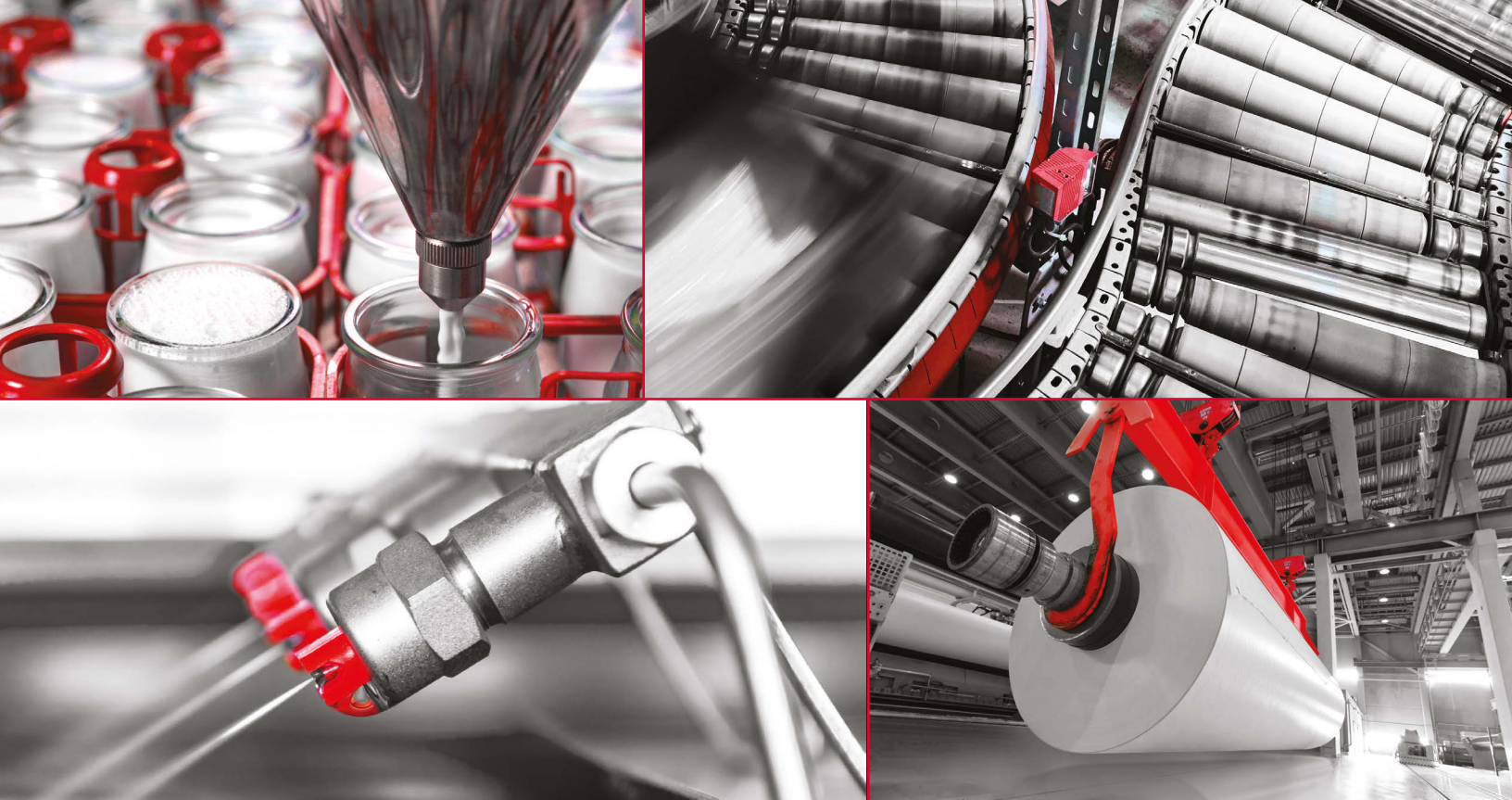


NSK

MOLDED OIL™ BEARINGS



STAY IN MOTION. STAY IN CONTROL.



