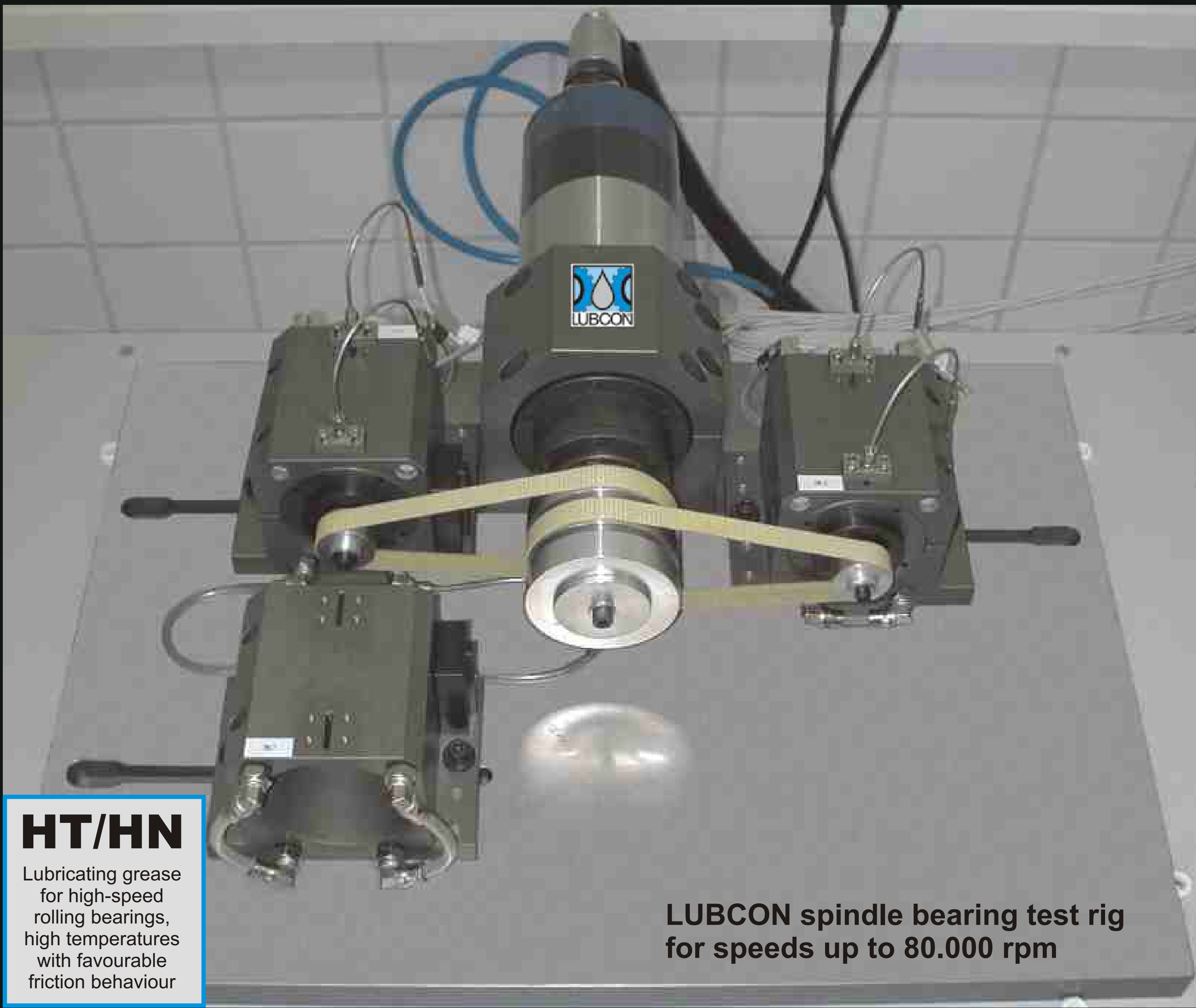
We have the solution...

...the future has a name

LUBCON®



HT/HN

Lubricating grease for high-speed rolling bearings, high temperatures with favourable friction behaviour

LUBCON spindle bearing test rig for speeds up to 80.000 rpm

Reg.-Nr. 17581-04 Reg.-Nr. 17581-04

THERMOPLEX®
2 TML

Use Lubricants which are Successfully Applied by the Industry.

The high efficiency of the **LUBCON** lubricants is proven by

- **long service life**
- **good running properties**
- **high operational reliability**

THERMOPLEX® 2 TML for

- rolling bearings subject to high temperatures
- high temperatures up to +160 °C
- low up to high speeds
- low up to high loads
- the lubrication of various types and sizes of bearings

Advantages

- **good protection against corrosion and ageing**
- **compatible with non-ferrous metals, NBR elastomers, PA 66-GF 25 plastics**
- **favourable noise behaviour**
- **good oxidation stability**
- **load-carrying capacity is sufficient even at a high temperature**
- **suitable for application in critical types of rolling bearings**
- **service life of grease and the achievable bearing life is above average**
- **tailor-made formulations, if required specifications exceed THERMOPLEX® 2 TML standards**

The friction behaviour of small to medium-size deep groove ball bearings lubricated with **THERMOPLEX® 2 TML** is very good. Friction is generally low, the grease spreads within a relatively short time and grease losses in **2 ZR bearings** are comparatively low.
This grease meets the requirements of **grease class D** in accordance with FAG specifications, a fact proven in several tests.
It also meets requirements usually only met by special greases for high speeds, high temperatures and high bearing loads.

