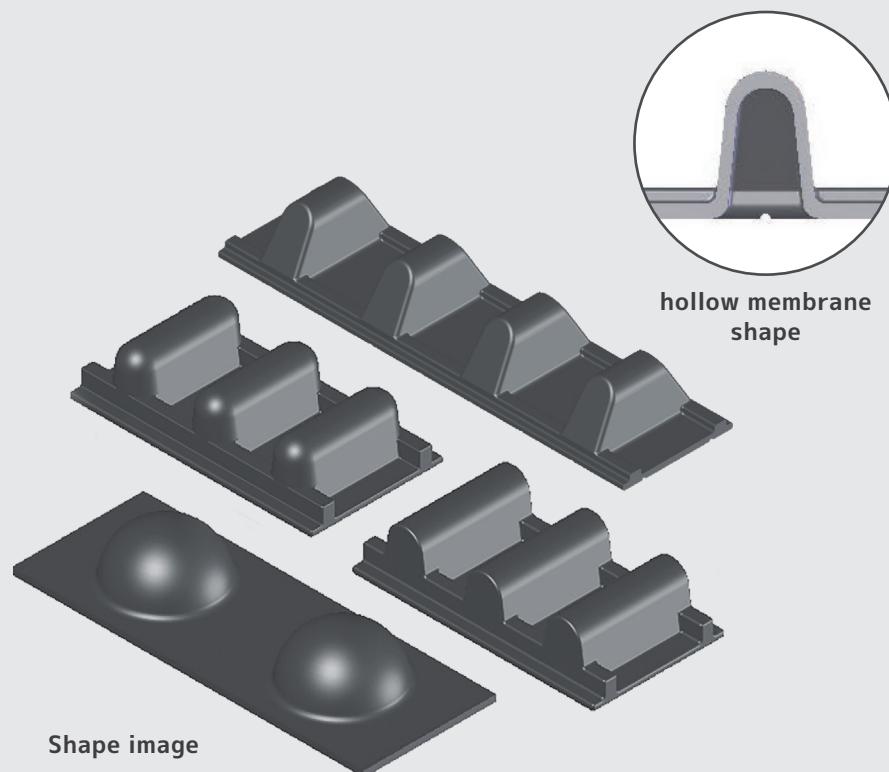


**Displacement Absorption****Large deformation cushioning rubber **cushion rubber****

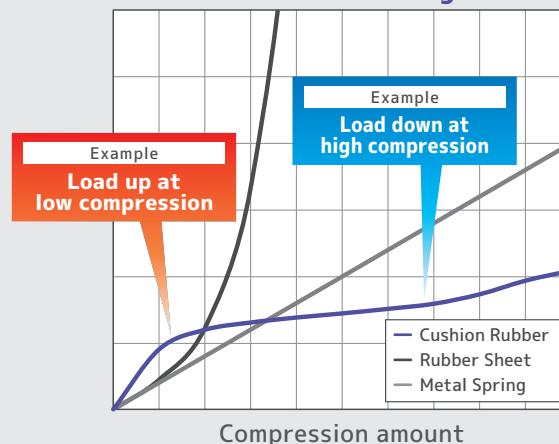
- Achieves both large deformation and low reaction force



Cushioning material with hollow structure that fills gaps between units and prevents rattling



**Load characteristics image**



**NOK's technological superiority points** ○: Excellent, △: Fair, ×: Poor

	Features	Rubber sheet	Metal spring	Sponge	Cushion Rubber
①	Large Deformation	×	○	○	○
②	Low Reaction Force	×	○	○	○
③	Load Control	△	△	△	○
④	①②③ Combination	×	×	△	○

## Displacement Absorption

# Pipe fitting seal (pipe connector seal)

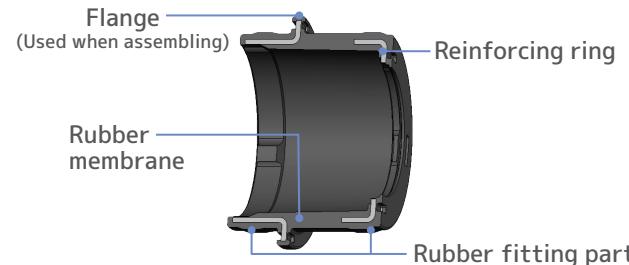
- ▶ Seals specialized for eccentricity following between piping



EV Motor

Since it is an integrated molded product, it can be mounted simply by press-fitting into the joint of eccentric piping.

## Integral molding structure of rubber and metal tube

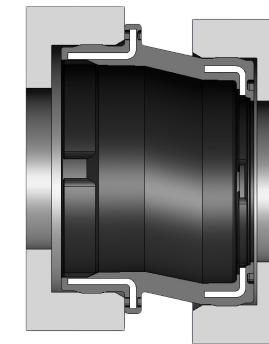
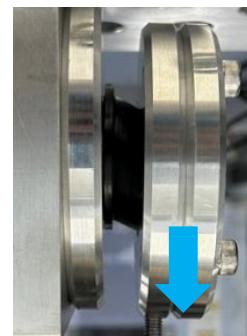


Can be customized to meet your needs



## Evaluation of eccentricity followability

Evaluation of leakage pressure when internal pressure is applied with eccentricity. No leakage even at 0.5 MPa air pressure and 5 mm eccentricity

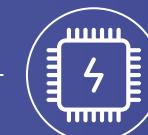


Improvement of seal reliability with rubber fitting design technology equivalent to oil seals

## Heat conduction

# Thermally conductive material

- ▶ Thermal management component that efficiently transmits heat with original concept



PCU/  
Electric Auxiliary  
Devices



Batteries



Power Supply  
Port

## 『QLEASE』series

New concept heat conduction member that differs from conventional heat dissipation sheets by improving heat transfer and adhesion. Utilizing NOK's technology accumulated over the years, the heat is efficiently transmitted by eliminating the insulation layer of air between the heat source and heat dissipation member as much as possible.

