

O' mag

[O] THE NTN-SNR GROUP PARTNERS' MAGAZINE

N°14

INDUSTRY	02
« THE FACTORY OF THE FUTURE REFOCUSSES THE HUMAN FACTOR ON VALUE CREATION »	
MAINTENANCE	08
MONITOR'IT: SMART INDUSTRIAL MONITORING	
AUTONOMOUS VEHICLE	10
THE ANGLE SENSOR THAT MAKES VEHICLES SMARTER	

WELCOME TO FACTORY 4.0



NTN-SNR plant in Argonay (Haute-Savoie, France)



Industry 4.0 : The concept becomes reality

Industry 4.0, a concept widely used by marketing professionals, remains difficult to define. What is undeniable, however, is that factories are increasingly digital, connected and smart.

In the factory of tomorrow, sensors collect ever more precise information on the production equipment. Big data algorithms convert this data into relevant indicators for managing activity. Industry leaders benefit from intuitive interfaces – smartphones and tablets accessible wirelessly – that facilitate their decisions. Based on these principles, we have designed the smart diagnostic solution Monitor'IT to help maintenance managers target interventions on rotating machines.

We are also implementing this new intelligence in our own industrial sites: in Argonay and Alès (France) and in Mettmann (Germany), production flows are adjusted in real time thanks to data exchanged between programmable logic controllers. At NTN-SNR, factory 4.0 is a reality.

HERVÉ BRELAUD

Deputy CEO, Europe and Africa
Vice President, NTN-SNR Industry



INDUSTRY « The factory of the human fac

As part of the operational excellence programme launched in 2015 on its French and German plants, NTN-SNR is deploying a more connected production tool, where human intervention focuses on value-added tasks. An interview with Jean-Michel Murison, Director of Operations.

How would you define the concept of the factory of the future?

Jean-Michel Murison: First, there is an operational reality behind the concept: that of a production site that aims at the continuous improvement of its industrial, economic and environmental performance. The factory of the future is at the same time more connected, more innovative, more ergonomic and cleaner, on site as well as in regard to the environment, with optimised upstream and downstream logistics. This concept also implies a second reality, a human one this time: by increasing the robotisation of lines, by introducing instruments for measuring and controlling machines – as we have done on our Alès site (see box) – we are realigning the teams towards value creation. Operators are no longer called upon



LE MAGAZINE DES PARTENAIRES DU GROUPE NTN-SNR

NTN-SNR Roulements Magazine
Listed in the Anancy Trade and Companies Register
RCS Anancy B 325 821 072
Publication management: Hervé Brelaud
Design/production: Advertising department
NTN-SNR ROULEMENTS
Drafting and formatting: ARCA agency

The following have contributed to this issue:
H. Brelaud – J.-M. Murison – L. Condomines – J. Ruzdzinski – C. Espine – C. Ollier – A. Paviet – C. Joly – J. Ferraro – E. Muggiasca – T. Sautel – A. Delsart – J.-H. Bulit – F. Martins – F. Guerre-Chaley – G. Lefort – C. Duret – O. Mulliez – L. Rambaud
Photo credits: Shutterstock, Pedro Studio Photo, Visuelys, OEA, Valeo Scala, NTN-SNR

Copyright: no. ISSN 1961-4241
Any reproduction, even partial, of this magazine requires our authorisation.
Printed in June 2017.

SOMMAIRE

N°14

MARKETS	04
ALBECO, WIDE RANGE AND TURNAROUND TIMES GUARANTEED OVER THE LAST 25 YEARS	
PRODUCTS AND SERVICES	06
THE RIGHT RECIPE FOR CUSTOMER CONVENTIONS	
INNOVATION	08
MONITOR'IT OFFERING: SMART INDUSTRIAL MONITORING	
INNOVATION	10
AUTONOMOUS VEHICLE: THE ANGLE SENSOR THAT MAKES VEHICLES SMARTER	
EVERY DAY	12
HOW MANY BEARINGS ARE THERE ON THE AIGUILLE DU MIDI CABLE CAR?	



