

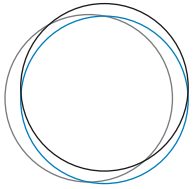


MANUFACTURING RELIABILITY AND MATERIALS EXPERTISE IN MEDICAL TECHNOLOGY

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Freudenberg-NOK
Sealing Technologies

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MASTERING DEMOGRAPHIC CHANGE – WITH MORE EFFICIENT MEDICAL TECHNOLOGY

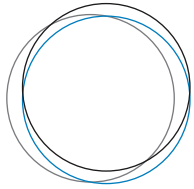


We all want to live longer. The fact that we can is mostly due to better medical care. The face of humanity is changing: In 2030, for the first time, there will be more people worldwide over the age of 65 than children under the age of 5. The average life expectancy of a newborn has increased by 10 years over the last four decades. In Japan, it is already more than 83 years. Even in developing countries, the share of older people is growing tremendously – by more than 50 percent by 2030.

While this may be a happy development for individuals, it is challenging for society, since healthcare costs for a 65-year-old are about four times higher than those for a 30 to 45 year-old. It is mainly the cost of chronic ailments that weigh heavily on budgets. In all industrialized countries, healthcare costs are growing faster than their respective economies.

The increased burden is almost certainly unbearable. Existing resources must be used more efficiently. Productivity and cost sensitivity will continue to gain importance in the healthcare market. New technologies and procedures must not only be better, but more affordable as well – so one individual's aging does not become everyone's problem.

This is precisely where Freudenberg Sealing Technologies can assist within the healthcare device market. Innovation, productivity and efficiency are our passion. In many sectors, we are a valued development partner and reliable supplier because we always bring cost and quality into the best possible harmony for our customers.



IT ALL COMES DOWN TO EXPERTISE

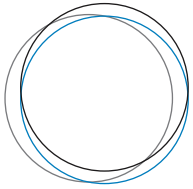


As the market leader in sealing technology worldwide, with more than 160 years of experience, our material expertise is unmatched. We offer the industry's broadest line-up of standardized materials and develop new materials for customer applications, meeting the toughest possible requirements and having all required approvals. With our own development lab, our in-house mixers and an array of more than 1,700 compounds made from 850 raw materials, our options are virtually unlimited.

We meet the highest requirements for production reliability due to our uncompromising standards. We focus on both standardized and customer-specific seals, specialty molded components and assemblies made from elastomers, silicone, polyurethane, thermoplastics and multi-component solutions (e.g.

rubber-metal or rubber-plastic solutions). We support our customers in product development and guarantee cost efficiency by choosing the most sensible production process. With our comprehensive simulation and testing processes, we help make your product ready for market more quickly. Our in-house tool making and our experienced development teams enable us to achieve extraordinary results when it comes to product geometry, production tolerances and manufacturing efficiency.

Our global presence puts us close to our customers. Our team of experts advises and guides you throughout the process, from selection of materials, through the test phase, all the way to start-of-production. Talk to us at **health@fnst.com**



HIGH ROTATIONAL SPEEDS AND DELICATE PRECISION



The high-tech designs of today's dental facilities are examples of the rapid advances in dental technology – whether in digital dentistry with intraoral scanners or for treatment units, dental instruments or CAD/CAM technology. The megatrend of medical technology miniaturization has long been the standard in dentistry. Dental instruments are mostly small and exceptionally delicate tools. Dental drills operate at extremely high rotational speeds of 300,000 to 400,000 rpm and are in contact with a variety of abrasive substances. At the same time, the high temperature resistance of the miniature components must be guaranteed as instruments must be thermally disinfected in autoclaves at 135 °C.

Miniature dental O-rings from Freudenberg Sealing Technologies are extremely well suited to these multi-faceted tasks. Be they on couplings, hand pieces, angle pieces, surgical instruments or exchangeable units, our O-rings seal reliably against all media. This is not always easy since plug connections on couplings can be changed effortlessly and must be ergonomically capable of 360° rotation. Under these conditions, frictionless sealing is only possible with extremely strong materials and production expertise. Unique, innovative production processes enable us to reproduce extremely tight manufacturing tolerances consistently. Manufactured with special materials, our O-rings also

function as **vibration dampers** on high-speed turbines.