Service temperature range: -35 °C up to +140 °C, short time up to +160 °C	
Suitable for the following rolling bearings:	Speed factor $n \cdot d_m$ ($min^{-1} \cdot mm$)
Spindle bearings	up to 1 300 000 for P/C < 0.05
Deep groove and angular contact ball bearings, cylindrical roller bearings	up to 600 000 for P/C < 0.05 up to 1 000 for P/C < 0.5
Self-aligning and tapered roller bearings	up to 300 000 for P/C < 0.05

Practical application

This high-performance lubricating grease for high temperatures, speeds and loads is applied successfully in spindles, textile machines, electric motors, fans also in small and miniature bearings.
It is also particularly suitable for electric contacts.

Application in rolling bearings

Requirements

- proper bearing assembly
- sufficient lubricant quantity on all functional surfaces
- suitability of rolling bearings for such requirements (cage design and material, dimensional accuracy of the bearings and the surrounding components)

Low-speed bearings and their housings generally require a complete grease fill.
Bearings operating at low medium speeds (corresponding to $n \cdot d_m < 200\,000\ min^{-1} \cdot mm$) have to be completely filled with grease, the adjacent housing space, however, only to such an extent that the grease emerging from the bearing can be incorporated easily.

In case of high rotational speeds the bearings should only be filled to 40 - 60 % of the free bearing space, if the running-in period to distribute the grease is required to be short.
If, however, a longer running-in period is acceptable the free bearing space can be filled up to 80 %.

The service life of the grease increases with the grease quantity. If the free space adjacent to the bearing is large, we recommend to use seals or shields to ensure that a sufficient grease quantity is retained in the bearing.

Relubrication intervals

Relubrication quantities are indicated in **table 2**, **p. 5**. Relubrication is a problem in case of high speeds. If the used grease is not replaced by a sufficient quantity of new grease this may result in overlubrication, a condition which cannot be corrected by means of intensive running-in and which may lead to increased temperatures. A better solution is to clean the bearings and relubricate them with fresh grease. The relubrication interval t_f for favourable operating and ambient conditions is indicated in the **diagram 1**, **p. 5**. **Table 3**, **p. 5** shows the reducing factors f_1 to f_5 applicable in case of unfavourable operating and ambient conditions.

THERMOPLEX® 2 TML is a high-performance grease ensuring extended relubrication intervals: the upper limit of the wide curve shown in the **diagram 1**, **p. 5** is valid for this grease. To obtain the actual lubrication interval t_{fq} multiply the relubrication interval as given in the **diagramm 1** with the reducing factors:

$$t_{fq} = t_f \cdot f_1 ... f_5$$

The technical data of this grease including information on compatibility with sealing and cage materials are listed on **table 1**, **p. 4**.

Noise test with FAG MGG 11

The noise behaviour was tested on an MGG 11 noise tester. The result (noise class II/1) is good, taking into consideration that the range from I to IV covers very good moderate results.

Determination of the application range

The upper service temperature limit of +160 °C is based on DIN 51821 and the result of FE9 test runs with bearings of a 30 mm bore diameter and an operating time F_{50} = 112 h, **diagram 2**, **p. 6**.

In the specifications according to DIN 51825 for “lubricating greases K” the upper temperature limit has to be ensured throughout an operating time of 100 hours.

Further FE9 tests provide information about the extension of the operating time at temperatures below the upper temperature limit and with a speed increased beyond the standard test value:

- Standard test at +140 °C: F_{10} = 400 h, i. e. seven times longer than normal, see **diagram 3**, **p. 6**.
- Standard test at +140 °C and a 50 % higher rotating speed: F_{10} still is 224 h, see **diagram 4**, **p. 7**.

- Standard test at +140 °C and a 100 % higher rotating speed: a shielded bearing achieves an operating time of F_{10} = 151 h, see **diagram 5**, **p. 7**.

This comprehensive high-temperature test clearly shows that the product is also suitable for increased rotating speeds. Bearings with cages made of plastic material have proven especially suitable. The operating time were shorter when sheet metal cages were used.
The lower temperature limit was deducted from the flow pressure at -35 °C specified in DIN 51805.
Owing to the low flow pressure of 1365 hPas as determined in the DIN test, relubrication is still possible at -35 °C.

The range of application of the rolling bearings is based on the **FE8 test** with bearings of a 60 mm bore diameter:

- At a low rotating speed and a relatively high load the specified 500 operating hours were achieved without any failures and with only very little wear of bearing elements. This test was carried out with angular contact ball bearings at a temperature of +140 °C.
  The **diagram 6**, **p. 8** shows the results.
- The high-speed range was tested at speeds close to the upper limit of the permissible speed range. This test was also carried out with angular contact ball bearings at a temperature of +140 °C. The **diagram 7**, **p. 8** shows the pertinent results. The **diagram 8**, **p. 9** gives the results obtained at the same temperature with tapered rolling bearings.

The test was evaluated by comparing the wear results to FAG’s grease classes (= FAG specification).
For the evaluation it was decisive that the 500 hour tests were completed without failures and that wear was only moderate.

Important test runs were repeated several times, i. e. the results can be considered reliable.
Even though these were short-period tests they prove that the suitability of **THERMOPLEX® 2 TML** for the indicated requirements is above average.

When the speed and load limits pertaining to the individual bearings types are observed, the indicated lubrication intervals are achieved and performance is generally satisfactory.