A «Showcase for the Industry of the Future» in Alès

Since October 2016, the NTN-SNR plant in Alès (Gard) has been certified as a «Showcase for the Industry of the Future». This label of excellence awarded by the French Alliance for the Industry of the Future testifies that the site, which specialises in third-generation automotive bearings (12,000 units/day), boasts “a competitive industrial tool that fully meets the needs of European manufacturers”. With no trolley inside, the lines are supplied with parts by milk run, in a pull-flow system. The intervention of operators on the lines is facilitated by self-diagnostics and predictive maintenance tools. On the environmental front, petroleum by-products have been eliminated and all waste from material grinding is recycled into compressed sludge for other industries. “These advances were initiated with the consent of our customers”, says Laurent Condomines, Site director.

the future refocuses tor on value creation»

to collect data; they have real-time information to guide their interventions.

How is this transformation playing out today at NTN-SNR ?

JMM: Since 2015, all of our production sites in France and Germany have been engaged in an operational excellence programme. On the Argonay (Haute-Savoie) site, for example, where NTN-SNR manufactures the latest generation of bearings for aeronautics, the throughput time of a product on the line

will be divided by four. The accuracy of the diagnostics, via connected tools, will allow us to target the necessary interventions – quality expert assessments, additional diagnostics, etc. – and thus eliminate unnecessary waiting periods.

Why did NTN-SNR undertake such an approach?

JMM: The first challenge has to do with the markets we are serving. It seeks to perpetuate our model in Europe through the

expected performance gains, and to remain competitive in high-value-added productions. The second challenge is to demonstrate the relevance of our connected product ranges – in mechatronics in particular – by using them ourselves. NTN-SNR now uses the smart diagnostic and data-processing solutions it offers to its customers for its own production. Finally, the third challenge concerns the attractiveness of our factories: by modernising our tools, we offer better working conditions to our employees and attract future recruits.

How can your customers benefit from this reorientation ?

JMM: Today, we are much more agile, responsive and connected. The Lean Management System, implemented in such a corporate project, engages everyone in short-term projects (three months maximum) as close as possible to the field, with immediate operational results. This approach is in line with the increasingly condensed production and sales cycles of our customers – especially in the automotive sector. For them, a supplier’s factory of the future is nothing futuristic: it simply makes it possible to meet the needs of tomorrow today.



The ultramodern NTN-SNR plant in Argonay (Haute-Savoie), where the latest generation of bearings for the aeronautics industry is manufactured.



«We are seeking to attain a leading position on the industrial aftermarket. Our competitiveness relies on excellent communication with NTN-SNR and almost instantaneous access to the latest technical information»

Waldemar Konopka, Chairman, Albeco

POLAND

Albeco, wide range and turnaround times guaranteed over the last 25 years

Since the early 1990s, Albeco has been supplying Polish industry with spare parts, and bearings in particular. Although its sales and distribution methods have changed a lot, its undertaking as to product quality and availability remains the same.

In Poland, Albeco's own little story is rooted in history. «At the end of the communist era, the site equipment factory where I worked had a hard time procuring bearings. As soon as it became possible to set up private companies, in 1989, I created mine», says Waldemar Konopka, Chairman of Albeco. From the start, the Company built its reputation on short turnaround times and the quality of its technical advice.

WIDE RANGE

By 1995, Albeco already had a staff of 18. To enhance its offer, the distributor then contacted NTN, followed by SNR a year later. «We wanted to work with major manufacturers because of the wide ranges and product quality they offered», says Agnieszka Konopka-Lulek, Marketing Manager. Twenty years later, now that the two companies have merged, NTN-SNR accounts for an even larger share of Albeco's activities.

