



SKF @ptitude Exchange



LubeSelect

A bearing lubrication advisory system

Summary

Selecting the correct lubrication for a particular bearing is a crucial step for bearing longevity. SKF engineers have considerable experience and knowledge of greases and oils in association with bearing operation. This knowledge has been encapsulated into an online computer program called LubeSelect, available on <http://www.skf.com>. The program allows users to choose from a range of grease and oil types, dependant on the particular operating conditions of the application.

Contact details and further information:

Email : skfweb@skf.com

Web: www.skf.com/group/index.html

GS02001

Gerard Schram

8 Pages

Published April,

2001 Revised July, 2012



Introduction

Appropriate lubrication is crucial in all bearing applications. SKF has developed deep knowledge of this topic through fundamental understanding of lubrication, empirical test results, and application experience. SKF's understanding of bearing lubrication has been condensed into a knowledge-based System called LubeSelect. The system, accessible internally since 2000, and externally via Internet since 2002, helps select lubrication by tapping into the combined experience of SKF engineers. As many as 300 SKF engineers use LubeSelect every week. LubeSelect ranks greases and oil types on the basis of their relevance to the application conditions.

the creation and flow of knowledge through the company. Amongst the ways to exploit knowledge are expert systems for decision-support. Knowledge can be represented in best practice examples (generalized rules of physical relations with empirical parameters). Different knowledge-based solutions are available depending on the nature and maturity of the knowledge. In line with the dot.com revolution, expert systems can be accessed on the web. Within the SKF Engineering and Research Center, a system was developed for decision support in lubrication. The knowledge resides in fundamental understanding of grease and oil lubrication, empirical test results, and application experience. This knowledge is utilized through LubeSelect, which is available globally via the Internet.



Figure 1. LubeSelect is a knowledge-based system for bearing lubricant selection.

In today's knowledge economy, companies need to differentiate themselves with high quality products, and by exploiting their unique knowledge. Knowledge management introduces ways to optimize

Background

Bearing lubricant selection has traditionally been based on the oil viscosity ratio only. The goal of adequate lubricant viscosity was to build up a thin film of lubricant to prevent direct metallic contact between the rolling elements, raceways and cages. Depending on the various bearing operating conditions, the required oil viscosity can be determined with bearing manufacturers' recommendations with the help of (on-line) catalogues. The ratio between the viscosity of a particular (base) oil at the operating temperature, and the required viscosity needed in the bearing application, is called the viscosity ratio (denoted by a kappa). A rule of thumb is that values between 1 and 2.5 are desired,



but this depends on various other bearing and lubricant factors as well, as discussed below.

A rudimentary expert system, based on viscosity ratio calculations, was developed for grease selection. That system served as a base for recommendations that further differentiated between greases by adding selection criteria other than the viscosity ratio.

A recently developed database, LuBase (www.skf.com), contains product information on a wide range of greases. The system allows for simple searches based on viscosity or consistency. Other bearing suppliers have introduced similar databases and a search facility based on consistency, thickener type, base—oil type and viscosity.

Although the viscosity ratio is still a useful parameter (in particular for oil lubrication), the complexity of grease lubricant performance with special additives, solids, thickeners, base-oil types and other factors is not fully represented. Instead, one must consider all performance characteristics of the grease lubricants light of the bearing application.

Searching on consistency, thickener type, etc. is a step in the right direction.

However, the most important translation from application conditions to desired grease properties is missing. LuBase and other systems operate by allowing users to search through a grease database. LubeSelect, on the other hand, provides lubricant suggestions based on application conditions.

Working principles

LubeSelect can be consulted in two ways:

1. Via application conditions. The conditions describe the bearing environment and are mapped to the performance characteristics of individual greases or oil types. The best “rated” lubricants are ranked first.
2. Via application profiles. For a range of typical bearing applications, grease advice is formulated based on proven-practice examples.

Selection via application conditions

The first step in selecting a lubricant is to get basic information about the bearing application. The user supplies about 30 application parameters. For particular requirements, the user can differentiate importance. Requirements are high rust protection, low noise, biodegradability, etc.