MOLDED-OIL™ BEARINGS

CLEAN, CONTINUOUS BEARING LUBRICATION

Lubrication is essential to bearings to achieve the level of performance for which they were designed. Appropriate lubricant selection and methods will ensure reduced friction and wear inside the bearing, while allowing the bearing to perform optimally for the duration of its expected life.

In cases where bearings are exposed to water and dust, where relubrication is difficult, or where particularly stringent requirements for clean operation must be met, NSK's Molded-Oil bearings are an ideal solution. Typical applications include:

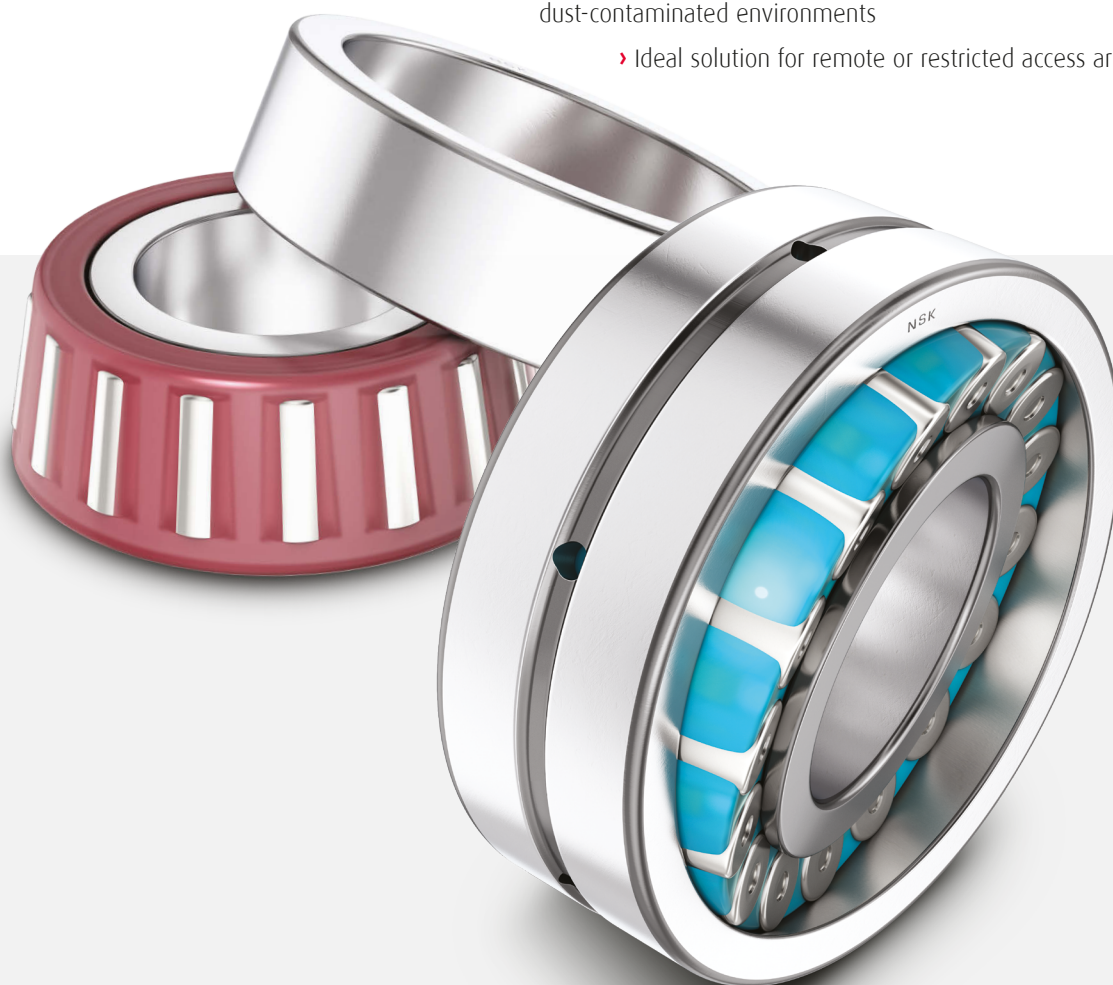
- › Steel mill equipment
- › Paper mill equipment
- › Semiconductor manufacturing equipment
- › Food and beverage processing equipment
- › Agricultural machinery
- › Cleaning equipment and lines
- › Conveying equipment

MAINTENANCE-FREE, LONG-LIFE PERFORMANCE.