What is the secret behind their long-term cooperation? An alignment between supplier and distributor that has never been brought into question over the years. «By providing quality bearings, we help our customers' facilities to become more robust. Thanks to the size and range of our stock, we can deliver fast, in under 24 hours, and we reduce the risks of production shutdowns for them», explains Agnieszka Konopka-Lulek.

DIRECT CONTACT

To back this added value offer, NTN-SNR goes much further than supplying reliable parts. The manufacturer and its distributor draw up an annual delivery schedule that is reviewed and readjusted quarterly. Albeco also has a direct contact at NTN-SNR to deal with orders on an everyday basis, and handle specific requests and lead times. Furthermore, the manufacturer provides its distributor with technical support – training, reference

documentation, and joint visits to customers. «It is crucial to be able to access product information at the earliest possible moment in order to be competitive», explains Waldemar Konopka. «The excellence of our teams is one of our strengths. We attach great importance to enhancing their skills», says Agnieszka Konopka-Lulek.

60 % OF SALES ONLINE

With a staff of 63, Albeco now has three sites in Poland: Katowice (in the south), Olsztyn (in the north) and its headquarters in Poznan (in the centre), where it opened an ultramodern depot in 2016. Albeco has constantly modernized its ways of doing business while remaining loyal to the factors that led to its success. The Company now makes 60 % of its sales online, has 40,000 references in stock and supplies over 10,000 customers in Poland and elsewhere in Europe.

AUTOMOTIVE AFTERMARKET NTN Transmission seals enter the catalogue

In 2017, the best way to replace an NTN transmission seal on a vehicle manufactured in Europe will be ... an NTN-SNR transmission seal! At the end of 2016, 450 transmission kit references were added to the manufacturer's Automotive Aftermarket catalogue. The range includes complete transmission kits, wheel seal kits and boot kits (wheel or gearbox side). Components are manufactured at Le Mans (France) in the same factory as the original equipment models. "In Aftermarket, meeting manufacturers' requirements is essential for safety parts such as transmissions", says Christophe Espine, NTN-SNR Automotive aftermarket marketing director. With 40 million units produced per year, NTN is the world's second-largest manufacturer of transmission seals.



HEAVY GOODS VEHICLES Aftermarket ramps up

In 2016, NTN-SNR strengthened its Heavy goods vehicle offer in Europe. The brand launched about one hundred references of gearbox bearings and increased the number of wheel bearing references available to 142. "We are an OEM manufacturer, present around the world on American, Asian and European HGV markets. We are diversifying this offer in

the European aftermarket market", says Céline Ollier, Head of the HGV range. The references introduced in 2016 cover European models such as Mercedes-Benz, Volvo Trucks and Renault Trucks. As of 2017, the range will expand with transmission bearings for Asian vehicles – including the Hino and Fuso brands, which are frequently sold in Germany and Poland.

CONNECTED SERVICES TechScan'R packs new features, and wins more and more awards

Repairmen and distributors could already get Tech'Info sheets, 3D part views and assembly guides by scanning an automotive aftermarket product reference with the TechScan'R app on their smartphone. From late 2016, TechScan'R has also given them access, via 500 references, to assembly tutorial videos, the list of vehicle applications for each reference, and the composition of the kits with access to the parts sold singly. Useful both in the workshop and at the store. Launched at the end of 2015, TechScan'R recorded more than 25,000 logins in one year. A success story confirmed by several awards in 2016: Supplier of the Year Award and Automotive/HGV Innovation Award.



MECHATRONICS A new range of wheel speed sensors

In January 2017, NTN-SNR launched its own line of wheel speed sensors for the Automotive aftermarket. Twenty years after inventing the ASB® (Active Sensor Bearing), the Group is now allowing car dealers to purchase the bearing with magnetic encoder and the sensor that converts the measured rotation speed into wheel speed for various

vehicle safety devices (ABS, ESP, ACC, ASR, etc.) for the first time from a single supplier. "The advice given in the technical data sheets reflects our mastery of the entire application environment", says Amélie Paviet, the Wheel range manager. This new range, which includes 214 references (6,500 covered vehicles), will be completed by a hundred more by the end of the year.