	Thermally conductive material			
	Rubber type	Clay Type	Cross Type	Resin Type
Schematic				
Hardness	Medium Hardness *Durometer A60	Soft (Low)	Soft & Hard (Low)	Hard (High) *Rockwell R110
Thermal conductivity	+	+++	++	++++
Degree of adhesion (integral molding)	++(++)	+++	+++	+ (++)
Handle ability	+++	++	+++	+++
Heat resistance	+	++	++	+++

## Heat conduction

# Clay-like thermally conductive material

- ▶ Fits freely in complex and uneven spaces to achieve a high heat dissipation effect



PCU/  
Electric Auxiliary  
Devices



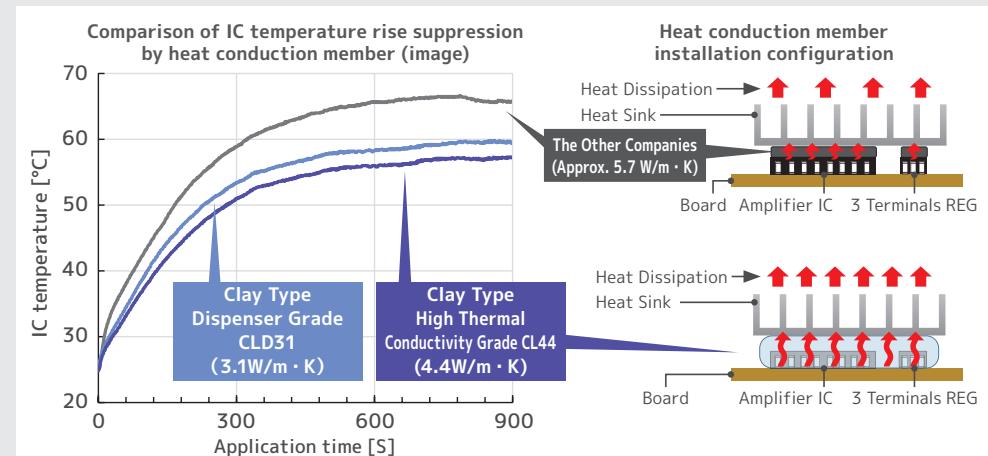
Batteries



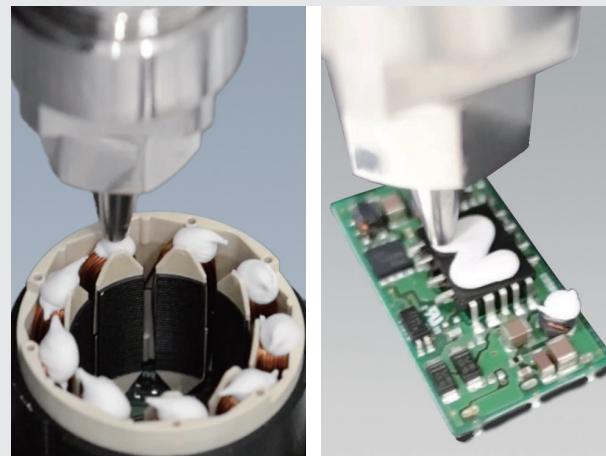
Power Supply  
Port

Soft clay type, available in three grades according to application

## High heat conduction grade for parts requiring higher heat dissipation



## Dispenser grade contributing to automation



Item	Product grade	
	Dispenser Grade CLD31 (Developed Product)	High Thermal Conductivity Grade CL 44 (Developed Product)
Hardness (unworked penetration)	220	120
Thermal Conductivity	W/m · K 3.1	4.4
Dielectric Breakdown Strength (AC)	kV/mm 4.5	8.4
Low-Molecule Siloxane (D3 to D10)	ppm 56	44

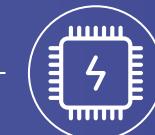
\*Clay-like thermally conductive material complies with REACH regulations and complies with the RoHS Directive.

\*CL44 and CLD31 are products under development. Specifications are subject to change without notice.