SKF

LubeSelect

Application Conditions | Application Profiles | Links | Help

About

About LubeSelect

LubeSelect is developed by [SKF](#). Through this application, you will access a knowledge base to help you in the selection of an appropriate lubricant for a particular application. You can select a lubricant based on:

- [application conditions](#)
- [application profiles](#)

By filling in the **application conditions**, an analysis is made and greases are suggested. This analysis is based on **generalized selection rules** that are carefully developed with SKF lubrication experts. The suggested greases and oils are a weighed compromise to fulfil the described application conditions as well as possible.

By selecting an **application profile** that is most similar to your application, these profiles give **best-practise** suggestions, based on (years of) experience of business segments, product center's, and SKF lubrication experts.

The two approaches are complementary, the application profiles give suggestions "from the field", while the suggestion based on a description of application conditions is based on extensive "analysis".

[Start](#)

Figure 2. Lubricant selection by application conditions, or application profile

LubeSelect

Application Conditions | Application Profiles | Links | Help

About

Select on application conditions

Fields marked with * are mandatory

[Click here for help on conditions](#)
[Click here for other languages](#)

Dimensions:

Bearing designation

or

Bearing type *

Inner diameter d mm*

Outer diameter D mm*

Bearing width/height mm

Bearing Serie (Only spherical roller bearings)

Load ratio $F_a / F_{rl} > e$ (Only spherical roller bearings)
 No Yes

Bearing Arrangement (Only cylindrical roller bearings)

Filling Type*

Pre-greased (SKF only)
 Relubricated
Preferred supplier:

Oil

Load (C/P)*

Low (>15)
 Medium (8-15)
 High (4-8)
 Very high(<4)

Shock load*

No Yes

Ambient Temperature*

Less than -10°C
 Between -10 and 35°C
 More than 35°C

Outer ring temperature:

Typical temperature °C*

Minimum temperature (start-up) °C

Maximum temperature (peak) °C

Rotational speed RPM*

[Start](#)

[Click here for help on conditions](#)
[Click here for other languages](#)

Figure 3. Lubricant Selection via Application Conditions. Other Conditions like Vertical Shaft, Outer Ring Rotation, and Special Requirements like High Rust Protection, Low Noise, Biodegradability, etc., can also be specified.



If application conditions are outside the standard range or special conditions apply, a wider range of greases is considered. These preferred greases are differentiated by their individual performance on bearing-specific criteria. Assuming a range of criteria, specific performance tests are applied (such as a test-rig for noise level measurements, or one of the many lubricant standard tests). After considering the application conditions, the grease`s total score is determined as a fuzzy number between 0 and 1 (no fit : 0, full fit = 1) from the required criteria.

The relevant fuzzy logic calculations are selected from fuzzy decision theory — a computational intelligence methodology. In essence this means that;

- The scoring on different performance criteria is (weighed) averaged.
- The user selects "importance factors" to weigh the criteria, and
- A "zero" score on one criterion cannot compensated by other criteria.

Therefore, the so-called geometric mean operator is chosen by:

$$Score_j = \prod_{i=1}^{n_p} (\mu_{i,j})^{v_i}, \text{ for } i=1, \dots, n_p \text{ and } j = 1, \dots, n_g$$

Where

v_i = normalized weight factor

$\mu_{i,j}$ = performance of the jth grease for the ith criterion

n_g = number of greases

n_p = number of performance criteria

$Score_j$ = total score for the jth grease

After assessment, the grease lubricants are ranked according to their individual scores, the final scores are expressed in percentages. The grease's rating, including its scoring is the key outcome of selection advice (Figure 4). A range of non-SKF grease lubricants is included as well. This range can be extended by consulting the SKF Engineering and Research Center about the criteria.

The system is further extended by various rules for exception handling and ranking. The recommended grease(s) are accompanied by calculated grease life (or relubrication interval), viscosity ratio, warnings on high start—up (viscous) friction, grease quantity and other grease information.

The oil (type) lubrication advice is mainly based on temperature and viscosity ratio. The result is a list of possible oil types and the desired viscosities (Figure 5). The additional information is provided for the oil types as well. With the information, the user can select a particular oil from any supplier.



SKF Home | Help

LubeSelect Application Conditions Application Profiles Links Help

About

Advise

The following lubricants have been found to be appropriate for the specified application conditions. A **green** color indicates a suitable lubricant for this application. A **red** color indicates that one or more application conditions are not fulfilled. Click on a lubricant to view calculated results and additional information.