Molded-Oil™ bearings are uniquely designed to prevent the ingress of contamination from detrimentally impacting bearing performance, while providing a continuous and clean source of lubrication to the bearing. Oil-impregnated polyolefin resin serves as a barrier to water and dust, and slowly releases ample lubrication to the bearing with minimal risk of oil leakage for an extended maintenance-free service life and reduced operating costs.

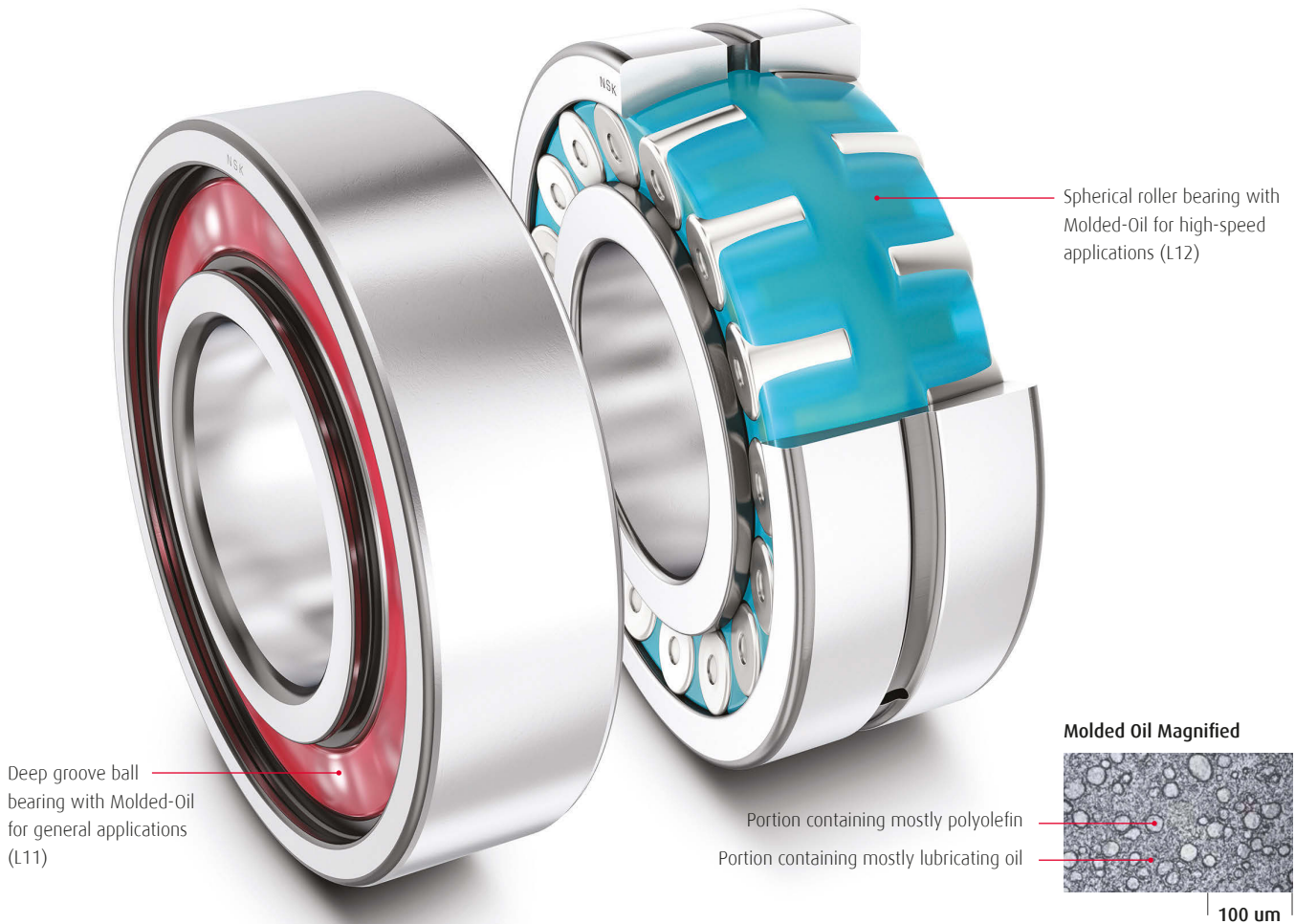
PROVEN ADVANTAGES

- › Extended bearing performance with continuous supply of clean lubricant
- › Eliminates the need for relubrication, reducing maintenance costs
- › Eliminates risk of grease leakage, promoting clean operating environments
- › More than twice the operating life of grease-lubricated bearings in water or dust-contaminated environments
- › Ideal solution for remote or restricted access areas



DESIGN AND OPERATING ADVANTAGES

NSK's Molded-Oil bearings provide a continuous and clean source of lubrication to bearings, promoting a clean operating environment, an extended maintenance-free service life and reduced operating costs.



DESIGN FEATURES

- › Bearings lubricated with oil-impregnated material consisting of lubricating oil and polyolefin resin
- › Oil slowly seeping from this material provides ample lubrication to the bearing for extended periods
- › Solid lubricant acts as a barrier to water and dust ingress