## Heat conduction

# Thermally conductive rubber

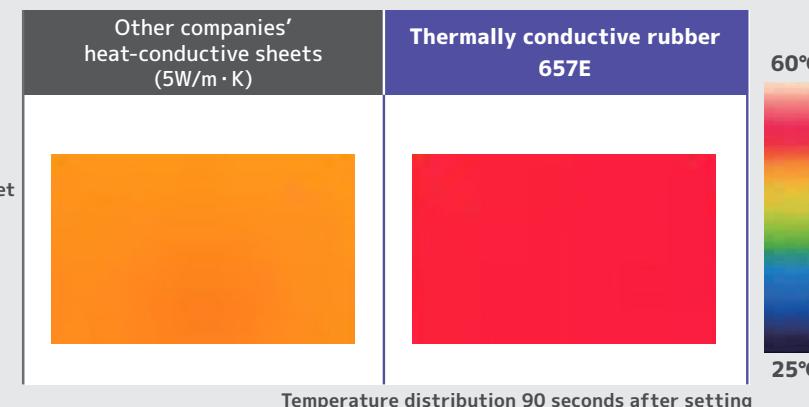
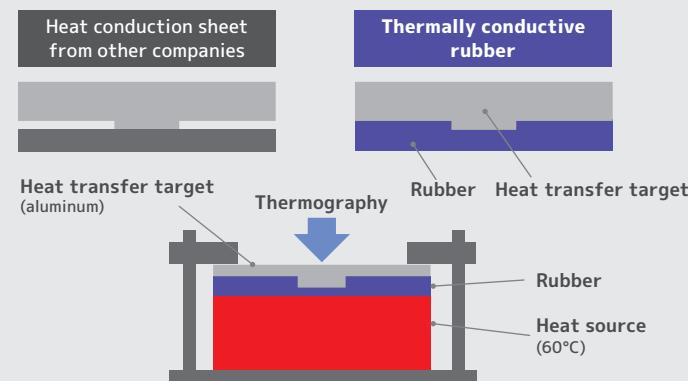
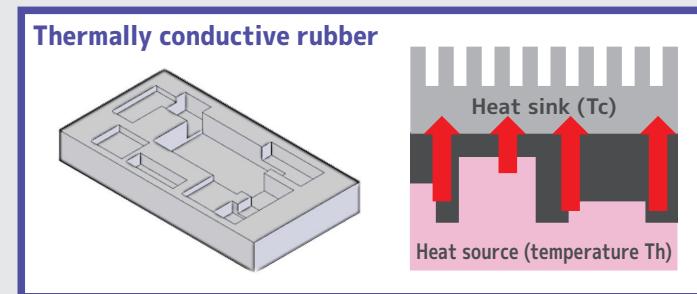
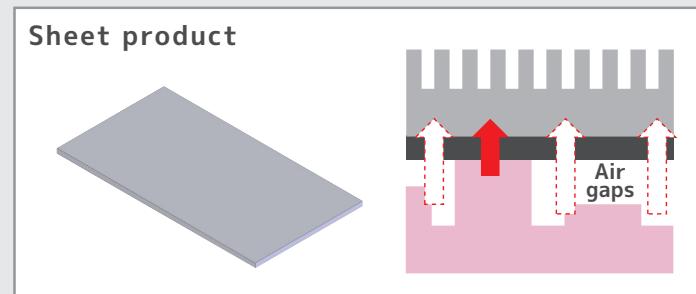
- **High Heat Dissipation Effect**  
Achieved with Rubber Shaped Along Heating Element

PCU/  
Electric Auxiliary  
Devices

Batteries

Power Supply  
Port

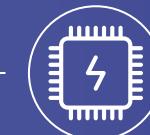
High heat dissipation effect achieved by eliminating air gaps with rubber shaped along the heating element



## Heat conduction

# Hybrid thermal conductive material

- Handability and heat dissipation at the same time, excellent workability and automation are possible



PCU/  
Electric Auxiliary  
Devices

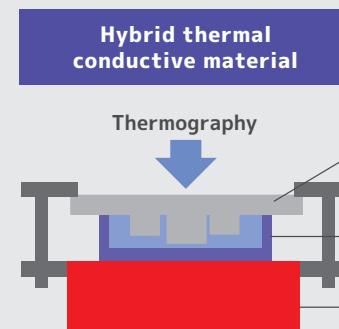
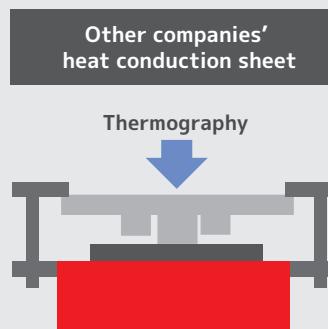
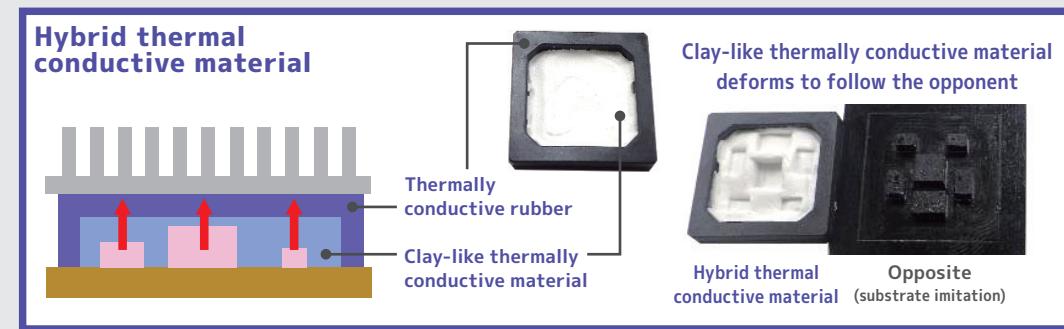
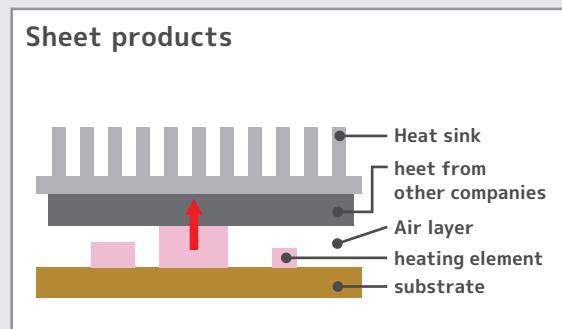


Batteries



Power Supply  
Port

The heating element is gently wrapped in clay and surrounded by heat-conducting rubber.