Examples of our molding expertise include molded gaskets for couplings, ensuring the inflow and outflow of air, liquids and light into dental turbines. Dental drills should also

also support development projects and work as sparring partner to identify a technical solution in the overall context. It is a major challenge to seal a dental turbine against saliva, blood and particles at high speeds. Together with their suppliers, we have developed a design for a shaft



come to a stop abruptly to avoid the risk of injury. This is achieved with **micro-molded parts** with extremely narrow tolerances that bring turbines to a stop in just one second. The potential applications of molded parts and seals in dental devices are many and varied. We currently supply a wide range of diverse, customer-specific molded parts for this field.

When the requirements are demanding, it is sometimes not enough merely to develop an appropriate seal. In these cases, we

and the accompanying **mini slide seal** for our customers to achieve the maximum performance in service life, sterilization and assembly.

Freudenberg Sealing Technologies' know-how and competence have made dental technology more efficient and safer in many areas. We will find the right solution in your field of application, too.



Micro Molded Seal



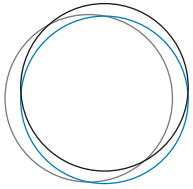
Molded Seal



Micro O-ring



2K Radial Shaft Seal



DURABLE PRECISION



Precision diagnostics are indispensable for greater efficiency in the medical field. New x-ray systems for three-dimensional imaging are making more detailed images possible with shorter exposures. Due to the enormous investments, a high level of utilization of diagnostic capacity is crucial. With some devices, many clinics aim for 24/7 operation to keep medical examinations affordable. Diagnostic devices can only operate cost-effectively if they function safely and reliably.

You can count on Freudenberg's materials expertise when these standards are required. Our seals are used in **compensation diaphragms** in x-ray machines and computer tomography. To avoid repairs and expensive downtime, especially good media resistance against insulating oils is

indispensable for x-ray tubes. We have exactly the right materials to deal with all the insulating oils and additive packages on the market.

In these applications, our customers rely on the tried-and-tested features of our **O-rings** made of HNBR, FKM, EPDM or Simriz®. They provide superb sealing in the high-voltage generators and cooling systems of computer tomographs, where they are extremely insensitive to temperature and exceptionally well equipped to provide years of continuous equipment operation.

Faster-rotating computer tomographs in particular expose elastomers to severe deformation and thus place high demands on the durability and strength of all components.

By applying our **simulation processes** (e.g. finite element analysis), we can simulate product functionality during the development stage and shorten the development phase significantly. Our diaphragms, damping elements, brake elements and elastomer couplings are developed specif-

and x-ray equipment, CTs and MRTs can rely on **profiles** and **housing seals** made of media-resistant materials from Freudenberg Sealing Technologies.

Seals are extremely critical components in diagnostics – since failure always leads



ically for their areas of application in x-ray machines and computer tomographs. Diagnostic equipment is controlled by highly sensitive electronic components. They must be protected from contamination as well as disinfecting and cleaning agents. At the same time, manufacturers of ultrasound

to a system malfunction. Our materials expertise creates reliability and enables added efficiency. We are your point of contact for all types of seals used in diagnostics, whether for **housings, profiles, molded parts, bearings or hydraulic components.**



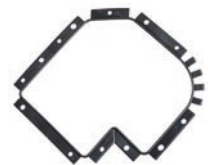
Claw Coupling



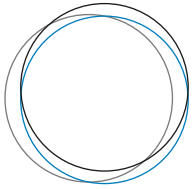
O-rings



X-Ray Tube Diaphragm



Profiles



EXTREME HYGIENE REQUIREMENTS – AND TIGHT AT ALL TEMPERATURES



Materials used in laboratories must be extremely multifaceted and deal with extreme high & low temperature variations. In addition, their chemical resistance to strong acids and bases, for example, must be beyond question.

All laboratory areas benefit from Freudenberg Sealing Technologies' materials expertise. As an example, the silicone **seal lips** for the doors of autoclaves are easy to keep clean, resistant to a vapor pressure of up to four bar and guarantee stability and trouble-free functionality at 150 °C. A new Freudenberg development prevents the frequent problem of door seals falling out.

We equip stirring devices with Simmerrings or our **Radiamatic® HTS II shaft seal ring** – a special development made of PTFE. This product stands out for its low friction and low lip contact force. Additionally, this product has a high resistance to media due to its zero-dead-space design. This is especially suited to stirring rods.

We have set a new standard with the world's smallest radial shaft seal. This elastomeric **Micro-Simmerring** is able to seal rotating shafts with a diameter of 1 mm at rotational speeds up to 10,000 rpm. In a lab environment, the diminutive high-tech element is used in pumps and pipettes that must dose the smallest quantities accurately.