IN THE FIELD

The right recipe for customer conventions

Customer conventions co-organised with NTN-SNR reinforce the manufacturer-distributor partnership and boost the brand's reputation. These joint events, like those organised in Greece in early 2016, lead to new business opportunities.

January 2016. Thessaloniki, in the north of Greece. Sferodynamiki, the local NTN-SNR distributor, organised a customer convention weekend in a city hotel, with the support and presence of the manufacturer. Fifty local customers responded to the invitation: half were OEM – manufacturers of machine tools, flour mills, agricultural machinery – and the other half were maintenance and construction companies. All the distributor's teams (about twenty people) were also present. *"This type of event shows those who use our products on a daily basis that we are really on the side of our distributors"*, explains Charles Joly, NTN-SNR Southern Europe export manager.

BRAND AWARENESS

The two-day programme, prepared jointly, alternated general information sessions with technical workshops. It first gave the distributor an opportunity to present its activities. For

NTN-SNR, it was an opportunity to showcase the brand through a wider prism: the richness and variety of the ranges, main application areas, and product performance. *"Explaining that NTN-SNR bearings equip aeronautical reactors or hold the world rail speed record reinforces our image of quality"*, says Joseph Ferraro, Southern Europe sales engineer, the main NTN-SNR speaker in Thessaloniki.

LANGUAGE, SECTOR: TAILORED CONTENT

The content of the conventions is adapted as far as possible to local expectations. In Thessaloniki, where NTN-SNR provided documentation on its range in Greek, the first day was devoted to industry-specific solutions, while the second day focused on the agricultural sector. *"The participants discover that NTN-SNR is also a specialist in their field"*, says Ferraro.

MOUNTING, DISMANTLING

This learning becomes more concrete with practical exercises of mounting and dismantling bearings. Organised in the afternoon, these workshops fuelled numerous interactions around very concrete situations, such as developing a hub for agricultural machinery, technical support for a mill, and much more, and generated several project opportunities.

In passing, the participants, as well as the technical teams of Sferodynamiki, were able to familiarise themselves with Experts & Tools. *"It is also an opportunity to train our distributors on elements in our range about which they know less and which can be a source of additional turnover!"*, says Ferraro.



On average, about 60 customers attended conventions in 2016.



NTN-SNR training courses combine theory, interactive quizzes and practical exercises.

EXPERTISE

Breton relies on NTN-SNR to train its operators

On 26 October 2016, NTN-SNR technical teams trained 15 operators at Breton. In its two divisions, this Italian company produces machine tools and stone-working machines sold worldwide. The day was dedicated to the mounting and dismantling of bearings, and included theory, interactive quizzes and practical exercises in real situations in small groups. The participants performed their exercises in the factory, in real situations, with tools from the BEBOX (the NTN-SNR training workshop vehicle) and the support of technical experts.

90 OPERATORS TRAINED SINCE 2011

This session was the sixth of its kind. Since 2011, 90 Breton operators have been trained by NTN-SNR. Breton chose to call upon its suppliers to equip its new recruits with knowledge essential to the quality of its production. *“Correctly mounting a bearing is essential for the life of the component and therefore for the reliability of Breton machines, which are used in aggressive, damp and dusty environments”*, explains Elio Muggiasca, NTN-SNR key account manager.

AEO CERTIFICATION

An additional pledge of security

In September 2016, NTN-SNR was awarded the Authorised Economic Operator (AEO) customs certification, confirming its mastery of import/export operations, even the most technical ones (storage and processing under customs control, management of preferential origins, etc.). The Group thus has access to simplified customs procedures, which also benefit its partners. *“The risk of goods being blocked at the border is almost zero”* says Jean-Hervé Bulit, Customs and transport manager.