The deviation of the test speeds from the indicated speed factors are due to the test rig.
The increased speed factor was chosen out of practical experience.

Determination of the application range

In case of tapered roller bearings it is of vital importance that the cylinder faces and the lip surface are rapidly run in.
Fig. 1, **p. 9** shows the running-in profile of the lip surface of one of the test bearings after test run 1 as shown in **diagram 8**, **p. 9**.
The lip surface was quite rough in the beginning and extremely smooth in the end.
This smoothing effect supports the formation of hydrodynamic contact areas and prevents further wear.

Friction behaviour

The friction behaviour was tested on an FAG R6 test rig. **Diagram 9**, **p. 10** shows the test results.
The rapid distribution of the grease and the low degree of deviation of the five bearings tested is particularly striking. The rapid grease distribution is shown by the early decrease of friction in the test run.
The low friction in the steady-state condition and the moderate loss of grease (<20 mg) show that this product is suitable for sealed and shielded bearings.

Table 1: Technical information of THERMOPLEX® 2 TML

Technical Data	THERMOPLEX® 2 TML
Colour	beige/transparent
Thickener	Lithium
Base oil viscosity (mm²/s) +40 °C/+100 °C	Ester 55/9
Drop point (°C), DIN ISO 2176	>190
Worked penetration 60 TT (mm/10) DIN ISO 2137	265 - 295
Water resistance +90 °C DIN 51807	1 - 90
SKF Emcor Corrosion protection DIN 51802	0 - 0
Oxidation resistance 100 h/+100 °C, DIN 51808	0.2
Copper corrosion +120 °C, DIN 51811	Rating 1
Flow pressure at -35 °C (hPa), DIN 51805	1365
Oil separation in % by wt. +40 °C/+100 °C, DIN 51817	2.8/8.9
Content of solid matters, particles 25 µm (mg), DIN 51813	<5
Behaviour towards NBR elastomer, 7 days at +100 °C Change of Shore A hardness, DIN 53505 ± 15 SAH, tearing elongation 150 % Change in volume max. ± 10 %, DIN 53521 PA66-GF25 42 days at +120 °C, tearing strength 130 N/mm² Tearing elongation 2 %, DIN EN 61 Impact tenacity, DIN EN 61 20 mJ/mm², DIN 53453	+3 SAH -18 % +1.5 % +3.9 N/mm² +17.8 % -15 mJ/mm²

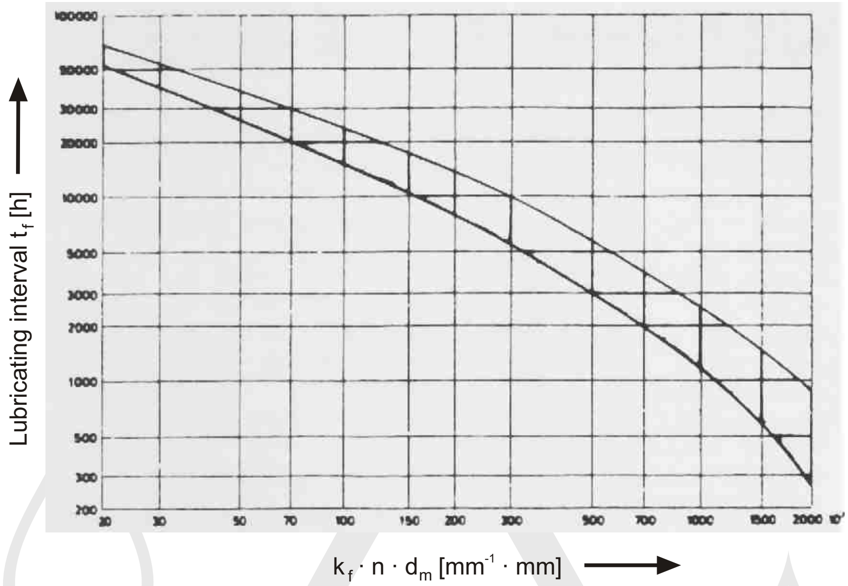


Diagram 1: Lubricating interval for favourable operating and environmental conditions

Type of bearing		k_f
Deep groove ball bearing	single-row	0.9 ... 1.1
	double-row	1.5
Angular contact ball bearing	single-row	1.6
	double-row	2
Spindle bearing	α = 15°	0.75
	α = 25°	0.9
Four-point contact bearing		1.6
Spherical ball bearing		1.3 ... 1.6
Deep groove ball thrust bearing		5 ... 6
Angular contact ball thrust bearing double-row		1.4

Type of bearing		k_f
Cylindrical roller bearing	single-row	3 ... 3.5
	double-row	3.5
	full-row	25
Thrust cylindrical roller bearing		90
Needle bearing		3.5
Tapered roller bearing		4
Barrel-shaped roller bearing		10
Spherical roller bearing without flanges (»E«)		7 ... 9
Spherical roller bearing with centre flange		9 ... 12

Relubrication quantity m_1 for weekly or annual relubrication intervals

$$m_1 = D \cdot B \cdot x \text{ [g]}$$

Relubrication interval	x
weekly	0.002
monthly	0.003
annual	0.004

Relubrication quantity m_2 for extremely short relubrication intervals

$$m_2 = (0.5 \ldots 20) \cdot V \text{ [kg/h]}$$

Relubrication quantity m_3 before starting reoperation after a standstill of severals years

$$m_3 = D \cdot B \cdot 0.01 \text{ [g]}$$

V = free space in the bearing

$$\approx \frac{\pi}{4} \cdot B\,(D^2 - d^2) \cdot 10^{-9} - \frac{G}{7800} \text{ [m}^3\text{]}$$

d = diameter of the bearing bore [mm]
D = outer diameter of the bearing [mm]
B = bearing width [mm]
G = bearing weight [kg]