- › Low torque is achieved for smooth rotation of rolling elements
- › Compositions available for both general (L11) and high speed (L12) applications
- › Available for spherical roller bearings, deep groove ball bearings, and tapered roller bearings



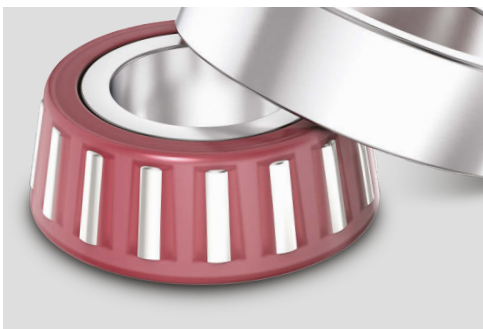
Spherical Roller Bearings

- › Available for a wide range of dimensional series and sizes with machined brass and pressed steel cages
- › Composition available for both general use (L11) and high speed (L12) applications
- › Molded-Oil for high speed operation is not available for spherical roller bearings with pressed steel cages



Deep Groove Ball Bearings

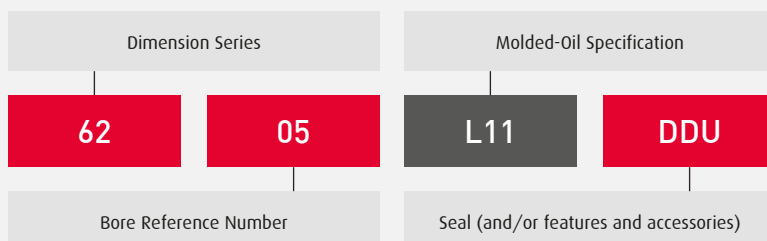
- › Available in standard bearing steel as well as stainless steel for a wide range of dimensional series and sizes
- › General use (L11) and high speed (L12) application compositions available
- › Sealed-type bearings are recommended for operating environments with continuous exposure to water and dust



Tapered Roller Bearings

- › Available only with general use (L11) application composition
- › Abutment and fillet dimensions must be taken into consideration

DESIGNATION SYSTEM



As demonstrated with this example for NSK sealed deep groove ball bearings, the Molded-Oil specification precedes design features and accessories in numbering systems for all bearing types.