Denis Martinez, Director of Léman Customs (left), presented the certification to Sébastien Nicolaux, NTN-SNR Logistics director.



The new packaging workshop (800 m²) is used to process custom requests.

INDUSTRY

Progress in availability times

Since 2016, NTN-SNR has been focusing its Industry distribution activity on its European logistics centre, a 20,000 m² platform located in Saint-Vulbas, near Lyon. The centralisation of stocks (22,000 references) has considerably simplified the flows, thereby reducing the availability time of products. Since March 2016, the site has been equipped with its own packaging workshop: an

800 m² area where customer-specific requests are handled – labelling in several languages, dedicated packaging, etc. *“Distributors here have access to a level of packaging service that meets their expectations and the needs of their own customers,”* says Alain Delsart, NTN-SNR manager of the platform.



MAINTENANCE

Monitor'IT offering: smart industrial

Taking advantage of its magnetic sensor technology, NTN-SNR has developed an early fault detection solution on rotating machines that is part of an Industry 4.0 approach.

In early 2017, NTN-SNR launched Monitor'IT, a range of innovative solutions for monitoring rotating industrial machines. Designed for maintenance managers, it gives access to a set of indicators on machines' operational status, available online and based on thresholds specific to the installation. This continuous

monitoring is supplemented by a detailed analysis along with recommendations, carried out at regular intervals by NTN-SNR experts. *"Monitor'IT is part of an Industry 4.0 approach. The solution helps to anticipate failures, target site visits, adapt the response when a fault occurs and more by using data sent back from*

the field," explains Fanny Martins, NTN-SNR Market manager. Monitor'IT applies an innovative magnetic technology that took several years of development at NTN-SNR.

MAGNETIC FIELD MEASUREMENT

The machines to be monitored are equipped with sensors, installed on the shafts, which measure the magnetic field emitted by the rotation. These signals are sent back via an acquisition unit to a database, hosted on a se-

Four advantages over vibration analysis

The magnetic acquisition technology of the Monitor'IT range offers four advantages over methods based on vibration analysis:



► **Remote sensor:** The sensors can be moved away from the device being monitored and thus installed according to the operational constraints of the line (dimensions, high temperatures, etc.);

► **Slow rotation speed:** The magnetic technology allows analyses on assemblies rotating at low speed - from 1 RPM onwards;

► **Low vibration sensitivity:** Magnetic sensors provide data usable in environments subject to vibration disturbances (e.g. quarry screens);

► **Reduced number of sensors:** A limited number of sensors (60 % fewer in some cases) is sufficient to feed the analyses produced by Monitor'IT.

One range for all situations

Monitor'IT's predictive analytical power is available to maintenance managers to monitor operating lines, as well as to industrial system manufacturers who want to enrich their products. In combination, or not, with vibratory analysis...



► **Monitor'IT Expert** : a combination of magnetic and vibration technologies, to detect defects in bearings, gears, unbalances, misalignments or structures on an existing installation. Exists in a version dedicated to wind turbines (Wind Doctor).



► **Monitor'IT Focus** : detection of bearing and gear defects in an existing installation based on magnetic technology.



► **Monitor'IT Custom** : integration of Monitor'IT analysis into an industrial machine at the manufacturer's site (OEM approach). Combines magnetic and vibration technologies.

monitoring

cure server for NTN-SNR. Different algorithms are then used to develop the dashboards and produce the expert analyses.

LOW SPEED

Validated by several pilot projects in railways and wind energy, this technology provides diagnostic capability in conditions where vibration analysis shows its limits, especially at low speeds (see box). It is particularly effective in detecting bearing or gear defects.

"Its scope is wide: iron and steel (continuous casting), mines and quarries (conveyors and screens), paper mills, etc., and in general monitoring components such as fans and speed reducers", explains Guillaume Lefort, NTN-SNR Innovation project manager.