Table 2: Relubrication quantities

Influence of dust and moisture at the functional surfaces of the bearing

moderate		f_1 = 0.7 ... 0.9
strong		f_1 = 0.4 ... 0.7
very strong		f_1 = 0.1 ... 0.4

Influence of impact loads, vibrations and oscillations

moderate		f_2 = 0.7 ... 0.9
strong		f_2 = 0.4 ... 0.7
very strong		f_2 = 0.1 ... 0.4

Influence of increased bearing temperatures

moderate	(up to +75 °C)	f_3 = 1 ... 0.9
	(+75 ... +85 °C)	f_3 = 0.9 ... 0.7
strong	(+85 ... +120 °C)	f_3 = 0.7 ... 0.4
very strong	(+120 ... +160 °C)	f_3 = 0.4 ... 0.1

Influence of high loads

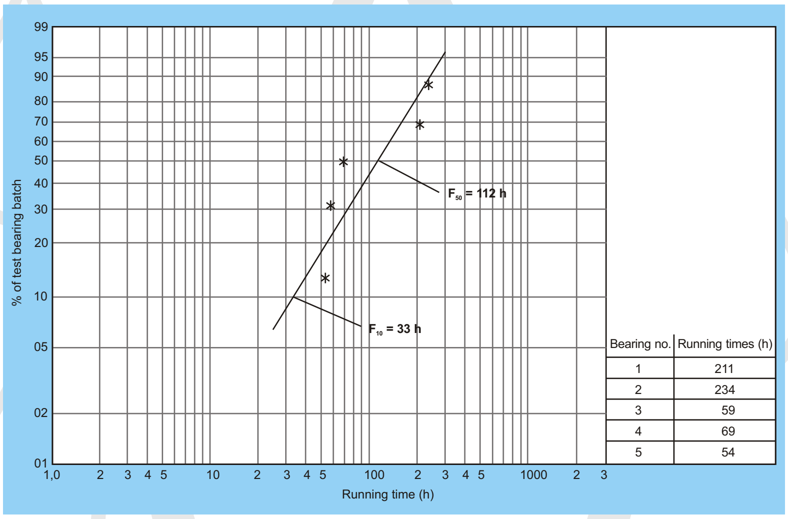
P/C = 0.05 ... 0.1	f_4 = 0.9 ... 0.7
P/C = 0.1 ... 0.15	f_4 = 0.7 ... 0.4
P/C = 0.15 ... 0.25	f_4 = 0.4 ... 0.1
P/C = > 0.25	f_4 = < 0.1

Influence of current streaming through the bearing

slight current	f_5 = 0.5 ... 0.7
strong current	f_5 = 0.1 ... 0.5

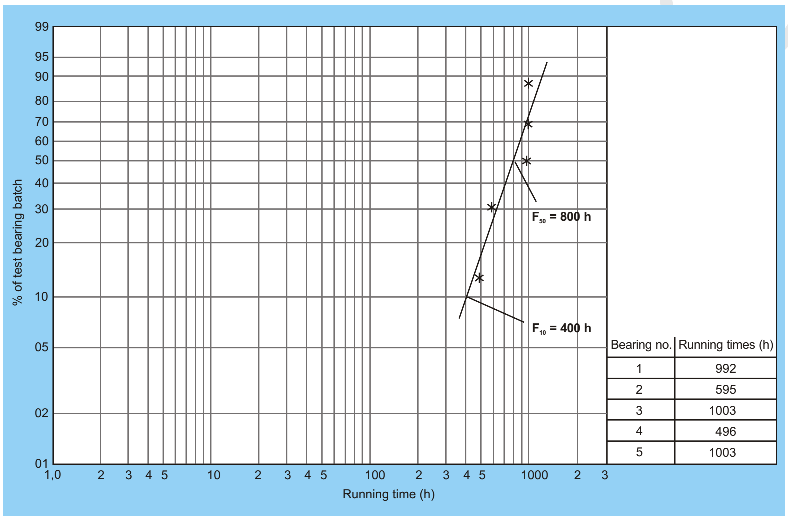
Table 3: Reducing factors for **THERMOPLEX® 2 TML**

FAG FE9 Test runs



Bearing no.	Running times (h)
1	211
2	234
3	59
4	69
5	54

Diagram 2:
FE9 test run with angular contact ball bearing 529689 (≙ 7206 B), assembly A, i. e. open bearing; axial load F_a = 1.5 kN; speed n = 6000 min^{-1}; temperature +160 °C; Lubrication with **THERMOPLEX® 2 TML**
Grease service life of the bearings in h: determination in Weilbull diagram of F_{50} = 112 h; F_{10} = 33 h
Requirements acc. to FAG and DIN 51825 F_{50} = 100 h → **Evaluation: fully meets the requirements**



