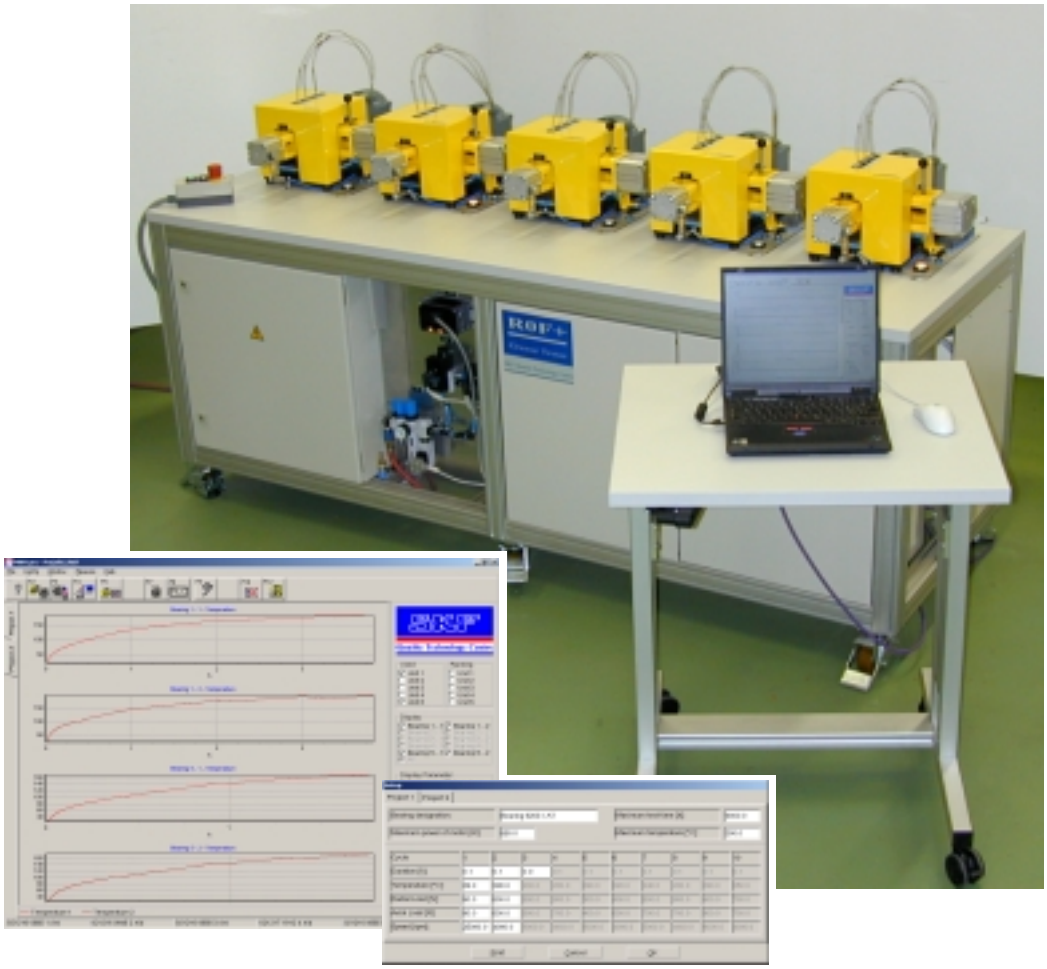
TMG/R0F+

Grease Testing Machine



General Description

Lubricating greases, that are developed for high temperature or high speed bearing applications or for a combination of both, should offer what they promise.
The problem, whatever, is to check these promises.
Current test methods give inadequate results. This is why many years ago SKF developed its own grease testing machine in order to be able to evaluate the most suitable grease qualities to perform with the SKF high quality bearings. The SKF TMG/R0F+ Grease Testing Machine now is available on the market.

Purpose of the Test

The purpose of the test is to measure the ability of a grease to lubricate under various speeds, at various temperatures and at various loads. Grease quality is measured by recording the number of running hours it takes before the grease ceases to lubricate and as a consequence the bearings fail. The longer the number of running hours in the test unit, the better the grease is at lubricating under those conditions. In this way the maximum operating speed, temperature and load for a particular grease can be determined.