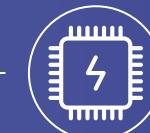
	Heat conduction sheet from other companies (5W/m·K)	Hybrid thermal conductive material Clay Type: 3.1 W/m·K Rubber Type : 1.2 W/m·K
Initial		
After 75 seconds		
After 150 seconds		



## Heat conduction

# Thermally conductive insulating resin

- ▶ High heat dissipation and high heat resistance contribute to weight reduction by replacing metal parts

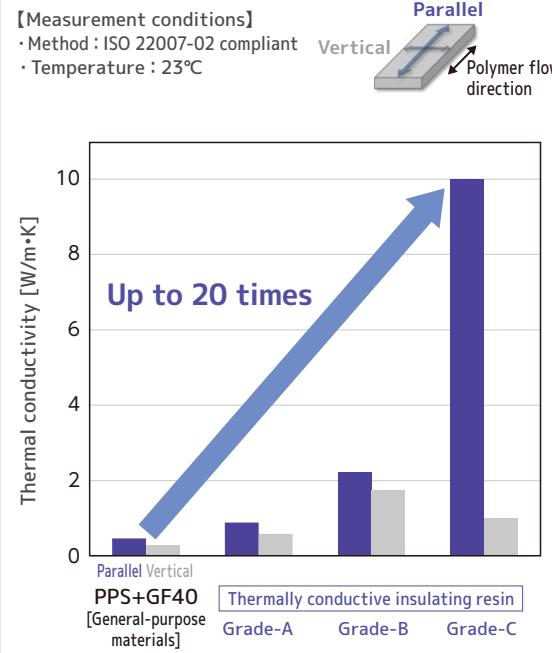
PCU/  
Electric Auxiliary  
Devices

Batteries

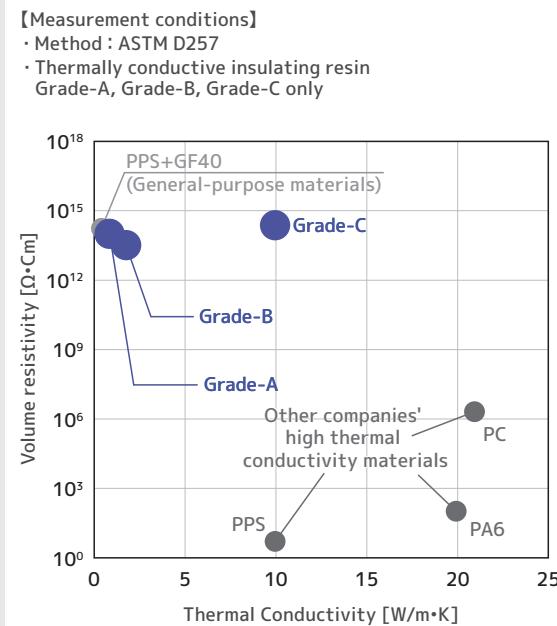
Power Supply  
Port

Can be molded with high precision, has high heat resistance, and can be used continuously at up to 220°C.