ADAPTED TO THE EXISTING FACILITY

To facilitate the adoption of this technology, NTN-SNR has designed a range suitable for different situations. To equip the installations already in operation, the brand proposes a solution combining magnetic and vibratory signals (Monitor'IT Expert) in a single acquisition

IN THE FIELD

Fewer sensors to monitor reducers

One sensor per reducer and nothing more! NTN-SNR teams installed a mere five magnetic sensors to monitor a machine producing plastic films rotating at low speed (less than 30 RPM) and consisting of five high-power reducers. *"For the same perimeter of detection with conventional vibration technology, it would have been necessary to install one accelerometer radially per bearing and one axially per reducer"*, explains Frédéric Guerre-Chaley, NTN-SNR Innovation project manager. In addition, the Monitor'IT sensors

were deployed in less than four hours with a scheduled shutdown in June 2016.

Using the data collected via the acquisition unit and specific algorithms, the NTN-SNR experts continuously monitor the state of the installation. Their analyses are compared with observations in the field through regular exchanges with maintenance teams and a complete review every three months. Following the satisfactory results of this initial phase, it was proposed to extend the system to other machines on the site.

unit with a very complete monitoring system for bearings, gears, unbalances, misalignments, and structures. The Monitor'IT technology can also be integrated into an industrial machine when it is manufactured (OEM-Monitor'IT Custom offering). *"Our engineers then work directly with*

the manufacturer's R&D teams to adapt our acquisition board to their products", explains Frédéric Guerre-Chaley, NTN-SNR Innovation project manager. End customers can thus have machines enhanced with smart monitoring functions from the outset. This too is factory 4.0.



The vehicle detects any element present in front of it, whether static or mobile (car or pedestrian).

AUTONOMOUS VEHICLE

The angle sensor that makes vehicles smarter

In 2017, several manufacturers will offer vehicles with a “high-precision” obstacle detection module. Operating through laser remote sensing, this piece of equipment marketed by Valeo takes advantage of NTN-SNR’s mechatronics know-how.

This year Valeo is embarking on an innovation that is as discreet as essential in the cars of several manufacturers: a wide-angle laser scanner – SCALA, its trade name. Nested in the front grille, this unit, barely one cubic decimetre, “sweeps” a wide horizontal field (angle of 145° and range of 200 metres), more than 10 times per second. The vehicle can thus detect any moving or static element in front of it, by day or night. Information on the nature of the obstacle, position, movement and more is then fed to the driver assistance functions: guidance, emergency braking, parking assistance, etc.

A NEW APPLICATION IN THE ASB® LINE

For this innovation, Valeo uses Light Detection and Ranging, or Lidar technology. The principle? A light pulse is sent to a rotating mirror, which diffuses it towards the front of the vehicle. On contact with an obstacle, the beam returns to its starting point. The device then measures the time delay between transmission and reception. This operation is reproduced at each angular position.

To meet this technological challenge, the equipment manufacturer has engaged NTN-SNR’s mechatronics services. The creator of ASB® (Active Sensor Bearing, dedicated to measuring the wheel rotation speed) provides the angle sensor positioned on the axis of rotation of the mirror. This device combines two elements: a two-track magnetic multipole encoder installed on the rotor and a fixed sensor (MPS40S) which defines the angular position. “This upgraded ASB®, 20 years after its creation, meets the customer’s objectives in terms of resolution, reliability and precision”, explains Christophe Duret, NTN-SNR Mechatronics manager.

HIGH RESOLUTION, CONTROL AND PRECISION

As regards resolution, the sensor first transmits several thousand signals (“fronts”) per

revolution, by interpolating the poles of the magnetic encoder. The reliability of the data is reinforced by a “trigger input” function provided by the external track of the encoder: the absolute angle is confirmed at the end of each rotation. All measurements, finally, are made with a much lower angular tolerance per degree. “With successful mechanical integration – the encoder is located directly on the motor rotor – we can thus achieve greater precision”, says Duret.