Bearing no.	Running times (h)
1	992
2	595
3	1003
4	496
5	1003

Diagram 3:
FE9 test run with angular contact ball bearing 529689 (≙ 7206 B), assembly A, i. e. open bearing; axial load F_a = 1.5 kN; speed n = 6000 min^{-1}; temperature +140 °C; Lubrication with **THERMOPLEX® 2 TML**
Grease service life of the bearings in h: determination in Weilbull diagram of F_{50} = 800 h; F_{10} = 400 h
Requirements acc. to FAG and DIN 51825 F_{50} = 100 h → **Evaluation: very good**

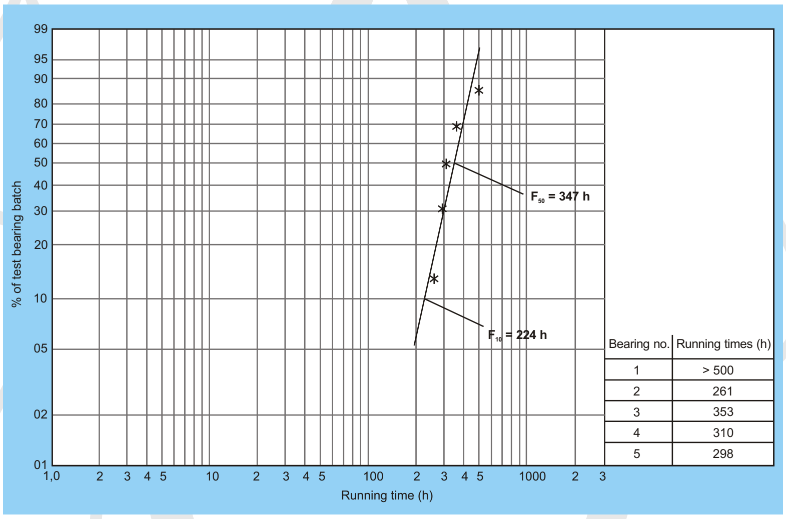


Diagram 4:
FE9 test run with angular contact ball bearing 529689 (≙ 7206 B), assembly A, i. e. open bearing; axial load F_a = 1.5 kN; speed n = 9000 min^{-1}; temperature +140 °C; Lubrication with **THERMOPLEX® 2 TML**
Grease service life of the bearings in h: determination in Weilbull diagram of F_{50} = 347 h; F_{10} = 224 h
Requirements acc. to FAG and DIN 51825 F_{50} = 100 h → **Evaluation: very good**

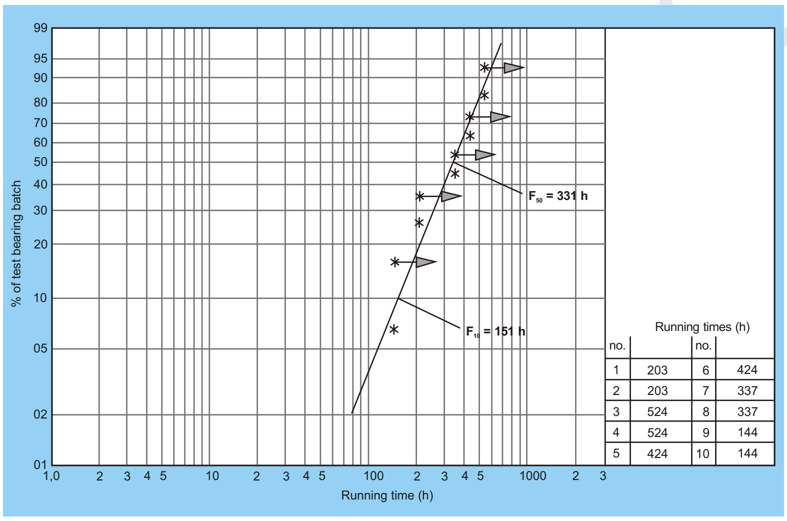


Diagram 5:
FE9 test run with angular contact ball bearing 529689 (≙ 7206 B), assembly B, i. e. shielded bearing; axial load F_a = 1.5 kN; speed n = 12 000 min^{-1}; temperature +140 °C; Lubrication with **THERMOPLEX® 2 TML**
Grease service life of the bearings in h: determination in Weilbull diagram of F_{50} = 331 h; F_{10} = 151 h
Requirements acc. to FAG and DIN 51825 F_{50} = 100 h → **Evaluation: very good**

FAG FE8 Test runs

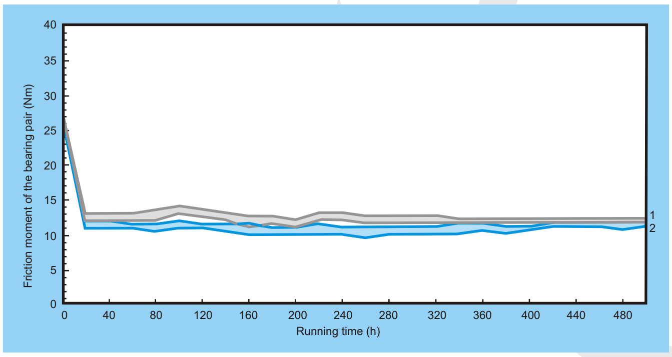


Diagram 6:
FE8 test run with angular contact ball bearing 536050 JP (≙ 7312 B); axial load F_a = 80 kN; speed n = 7.5 min^{-1}; time of operation 500 h
Lubrication with **THERMOPLEX® 2 TML**