The aseptic **Hygienic Usit®** is setting new standards for purity. It allows screw heads to be sealed in accordance with hygienic design standards and protects against contaminants. Hygienic Usit is an external seal that cleanly closes off the area between the screw and

For use in analytic devices, we offer **micro parts** made from all elastomers and silicones, with all-around media resistance. Our micro-molded parts made of butyl rubber, for instance, are used in blood analysis devices. These sealing solutions are resistant to blood components and analy-



the surface from any form of external influence. In addition, the sealing bead of the Hygienic Usit is made from 70 EPDM 291, which complies with the FDA and EU VO 1935/2004 and is biologically nonhazardous according to USP Class VI – 121 °C and thus the best possible choice for demanding laboratory applications.

sis agents and are especially well suited to this use due to their low permeability.

Whether the challenge is extremely high temperatures, low temperatures or chemical resistance, we are fully capable of dealing with any requirement in the laboratory environment, thanks to our many material options and production capabilities.



Micro-Simmerring



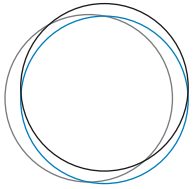
Profiles



Radial Shaft Seal HTS II



Hygienic Usit Ring®



MATERIALS KNOW-HOW FOR SAFE ANESTHESIA



Reliability tops the list when it comes to medical ventilation and anesthesia. Malfunctions or disruptions would have devastating effects, making it all the more important to use the right materials. The environment is complex: besides oxygen, various anesthetics come into use, including Isoflurane, Sevoflurane, Enflurane, Xenon and halothane. Even expelled anesthetics and CO₂ have to be taken into consideration.

We use high-quality and extremely media-resistant materials. As an example, we equip vaporizers with **lip seal rings, fore-seals, molded parts** and **O-rings** made of the special **Simriz® FFKM** (perfluoroelastomers). This material is only available from Freudenberg Sealing Technologies and the only one that does not swell when it comes into contact with halothane. We also supply a special variant of Simriz®-FFKM as a high-temperature material.

We use the same material for **2K products**, such as filling rod holders or our patented **Plug&Seal**, which is used in vaporizers and anesthetics units. To be successful, it is essential for an anesthetic to be controlled and circulated in a closed system. For this reason, multi-component seals from Freudenberg Sealing Technologies are a preferred, reliable solution that absolutely preclude the leakage of gases and enable precise dosing.

Medical ventilation during anesthesia is an especially sensitive issue, since the patient is dependent on sufficient ventilation with the correct ratio of respiratory gases and is in direct contact with the respiration device through the air flow. Our seals, diaphragms, valves, molded parts and hoses are physiologically nonhazardous and odor neutral and meet the highest standards for cleanliness.



Anesthesia Membrane



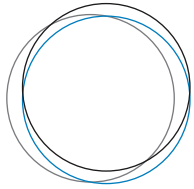
2K Specialty Molded Components



Plug & Seal



2K Valve Seal



TOTAL APPLICATION SAFETY



2K Valve Seal



Silicone O-Ring



Magnetic Anchor Seal

Millions of people owe their lives to dialysis. There are more than 180 hydraulic components in a dialysis machine and almost the same number of potential applications for sealing technologies.

Our **Duo Forseal** is used in high-performance pumps. It is designed for piston stroke frequencies of more than 200 Hertz and is extremely resistant to abrasion and heat.

Pumps and hydraulic elements handle the preparation of the dialysate. Complex valve control systems ensure that blood cleansing occurs with an individually adjusted blend of chemicals. Our special **plastic-silicone molded parts** regulate the flow of dialysate. Silicone has proven its suitability thanks to its biological compatibility, and the 2K model due to its resilience. A full 500 ml of dialysate is needed per minute, which works out at between 120 and 150 liters per treatment.

In the dialyzer, the transfer of toxic substances from the blood into the dialysate through the semi-permeable filter membrane must take place under absolute control and isolation. Our **silicone rings** provide the appropriate sealing of dialyzers and thus a reliable dialysis process.

Incubators also sustain life. Absolute hygiene and the reliable control of respiration and temperature are indispensable in helping to bring medical care to newborns or seriously ill infants.

Magnetic anchors from Freudenberg Sealing Technologies with RFN (Reduced Friction by Nanotechnology) elements are superbly suited for this field. Minimization of the adhesion tendency inhibits sticking and always ensures a valve's immediate response. And our products based on **hygienic design** help to meet high hygiene requirements.

Freudenberg-NOK Sealing Technologies

Marketing Communications
47690 East Anchor Court
Plymouth MI 48170
USA

Service contact:

E-Mail health@fnst.com
www.fnst.com

www.mfcp.com