The development of this piece of equipment required four years of work and was carried out jointly by Valeo technical teams, those of their manufacturer customers and the NTN-SNR design office. “Besides our mechatronics know-how, it is our ability to adapt ourselves to our customer’s constraints that decisively contributed to the success of the project”, says Duret.



Valeo SCALA® Laser Scanner is a Valeo product. www.valeo.com

AERONAUTICS

Tapered roller bearings are taking off

NTN-SNR has developed “high-speed” tapered roller bearings to equip new generation aircraft engines.

With a speed factor of one million nDm, the performance achieved by NTN-SNR's tapered roller bearing is exceptional. *“Three times more than a standard tapered roller bearing and twice more than those used on TGV (high speed train) bogies”*, confirms Olivier Mulliez, NTN-SNR application engineer.

15 SECONDS WITHOUT LUBRICATION

This technological breakthrough was necessary to allow the decoupling between the fan and the turbine in the engine: each rotates at its own speed to optimise efficiency. At the

front of the reactor, the very short fan shaft imposes stiffness constraints on the bearings ensuring connection to the engine crankcase. Tapered roller bearings, the only geometry possible, had to be adapted to fan speeds of up to 4,700 RPM. The NTN-SNR team made it possible to reduce temperature rise in the bearings with two innovative technologies: a multilayer carbon coating and a superfinishing that reduces the roughness of the contact surfaces. *“At full load, the bearing must withstand 10 lubrication interruption cycles of 15 seconds. We have tested it successfully on our test benches”*, explains Mulliez.



Bearings that are three times faster than standard “tapered” bearings.

SPHERICAL ROLLER BEARINGS

The new alternative that will go a long way



The protected SRB withstands higher temperatures than the sealed SRB.

By developing a model with two side shields, NTN-SNR is exploring a third way in the range of its spherical roller bearings (SRB).

NTN-SNR is expanding its range of spherical roller bearings with a third model: the protected SRB (also known as ZZ). With a shield fixed on either side of the cage, it strikes a compromise between the open environment of the Standard SRB and the totally airtight atmosphere of the sealed SRB (EE). *“It has the best of both worlds”*, summarises Laurent Rambaud, engineer in the design office.

MORE RESISTANT

The protected SRB has the same performance as the standard SRB, which it can therefore replace: high temperature resistance, easy control thanks to axial misalignment, ease of maintenance, etc. In addition to these qualities, the SRB ZZ adds protection against solid

contamination. *“The metal shields preserve the bearing from external particles. They also limit the loss of grease”*, explains Rambaud.

The protected SRB is also different from the sealed SRB in that it withstands higher temperatures (200 °C compared to 120 °C) due to the absence of a rubber seal. Still in its prototype stage, the protected SRB has been tested for several months on production tools, in quarries in France and Morocco.



440 bearings capable of withstanding extreme mountain conditions equip this 22 km long link.

Aiguille du Midi cable car: how many bearings are there on this line to the peak?

With its breathtaking view of Mont Blanc and peaks more than 4,000 metres high on the Alpine range, the Aiguille du Midi (France) is one of the culminating points of tourism in Europe (3,842 m). Half a million people visit this site every year. It takes less than 20 minutes to reach the peak from Chamonix in a cable car, which can accommodate 500 passengers per hour.

Divided into two sections, this upward link (2,747 m of vertical drop) totals 22 kilometres of cables and some 440 bearings, all by NTN and SNR brands. The most numerous are **1** ball bearings (series 6000), which are found on sheave trains and pylons. NTN-SNR also supplies **2** spherical roller bearings (series 23000 and 22000), used for the equipment at the departure and arrival stations.

These references are designed to withstand extreme mountain conditions. Their sealing is enhanced. The bearings are also filled with special low temperature grease, which is resistant to condensation and whose low viscosity index reduces the operating torque.