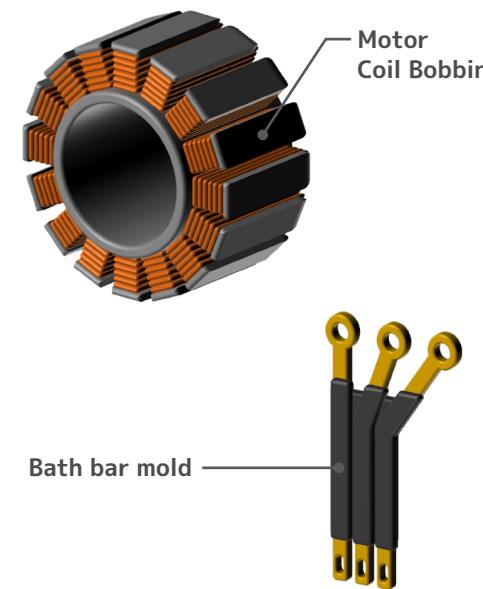
## Thermal conductivity



## Volume low efficiency



## Example applications



Pressure control and explosion-proof

# Pressure control valve series

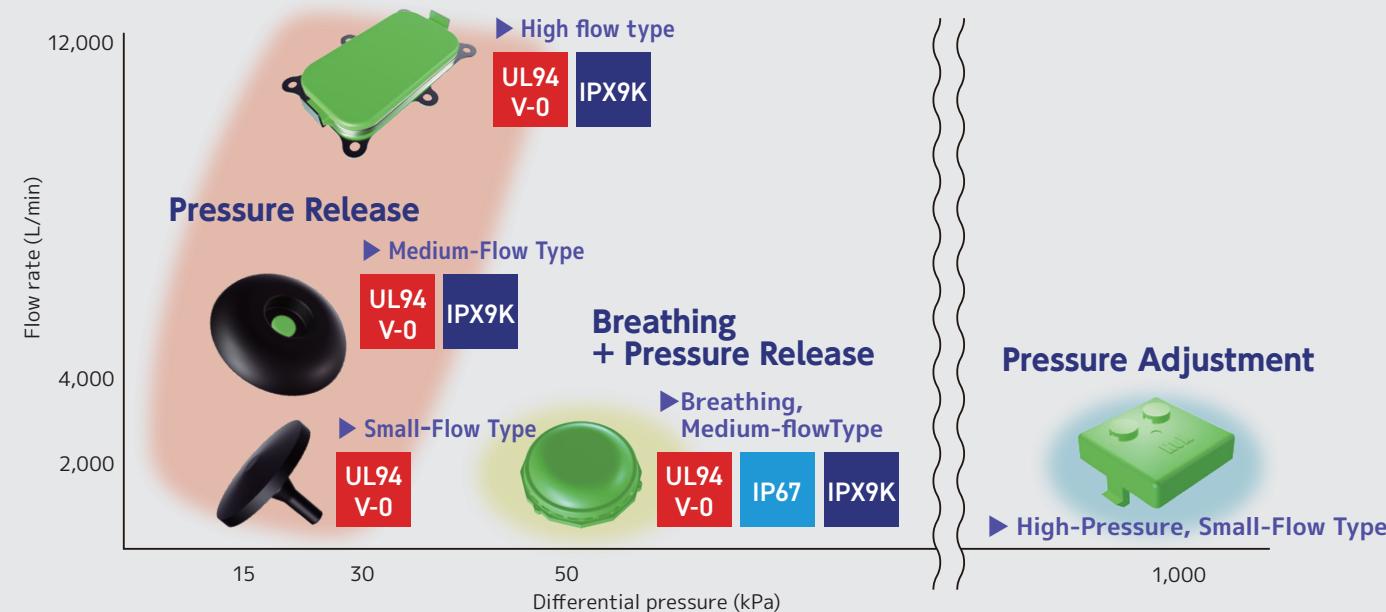
- ▶ A lineup of 5 types that can be selected according to valve opening pressure, flow rate, and application



Batteries

By attaching to the EV battery case

When a large amount of gas is generated due to thermal runaway in the battery, an appropriate amount of gas is released to the outside



## Pressure control and explosion-proof

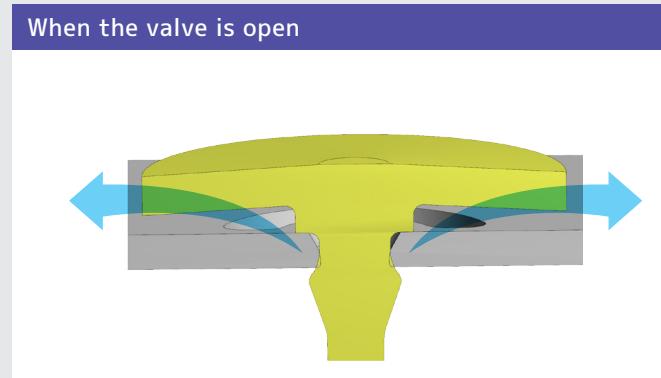
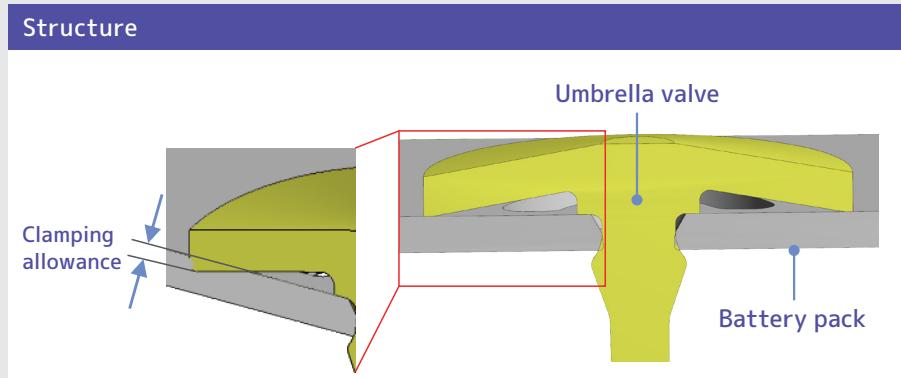
Pressure control valve **Small-flow type**

- ▶ Simple structure with only rubber valve opening



Batteries

Release increased internal pressure only by opening the umbrella valve

**Specifications and Main Features**

- Flame Retardant Standard UL94 V-0 Equivalent (EPDM Material)
- Compatible with a flow rate of 150 L/min
- Specifications can be set according to valve opening pressure by controlling rubber hardness and tightness