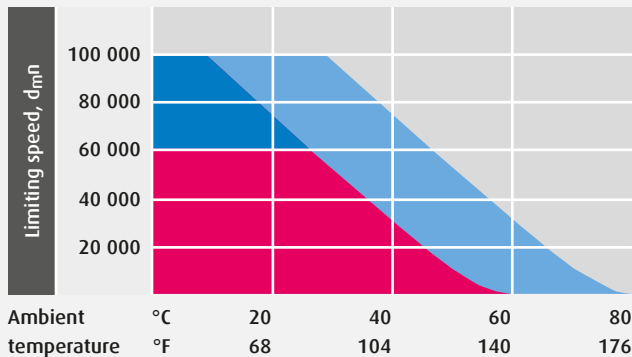
SELECTING CRITERIA AND HANDLING

BEARING TYPES	MOLDED-OIL TYPES		CAGE TYPES	LIMITING SPEEDS	O.D RANGE
				d_{mn}	mm
Spherical roller bearings	L11	For general use	machined brass	< 60 000	70 to 250
			pressed steel	< 30 000	70 to 215
Deep groove ball bearings	L12	For high-speed operation	machined brass	60 000 to 100 000	70 to 215
	L11	For general use	pressed steel	< 150 000	19 to 250
Deep groove ball bearings	L12	For high-speed operation	pressed steel	150 000 to 200 000	19 to 215
	L11	For general use	pressed steel	< 40 000	80 to 215

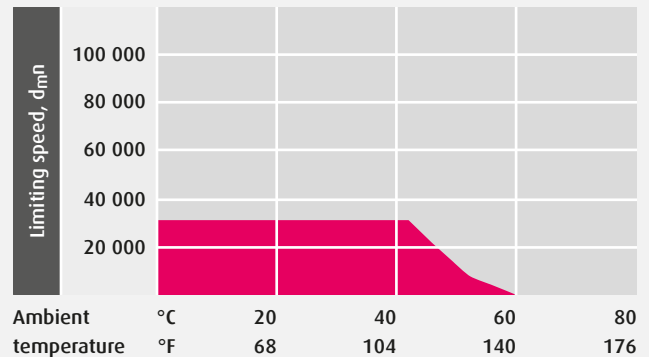
Note: $d_{mn} = [(Bearing\ bore\ diameter, mm + Bearing\ outside\ diameter, mm) \div 2] \times inner\ ring\ rotational\ speed, min^{-1}$
 Conditions including abutment and fillet dimensions must be taken into consideration for tapered roller bearings
 For tapered roller bearings and spherical roller bearings with pressed steel cages, Molded-Oil Bearings for high-speed operation are not available
 For the application under the condition of low speed and low temperature, Molded-Oil Bearings for general use are recommended

AMBIENT TEMPERATURE AND LIMITING SPEEDS

Spherical roller bearings, machined brass cage



Spherical roller bearings, pressed steel cage



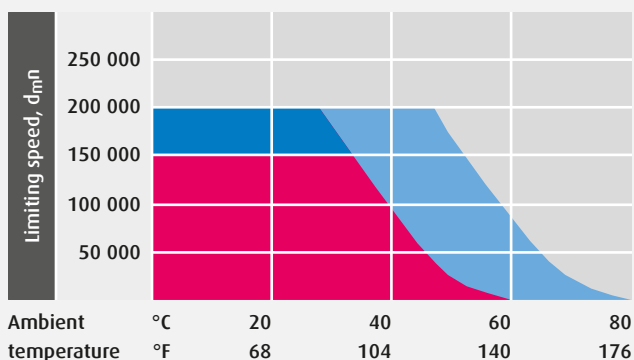
- Molded-Oil for general use, applicable range
- Molded-Oil for high-speed operation, applicable range
- Molded-Oil for high-speed operation, applicable range for intermittent use

PRECAUTIONS FOR HANDLING AND SELECTING

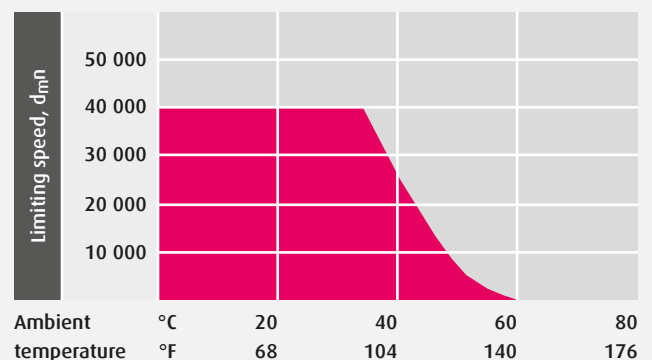
To maintain the excellent long-term lubricating capacity and high performance of Molded-Oil Bearings, the following precautions should be observed:

- › Molded-Oil melts at about 250° F, therefore the bearings must not be heated over 212° F by using an induction heater. Additionally, the bearings should not be heated by the oil bath method
- › The bearings should not be used under conditions involving liquid degreasing agents such as organic solvents that can affect Molded-Oil. The bearings also should not be used under conditions involving corrosive liquids or gases that can damage the parts of the bearing.
- › For low-temperature applications to -10° F, Molded-Oil bearings for general use are recommended
- › For the condition of high ambient temperature up to 250°F, Molded-Oil bearings for high-speed operation are recommended
- › For proper operation, bearings must be under a radial load of at least 1% of the basic dynamic load rating to prevent skidding
- › Since Molded-Oil Bearings are lubricated by capillary action, the bearings cannot be used under the condition where the bearings are exposed to water directly for an extended period of time (the oil could be washed away). If the application requires such exposure, consider using extra seals

Deep groove ball bearings



Tapered roller bearings



Limiting speeds (d_{mn}) shown in these examples for general housing. If there is a source of heat near the bearings, or cooling effect by radiation, or heat transmission, the above limiting speeds cannot be expected for the application.

PERFORMANCE: TESTING AND FIELD RESULTS

DURABILITY: WATER EXPOSURE TEST

Molded-Oil lubrication allows operation for extended periods of time, even if exposed to mist or submerged in water.

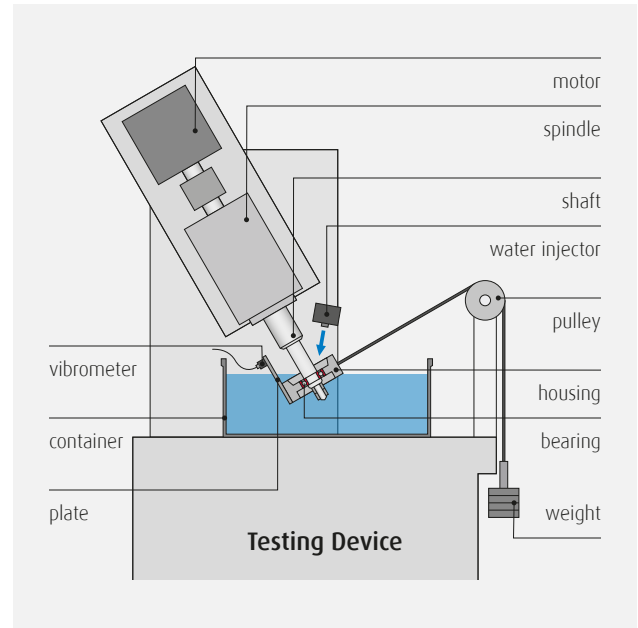
Continuous operation with grease lubrication:

approximately 20 days

With Molded-Oil Bearings:

50 days or more

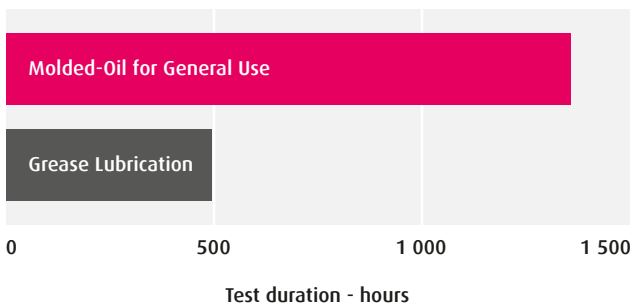
Molded-Oil Bearings can be operated for longer time than the bearings with grease lubrication even if exposed to mist or submerged in water.