SKF Österreich AG

Quality Technology Centre

SKF Österreich AG
Quality Technology Centre
Seitenstettner Str. 15
A - 4400 Steyr, Austria
Homepage

Phone +43 (72 52) 797-571
Fax +43 (72 52) 797-574
e-mail qtc@skf.at
Hotline +43 664 43 36 135
qtc.skf.com

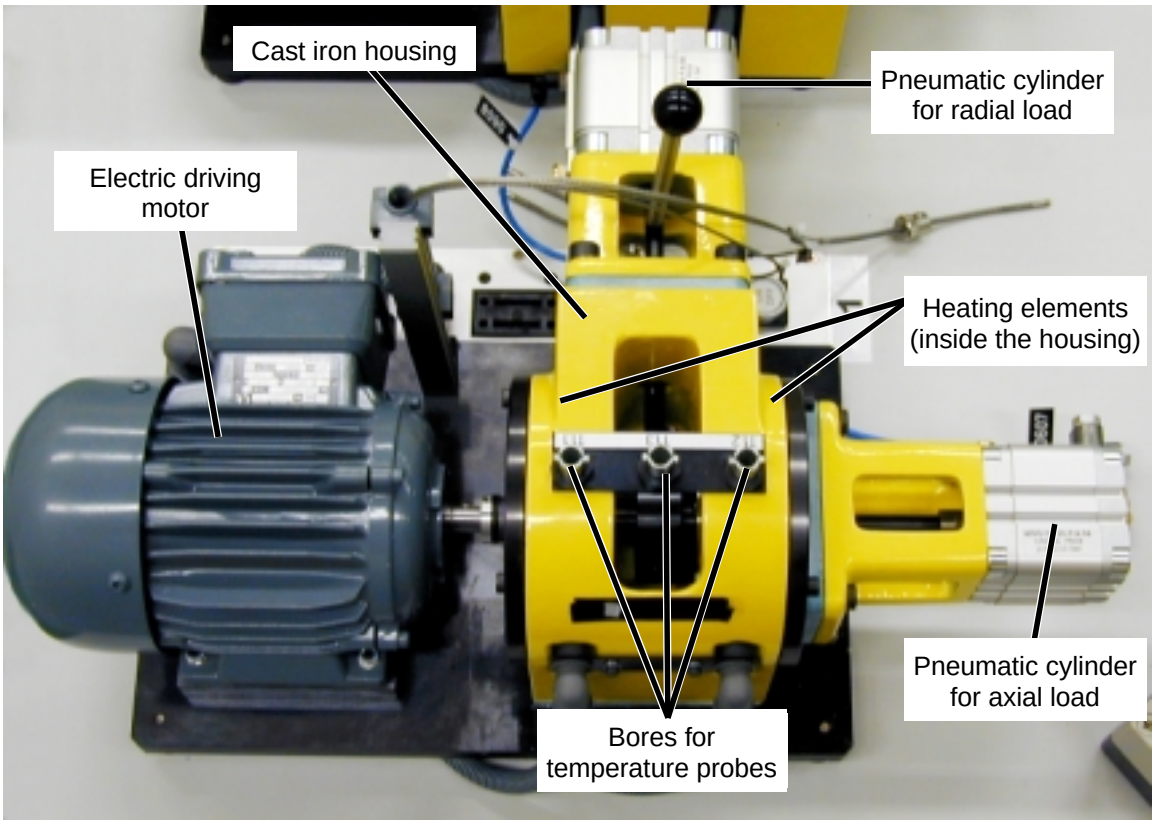
The New R0F+ Test Rig

After many years of succesful application, SKF's R0F grease testing rig was in need of an upgrade. The demand for flexibility in the test parameters and an extended failure detection is rising.

The main upgrades are:

- Improved flexibility of the input parameters, such as continuosly variable speed and higher and controllable radial and axial loads.
- Extended failure detection by monitoring more measuring signals during the tests. Lubcheck and the energy required for controlling the temperature can offer much more information about the time and cause of failure.

Machine Description



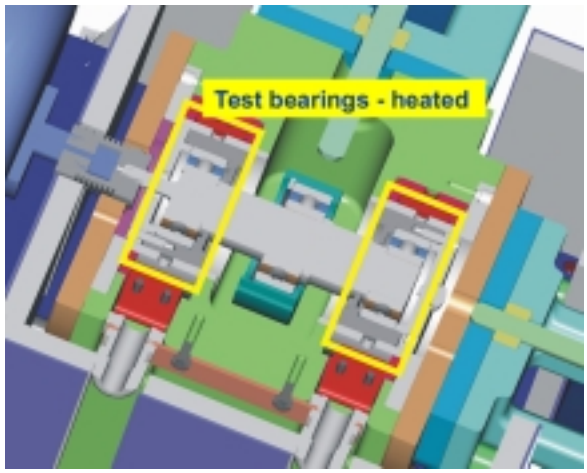
The SKF TMG/R0F+ Grease Testing Machine basically consists of two parts - a mechanical test unit and a laptop with control and evaluation software.