## Pressure control and explosion-proof

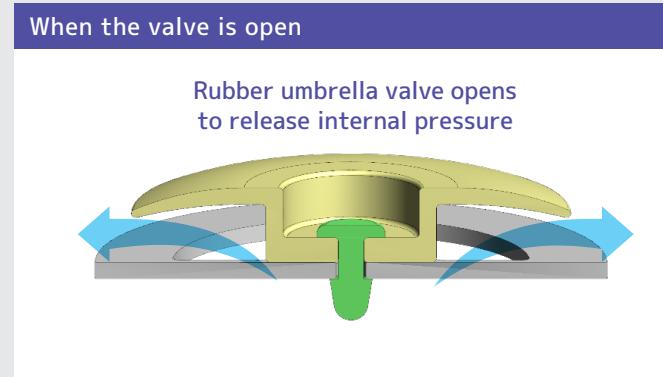
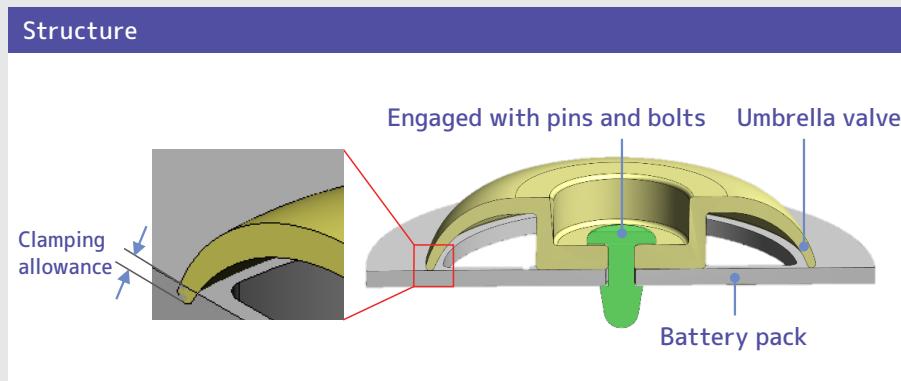
Pressure control valve **Middle-flow type**

► Middle flow pressure release with simple structure



Batteries

Simple structure of umbrella valve and pin releases increased internal pressure

**Specifications and Main Features**

- Waterproof and dustproof standard IPX9K compatible (can be set as desired)
- Flame Retardant Standard UL94 V-0 equivalent (EPDM material)
- Rubber hardness and tightness control allows specification according to valve opening pressure
- Easy installation

## Pressure control and explosion-proof

Pressure control valve **High Flow Type**

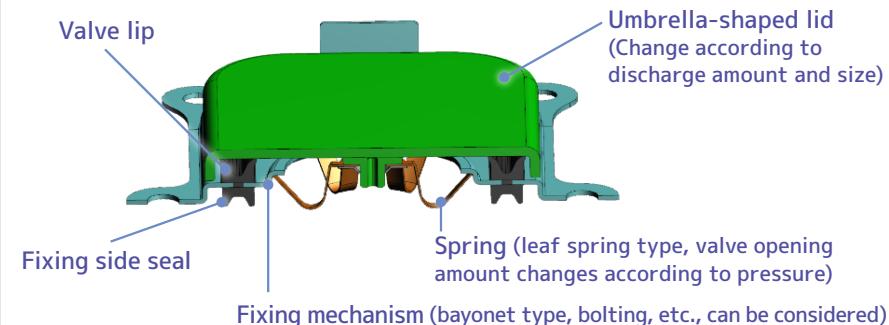
## ► Low Pressure Open/Large Flow



Batteries

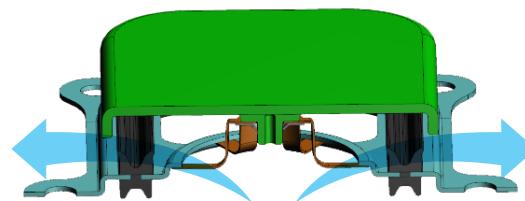
Achieves a high flow rate of 12,000 L/min at a differential pressure of 30 kPa

## Structure



## When the valve is open

Internal plate integrated valve  
Large flow pressure release achieved by spring repulsion.

Specifications  
and  
Main Features

- Compatible with IPX9K waterproof and dustproof standards
- Equivalent to UL94 V-0 flame retardant standards
- Shuts off oxygen inflow, prevents fire spread
- Specifications can be set according to valve opening pressure by controlling lid diameter and spring repulsion force
- Can be installed with one touch (by selecting bayonet fixing mechanism)

## Pressure adjustment and explosion-proof

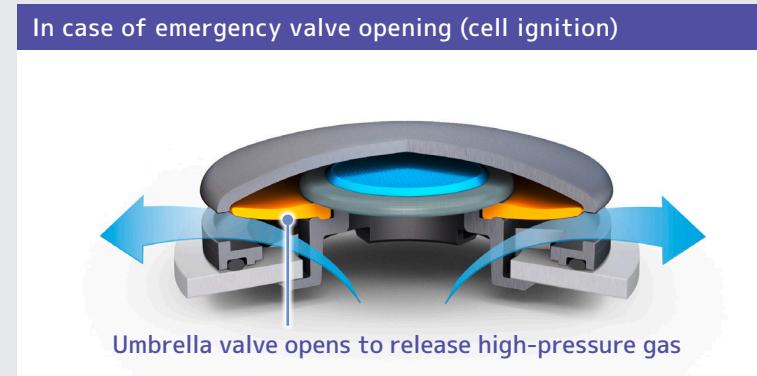
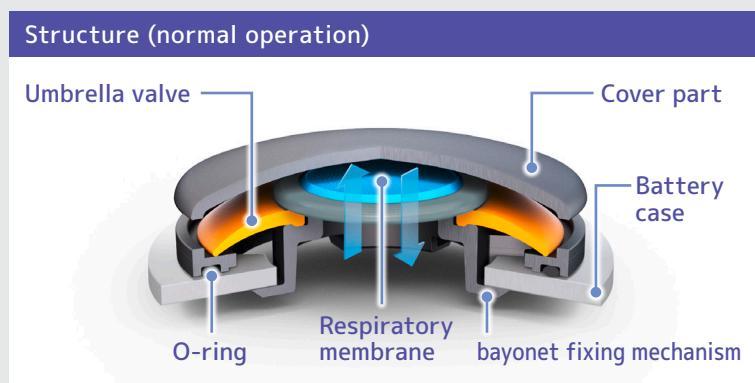
Pressure control valve **breathing, medium-flow type "Diavent"**