Parameters	**Test run 1**	**Test run 2**	**FAG requirements**
Steady-state temperature in °C	139	136	
Peak temperature in °C	143	141	
Wear in mg of - the rolling elements - the cage - the inner ring - the outer ring Frictional behaviour over the time (see diagram left)	 22/22 7/7 24/11 45/32 Running-in finished, very smooth	 17/15 9/9 25/25 76/52 Running-in finished, very smooth	 < 35 **Evaluation: very good**

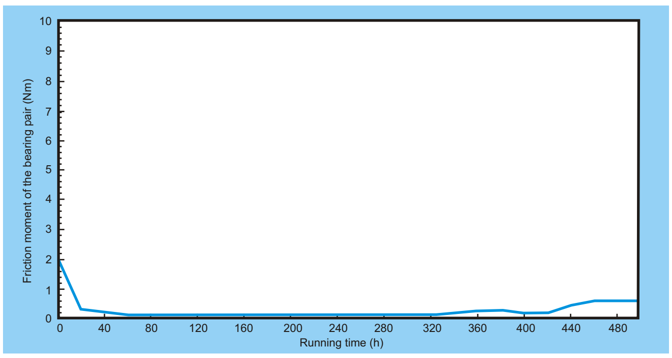


Diagram 7:
FE8 test run with angular contact ball bearing 536050 JP (≙7312 B); axial load F_a = 10 kN; speed n = 3000 min^{-1}; time of operation 500 h
Lubrication with **THERMOPLEX® 2 TML**

Parameters	**Test run 1**	**FAG requirements**
Steady-state temperature in °C	144	
Peak temperature in °C	167	
Wear in mg of - the rolling elements - the cage - the inner ring - the outer ring Frictional behaviour over the time (see diagram left)	 17/16 2/12 10/14 25/29 Running-in finished, very smooth	 < 35 **Evaluation: very good**

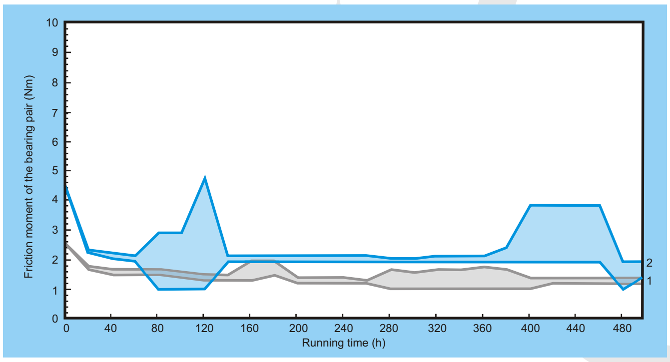
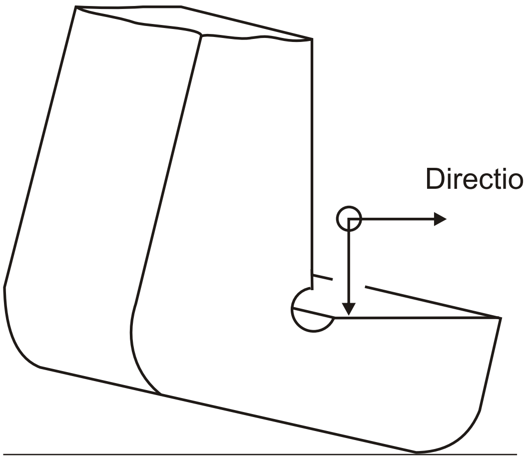


Diagram 8:
FE8 test run with tapered roller bearing 536048 (≙ 31312);
axial load F_a = 10 kN; speed n = 3000 min^{-1}; time of operation 500 h
Lubrication with **THERMOPLEX® 2 TML**

Parameters	Test run 1	Test run 2	FAG requirements
Steady-state temperature in °C	135	131	
Peak temperature in °C		140	
Wear in mg of - the rolling elements - the cage - the inner ring - the outer ring Frictional behaviour over the time (see diagram left)	 17/27 237/179 20/19 71/89 Running-in finished	 32/1 157/79 27/1 31/28	 < 35 **Evaluation: very good**



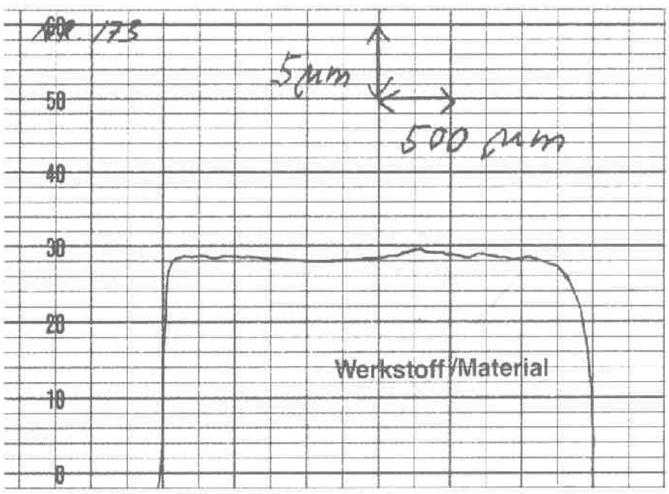


Fig. 1: Running-in profile of the lip surface of a bearing as tested in **diagram 8**.