Rating	Grease	Supplier	Kappa	Relubrication interval	Poor performance on
****	LGWA2	SKF	3.7	2300	-
****	LGHB2	SKF	>4	2600	-
***	Retinax LX 2	Shell	3.6	1400	-
***	Coralia-2	Verkol	2.6	1500	-
***	LGEP2	SKF	4.0	1500	-
***	Verkofood complex-2	Verkol	3.8	1100	-

Grease Rating A detailed explanation of the rating for all greases.

Report Create a final report including application conditions and selection results.

Figure 4. LubeSelect suggests a range of alternative lubricants. Apart from the scoring, viscosity ratio and grease life values are given as well. Individual information and reporting functions are provided by clicking on one of the grease designations.

The system is further extended by various rules for exception handling and ranking. The recommended grease(s) are accompanied by calculated grease life (or relubrication interval), viscosity ratio, warnings on high start-up (viscous) friction, grease quantity and other grease information.

The result is a list of possible oil types and the desired viscosities (Figure 5). The additional information is provided for the oil types as well. With the information, the user can select a particular oil from any supplier.

The oil (type) lubrication advice is mainly based on temperature and viscosity ratio.



LubeSelect Application Conditions Application Profiles Links Help

About

Advise

The following lubricants have been found to be appropriate for the specified application conditions. A green color indicates a suitable lubricant for this application. A red color indicates that one or more application conditions are not fulfilled.

Oil type	k (80°C) [-]	n_{req} (40°C) [cSt]	k (100°C) [-]	Risk of high start-up torque at 10°C	Poor performance
Mineral	1.0	38.0	0.62	Low	-
	2.5	130.0	1.4	Low	
Ester	1.0	31.0	0.65	Low	-
	2.5	100.0	1.5	Low	
PAO	1.0	31.0	0.65	Low	-
	2.5	100.0	1.5	Low	
Polyglycol	1.0	27.0	0.68	Low	-
	2.5	82.0	1.6	Low	

Remark:

- EP and AW additives are recommended. The suitability of EP additives depends largely on temperature and can become aggressive to the steel surface above 100°C.
- Minimum oil flow needed=0.16 [dm³/min] to lubricate the bearing, i.e. the oil flow does not cool the bearing. In case additional heat dissipation by the oil is needed, the required flow can be calculated with the SKF B3SL program in Galaxy.
- The permissible operating temperature depends on the interaction between oil and cage material. The SKF General Catalogue 6000 shows the variation of this permissible temperature for a glass fibre reinforced polyamide 6,6 cage with various lubricants.

Create a final report including application conditions and selection results.

Figure 5. LubeSelect suggests a Range of/ alternative oil types. Depending on the viscosity ratio at operating temperature, the required oil viscosity is provided. Additional input is given concerning the viscosity ratio at peak temperature and the risk of a high start-up torque at minimum temperature.

LubeSelect Application Conditions Application Profiles Links Help

About

Suction rolls in paper mills

Application profile	
typical bearing type / size	SRB / 300.0 - 800.0 mm.
operating temperature range	Medium
operating speed	Low, Medium
load	Low

Relevant properties for lubricant	
Decisive	Water resistance, Rust protection, Wear resistance, Smearing protection, Good lubricating ability
Substantial	
Minor	Cost

Lubricants (SKF grease designations; otherwise supplier indicated)	
Typically used greases; pre-greased	-
Typically used greases; relubrication	LGEP2
SKF alternative; relubrication	LGEP2, LGHB2
Typically used oils	-

Note: Relubrication: automatic (small quantities each 1-2 days) or manual once a week. At higher speeds oil lubrication is normally applied.

Figure 6. Application Profile Report for Suction Rolls in a Paper Mill.



Selection via application profiles

Another approach in selecting a lubricant is to consider proven—practice application profiles. In cooperation with SKF business segments, lubrication experts, application engineers and about 50 application profiles (for example, pulp and paper applications, Figure 6) are included.

Conclusion

The introduction of a knowledge-based system such as LubeSelect is an effective way to apply key company knowledge to daily decisions, available on <http://www.skf.com>.

References

Klir, G.J., Yuan, B., Fuzzy Sets and Fuzzy Logic. Prentice Hall NJ: 1995.

Schram, G., "Decision-Support System for Selecting Bearing Lubricants", Evolution, 4/2001. (see <http://www.evolution.skf.com>)