► The breathing membrane and waste valve are integrated, contributing to a lighter and more compact battery case



Batteries

Pressure is adjusted for normal operation. High-pressure gas is released for emergency.

**Specifications  
and  
Main Features**

- Compatible with waterproof and dustproof standards IP67 and IPX9K
- Equivalent to flame retardant UL94 V-0
- High flow type with large gas emissions in case of emergency is also available (compatible with large battery pack)
- Can be installed with one touch

Pressure adjustment and explosion proof

# Pressure control valve **High-pressure, small-flow rate type**

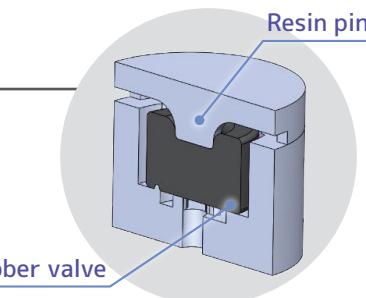
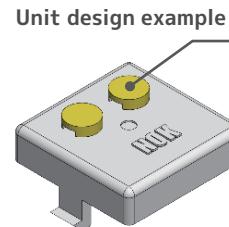
► Compact and space-saving while meeting high valve opening pressure requirements



Batteries

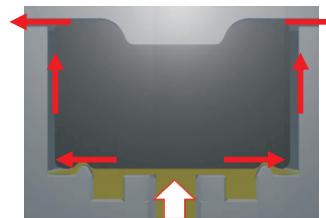
Internal plate integrated valve releases large flow pressure by spring repulsion

## Structure



## When valve is open

Valve opening pressure is controlled by controlling seal surface pressure with valve structure.



## Specifications and Main Features

- Can be used repeatedly without valve replacement
- Supports high pressure
- Space saving design with  $\phi 6\sim$  valve diameter
- Can seal gas, electrolyte, etc.
- Can be used in low temperature environments (when cold resistant rubber is used for valve part)

Thermal insulation and flame retardancy

# Flame retardant rubber

► Contributing to improved flame retardancy in electric vehicle units



Batteries

High flame retardancy EPDM material equivalent to UL94 V-0

	General-purpose EPDM	Flame-retardant EPDM
<b>Condition after combustion</b>		
Combustion	Fire spread	Fire suppression
Low-temperature properties	○	○
Volume Specific Resistance	○	○
Durability (Compressive Permanent Strain)	◎	◎
Flame Retardant UL94	Not Supported	<b>V-0 Equivalent</b>

◎:Excellent ○:Good

Low | HB | V-2 | V-1 | V-0 | High

## Thermal insulation and flame retardancy test

# Flame Retardant Insulating Rubber

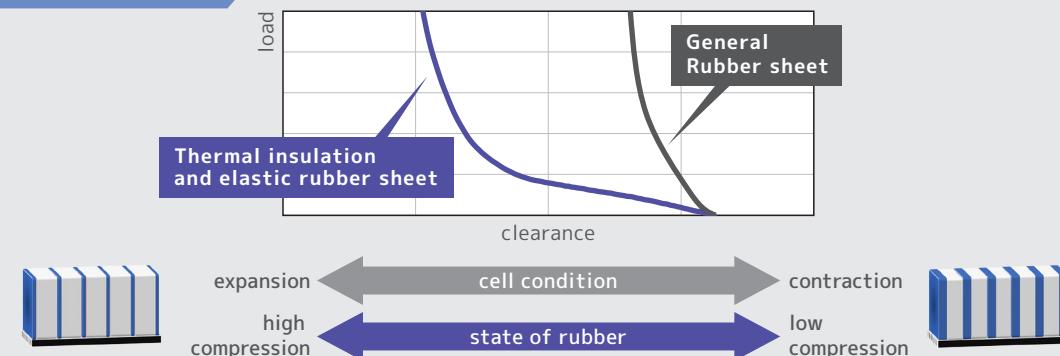
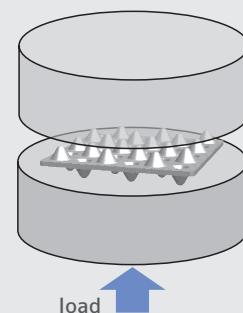
- ▶ Suppresses degradation of battery performance and improves battery safety through thermal insulation and flame retardancy



Batteries

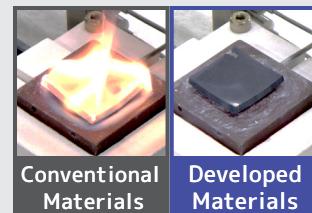
Ensure a constant reaction force and support the cell with an appropriate load.