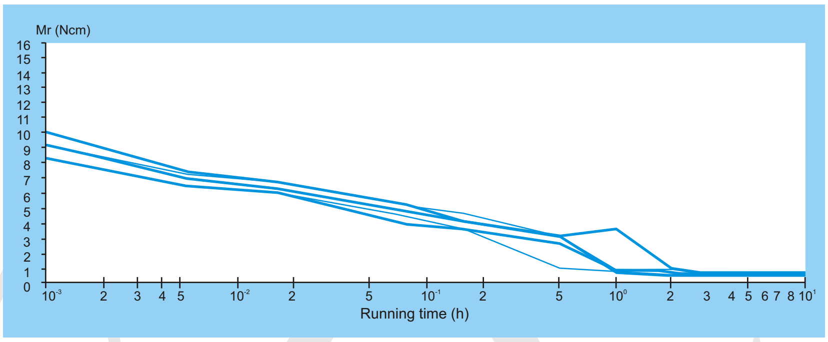


Diagram 9:
R6 test run with deep groove ball bearing 6203.2ZR.C3; preservation of the test bearing with Fuchs TX 10A; axial load F_a = 179 N; radial load F_r = 23 N; speed n = 7500 min^{-1}; running time 10 h
Lubrication with **THERMOPLEX® 2 TML**
Steady-state temperature +28 ... +30 °C; peak temperature +40 °C; grease loss 10 - 20 mg

THERMOPLEX® 2 TML; a lubricating grease for rolling bearings that has proven effective in many applications, particularly at high temperatures. **Modified versions with tailor-made formulations provide an extended range of performance for specific applications:**

Special application	Base oil V_{40} (mm^2/s)	Name of grease
High load; temperature: -40 °C up to +140 °C Speed factor: $n \cdot d_m$ ($min^{-1} \cdot mm$) = 1 mill.	MIN 85	TURMOGREASE® Li 802 EP
Temperature: -40 °C up to +160 °C	Ester 55	THERMOPLEX® 2 HPL
Rotating outer ring; temperature: -40 °C up to +180 °C Speed factor: $n \cdot d_m$ ($min^{-1} \cdot mm$) = 1 mill.	Ester 55	THERMOPLEX® L 553
Temperature: -40 °C up to +180 °C Speed factor: $n \cdot d_m$ ($min^{-1} \cdot mm$) = 1 mill.	Ester 70	THERMOPLEX® L 753
High temperature grease, high load; temperature: -35 °C up to +200 °C Speed factor: $n \cdot d_m$ ($min^{-1} \cdot mm$) = 1 mill.	Ester 55	THERMOPLEX® I/300
Temperature: -60 °C up to +260 °C Speed factor: $n \cdot d_m$ ($min^{-1} \cdot mm$) = 0,5 mill.	FK/Li 150	TURMOTEMP® LP 1502
Low temperature highspeed grease, life-time lubrication FE9 test F_{10}: A/1,5/6000-100°C-1000h; temperature: -70 °C up to +120 °C Speed factor: $n \cdot d_m$ ($min^{-1} \cdot mm$) = 1,6 mill.	Ester 20	THERMOPLEX® 2 TML spezial
Low temperature highspeed grease, life-time lubrication Temperature: -70 °C up to +120 °C Speed factor: $n \cdot d_m$ ($min^{-1} \cdot mm$) = 1,6 mill.	Ester 20	THERMOPLEX® 2 TML spezial A
Resistant to cold and hot water, resistant to alkalies Temperature: -40 °C up to +180 °C Speed factor: $n \cdot d_m$ ($min^{-1} \cdot mm$) = 0,75 mill.	PAO/Ester 150	TURMOGREASE® N 2
Rotating outer ring, resistant to alkalies; temperature: -35 °C up to +220 °C Speed factor: $n \cdot d_m$ ($min^{-1} \cdot mm$) = 0,65 mill.	Polyphenylether 100	TURMOGREASE® Hitemp 300 A
Chemically inert; temperature: -35 °C up to +260 °C Speed factor: $n \cdot d_m$ ($min^{-1} \cdot mm$) = 0,3 mill.	FK/PTFE 500	TURMOTEMP® II/400 RS 2

Die Welt der LUBCON®-Schmierstoffe

The World of the LUBCON® Lubricants

EUROPE

AUSTRIA
LUBCON AUSTRIA
Büro Linz
Pollheimer Str. 16
A-4020 Linz
Tel.: +43-7-3 26 71 63 0
Fax: +43-7-3 26 71 63 0
e.Mail: austria@lubcon.com
Internet: www.lubcon.com

BELGIUM
Van Meeuwen Special Lubricants N.V.
Parklaan 25
B-9300 Aalst
Tel.: +32-53-76 76 00
Fax: +32-53-21 52 03
e.Mail: info@vanmeeuwen.be
Internet: www.vanmeeuwen.be

CZECH REPUBLIC
LUBCON s.r.o.
Dlouhá 783
CZ-76321 Slavicín
Tel.: +420-577-34 36 18
Fax: +420-577-34 20 09
e.Mail: czechrepublic@lubcon.com
Internet: www.lubcon.com

DENMARK
A.H. INTERNATIONAL A/S
Vranderupvej 156
DK-6000 Kolding
Tel.: +45-75-50 11 00
Fax: +45-75-50 20 21
e.Mail: ahi@ahi.dk
Internet: www.lubcon.dk

FINLAND
Jukka Majuri Oy
Poikkikatu 15
FIN-38200 Vammala
Tel.: +358-3-515 41 26
Fax: +358-3-511 52 20
e.Mail: jukka.majuri@lubcon.fi
Internet: www.lubcon.fi