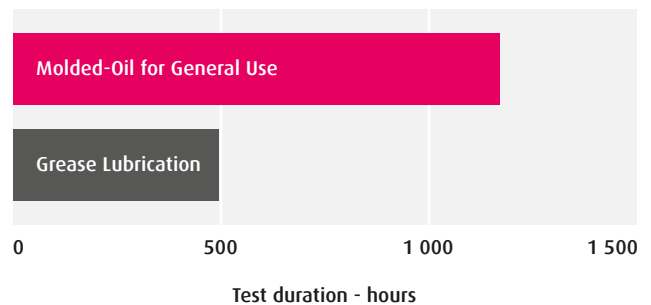
WATER EXPOSURE CONDITION		
TEST PARAMETERS	Test bearings	6000-H-DD stainless steel with contact seal
	Rotational speed	1 000 min ⁻¹
	Radial load	79.4 N
	Axial load	29.4 N
	Water exposure	0.8 cm ³ /min
	Spray Pressure	0.2 MPa

WATER SUBMERSION CONDITION		
TEST PARAMETERS	Test bearings	6000-H-DD stainless steel with contact seal
	Rotational speed	1 000 min ⁻¹
	Radial load	79.4 N
	Axial load	29.4 N

Durability test results: under exposure to water



Durability test results: under submerged condition

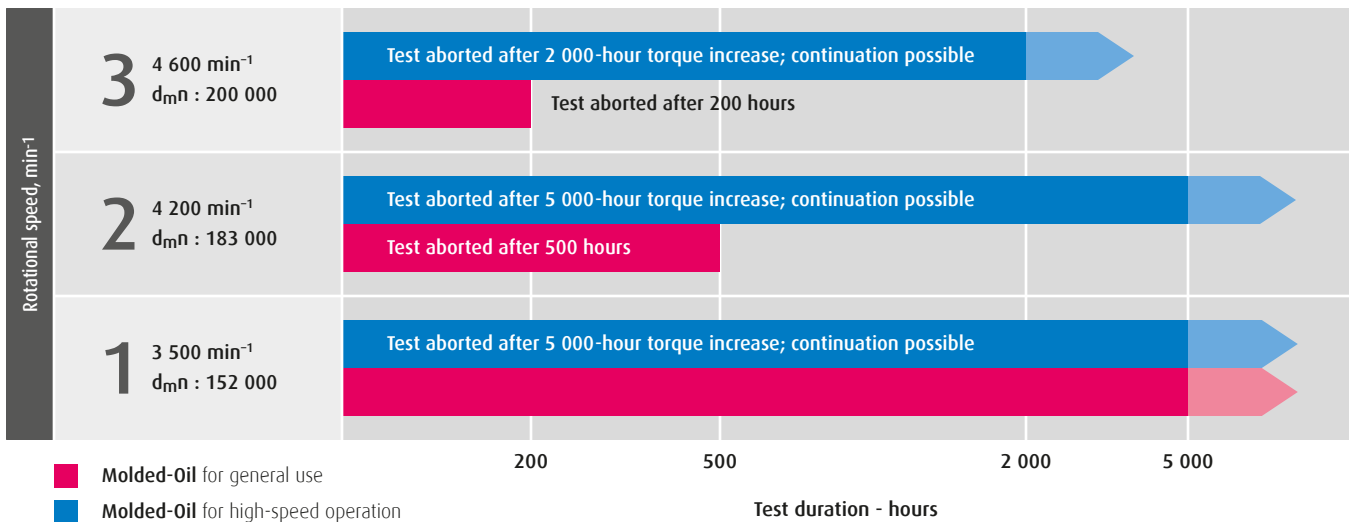


DURABILITY: PERFORMANCE TEST

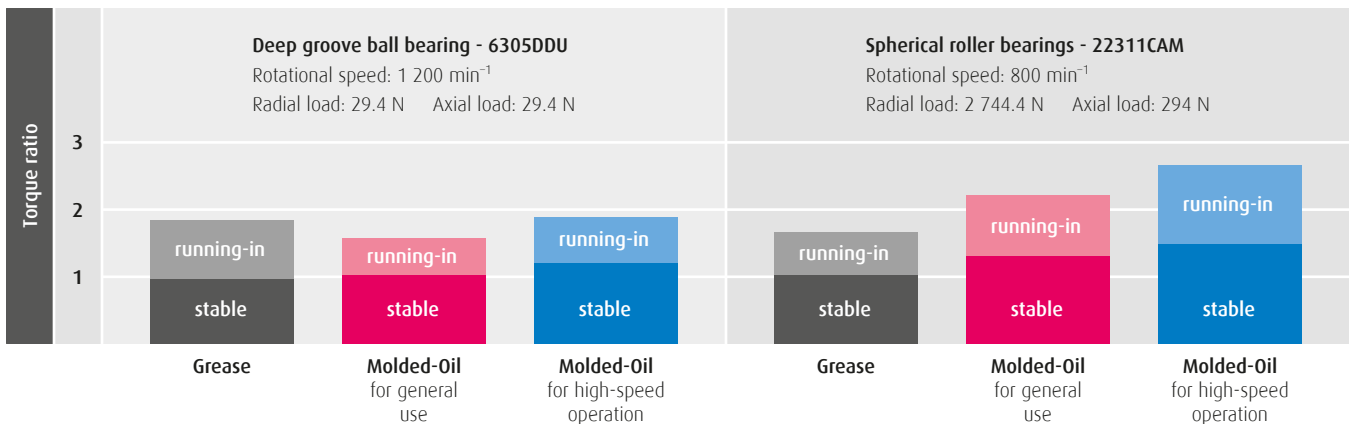
Slow seeping of the lubricant from Molded-Oil provides excellent lubrication performance for extended periods. Molded-Oil Bearings for general use cannot be used under conditions of high-speed rotation, but Molded-Oil Bearings for high-speed operation perform with excellent durability under such conditions.

DURABILITY PERFORMANCE TEST		
TEST PARAMETERS	Test bearings	6305DDU
	Radial load	98 N
	Axial load	245 N
	Rotational speed	1. 3 500 min ⁻¹ (d _{mn} : 152 000)
2. 4 200 min ⁻¹ (d _{mn} : 183 000)		
3. 4 600 min ⁻¹ (d _{mn} : 200 000)		

Durability test results of deep groove ball bearings



BEARING TORQUE COMPARISON: GREASE LUBRICATED AND MOLDED-OIL BEARINGS



ADDITIONAL SOLID LUBRICANT OPTIONS

A BROAD RANGE OF APPLICATION SOLUTIONS

NSK has augmented our “available from stock” Molded-Oil bearings with an expansive range of solid lubricant solutions tailored to meet specific customer requirements. The range of application challenges met includes:

- › Extreme temperatures, with solutions for temperatures ranging from as low as -50°F to as high as 350°F
- › Heavy loads with low speeds, with high viscosity oil to accommodate heavily loaded roller bearings
- › Food grade solutions, including suitability for incidental food contact and food processing
- › High temperature wash down applications

These highly customized solutions can be applied to a wide range of rolling bearing types including deep groove, angular contact and self-aligning ball bearings as well as spherical, cylindrical, tapered and thrust roller bearings.





IMPROVEMENT PAYS.

END-TO-END SERVICE DELIVERS CUSTOMER SUCCESS

Improvement never ends. And we never stop looking for better ways to support our customers in a complete, collaborative and continuous way. The focus of NSK isn't simply on a quick fix for immediate gain – it's about incremental and sustainable improvement to deliver long-term benefits.

When NSK is on-site, we're there to understand our customers' challenges and identify problems contributing to frequent bearing replacement, breakdowns caused by poor specification, high energy costs from inefficient product selection and lost production because of downtime. We collaborate with our customers to institute an **Asset Improvement Program (AIP)** that encompasses process and maintenance management, diagnostic and educational support to deliver measurable gains in output and cost-efficiency.

With NSK, our customers embark on a critical path to realizing improvements in equipment, productivity, people and financial performance.





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