Reaction force characteristic measurement test

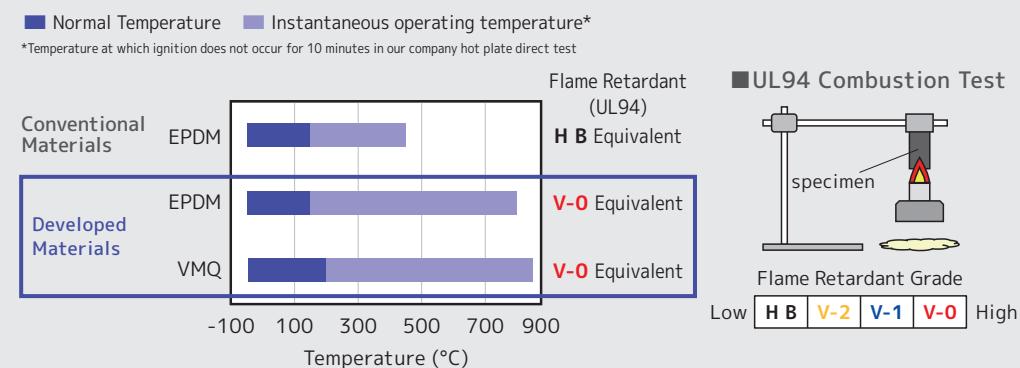


Comply with UL94 V-0 flame-retardant standards.

Hot plate direct placement test



Conventional Materials      Developed Materials



(\*) The values shown in the graph are for reference only and are not guaranteed. (\*) UL94 combustion test shows the results conducted in our company.

High voltage support

# Tracking-resistant rubber

- High voltage compliant rubber that achieves CTI\* 600 and is compatible with high voltage boundaries

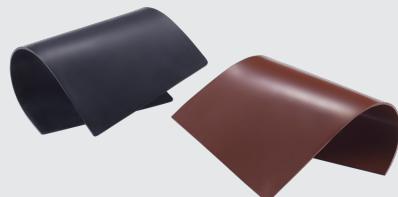
\* CTI: Comparative tracking index

PCU/  
Electric Auxiliary  
Devices

All tracking-resistant rubber materials are CTI 600.

Excellent ○○&gt;○○&gt;△ Poor

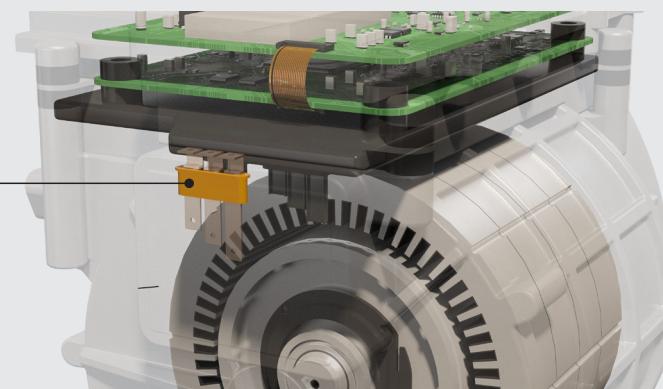
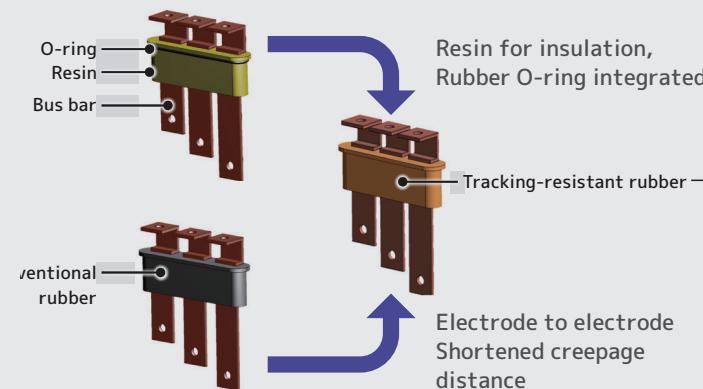
- Rubber materials suitable for use environments and application areas can be provided



	Silicone rubber (VMQ)	Ethylene propylene rubber (EPDM)	Acrylic rubber (ACM)	Hydrogenated nitrile rubber (HNBR)
heat resistance	○○	○	○	○
cold resistance	○	○	○	○
water resistance	○	○	△	○
oil resistance	○	△	○	○
tracking resistance	<b>CTI 600</b>	<b>CTI 600</b>	<b>CTI 600</b>	<b>CTI 600</b>

## Unit downsizing

- Reducing the number of parts and creepage distance between electrodes contributes to unit downsizing



# Support

## NOK supports your development

### Dependable



NOK's products are backed by repeated research on the materials used and mechanical designs. They are highly dependable and have been used for many years in a wide variety of machines.

### Technology development



NOK's self-contained development system covers the entire process from product design to product inspection. We actively integrate R&D and production technologies to create unique, cutting-edge technologies and products.

### Material technology



Material technology is one of NOK's core technologies. We have been working on the material compounding and chemical analysis technologies needed to develop rubber and adhesives used in seal products.

### Global development



NOK has established production bases around the world, including Japan, China, and elsewhere in Asia, and have built a stable supply system to meet our customers' needs.

For consultations and inquiries, feel free to **contact us using this form**.



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