FRANCE
LUBCON FRANCE S.A.R.L.
Parc d'activités Alpespace
161, Voie JF Champollion - Francin
F-73800 Montmélian
Tel.: +33-4-79 84 38 60
Fax: +33-4-79 84 38 61
e.Mail: france@lubcon.com
Internet: www.lubcon.com

GREAT BRITAIN
LUBCON Lubricants UK Ltd.
Unit 2, Wilmot Hall,
Golden Butts Road
Ilkley, West Yorkshire LS 29 8HS
Tel.: +44-1943-60 14 31
Fax: +44-1943-60 26 45
e.Mail: c.clayton@lubcon.com
Internet: www.lubcon.com

ITALY
LUBCON ITALIA S.R.L.
Via Trieste, 16
I-21040 Sumirago (VA)
Tel.: +39-0331-90 97 90
Fax: +39-0331-90 70 84
e.Mail: info@lubcon.it
Internet: www.lubcon.it

EUROPE

NORWAY
NORIKO AS
Kilengt 20
N-3117 Tönsberg
Tel.: +47-33-37 85 00
Fax: +47-33-37 85 01
e.Mail: bjorn.wilhelmsen@noriko.no
Internet: www.noriko.no

POLAND
LUBCON POLSKA Sp. z o.o.
ul. Piasecka 162
PL-21-040 Świdnik
Tel.: +48-81-7 21 68 30
Fax: +48-81-7 21 68 31
e.Mail: polska@lubcon.com
Internet: www.lubcon.com

SLOVENIJA
LUBCON d.o.o.
Adamičeva ulica 26
SLO-8000 Novo mesto
Tel.: +386-7-33 80 760
Fax: +386-7-33 80 763
e.Mail: lubcon@lubcon.si
Internet: www.lubcon.com

SPAIN
LUBRITEC, S.A.
Centre Industrial Santiga
Tallers 8, Nave 58
E-08210 Barberà del Vallès (Barcelona)
Tel.: +34-93-719 11 13
Fax: +34-93-719 12 57
e.Mail: lubritec@lubriservis.com
Internet: www.lubriservis.com

SWITZERLAND
LUBCON Lubricant Consult AG
Im Leisibühl 35
CH-8044 Zürich
Tel.: +41-44-8 82 30 37
Fax: +41-44-8 82 30 38
e.Mail: swiss@lubcon.com
Internet: www.lubcon.com

SWEDEN
TRIBOSCAND AB
Box 12131
S-102 24 Stockholm
Tel.: +46-8-37 35 01
Fax: +46-8-44 10 80 3
e.Mail: tribo@mailbox.calypso.net

THE NETHERLANDS
Van Meeuwen Smeertechniek B.V.
Korte Muiderweg 2 A
NL-1382 LR Weesp
Tel.: +31-294-49 44 94
Fax: +31-294-49 44 90
e.Mail: sales@vanmeeuwen.nl
Internet: www.vanmeeuwen.nl

TURKEY
GEOCON Ltd. Şti.
Yeni Çamlica Mahallesi
YEDPA Ticaret Merkezi
B Caddesi No. 21-22
TR-34779 Ümraniye - İstanbul
Tel.: +90-216-4 71 04 62
Fax: +90-216-4 71 03 23
e.Mail: geocon@geocon.com.tr
Internet: www.geocon.com.tr

EUROPE

Weitere Vertretungen/Further distributors

Bulgaria	Greece
Cyprus	Russia

NORTH AMERICA

UNITED STATES OF AMERICA
LUBCON TURMO® LUBRICATION, Inc.
4665 Broadmoor SE, Suite 150
Grand Rapids, Michigan 49512
Tel.: +1-616-554-7930
Fax: +1-616-554-7936
Tel.: US + CAN 877-887-6658
e.Mail: inquiry@lubconusa.com
Internet: www.lubconusa.com

Weitere Vertretung/Further distributor
Mexico

SOUTH AMERICA

BRAZIL
TRIBOTÉCNICA
Lubrificantes Sintéticos Ltda.
Rua Arthur Alves Bandeira,
200-Jardim Margarida
CEP 06730 000-V Gde Pta-SP-Brasil
Tel.: +55-11-4158-17 00
Fax: +55-11-4158-38 13
e.Mail: diretoria@tribotec.com.br
Internet: www.tribotec.com.br

AFRICA

SOUTH AFRICA, REPUBLIC of
VIRITH CONVERTING MACHINERY cc
16 Korannaberg Road,
Glenvista EXT 5
P.O. Box 617, Glenvista,
Gauteng RSA 2058
Tel.: +27-11-432 12 33
Fax: +27-11-432 12 11
e.Mail: terry.s@vcmsa.co.za

Weitere Vertretungen/Further distributors

Egypt	Tunesia

ASIA/PACIFIC

Wir sind vertreten in/We are represented in

Australia	New Zealand
Bangladesh	Pakistan
China/Hong Kong	Philippines
India	Saudi Arabia
Indonesia	Singapore
Iran	Taiwan
Japan	Thailand
Korea	United Arabian Emirates
Malaysia	Vietnam

e.Mail: asia@lubcon.com

LUBRICANT CONSULT GMBH
Schmierstoffe · Schmiertechnik · Lubricants · Lubrication Engineering
Gutenbergstraße 13 · D-63477 Maintal · Postfach 200 240 · D-63469 Maintal (Germany)
Tel. +49-61 09 - 76 50-0 · Fax +49-61 09 - 76 50-51
e.Mail: webmaster@lubcon.com · www.lubcon.com

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