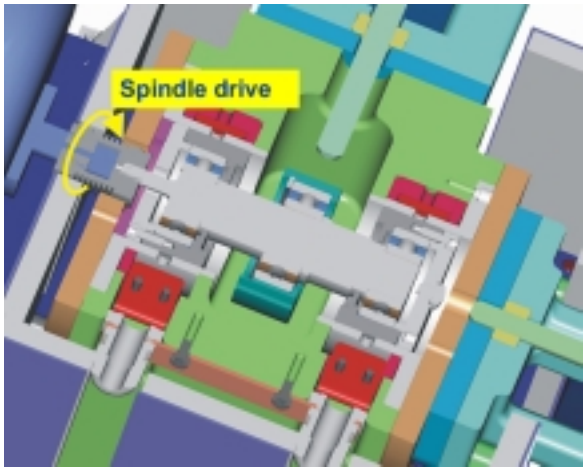
The mechanical unit contains five cast-iron housings. Each housing contains two bearings, mounted on a shaft, the total number of test bearings being ten.

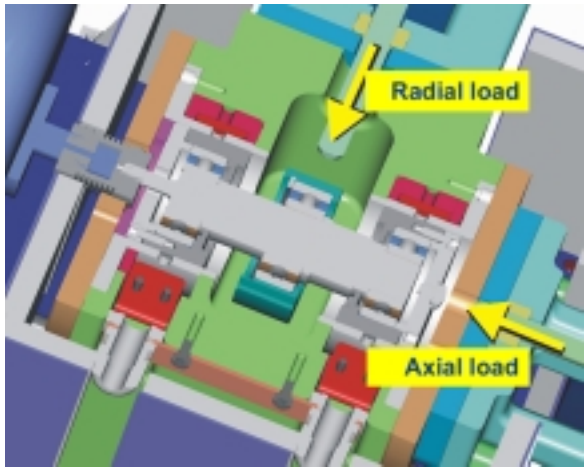
There are different test bearings possible (see technical data). The shields are delivered separately. The shaft is rotated by an electrical motor. The cast-iron housing contains two heating element. Each housing half has a feeler to check and regulate the temperature.

For control and evaluation, a laptop with the new R0F+ software is used.

Sectional Views of one Test Unit







Test Method

In the mechanical unit the test grease is checked in ten bearings at a preprogrammed temperature, speed and loading conditions. The standard running speed is 10000 rpm (d_m x n ~ 335000). The test prameters can be easily set via the control and evaluation software.

The test temperature can vary from room temperature up to 230° C.
The radial load (Fr) is 50 ... 900 N/bearing.
The axial load (Fa) is 100 ... 1100 N/bearing.

TMG/R0F+

Test Procedure

The test bearings are standard bearings with separate shields. The test bearings and shields are washed, rinsed, dried and lubricated with a standard quantity of the test grease, corresponding to one third of the free volume in the bearing, after which the shields are fitted.
The bearings are mounted on the shafts and in the housings and the whole mechanical test machine is assembled. The bearings are slowly brought up to the test temperature.

Each bearing is individually temperature-controlled by means of a thermocouple.
When the test temperature increases preprogrammed limits, the unit involved will be switched off automatically (Sudden Death Test). The other units will continue running.

Test Results

In the SKF R0F+ Grease Testing Machine greases are checked on their grease life at high temperature and high speed application.
The longer the running time, the better the grease.
The bearings run in pairs in a housing. Consequently to this, when one of the bearings fails due to temperature rise or seizing, both bearings stop running, although the other bearing may still be in excellent condition (Sudden Death Test Strategy).
From the number of running hours, the following values can be calculated, using the Weibull Probability Plotting.

a) Median life (L_{50}):

This is the estimated number of hours at which 50% of the bearings fail because of undue temperature change or seizing, caused by inadequate lubrication.

b) L_{10}:

This is the estimated number of hours at which 10% of the bearings fail because of undue temperature change or seizing, caused by inadequate lubrication.

c) Weibull Exponent β:

This is a measure of the spread in grease life.
For greases the exponent is very often between 1 and 3.
The smaller the exponent, the higher the spread.

d) 90% Confidence Limits for the L_{50} and L_{10}:

There is a 90% probability that the real L_{50} or L_{10} lies between the 90% confidence limits.

Thus, there is a 5% probability that grease life is less than the lower limit, and a 5% probability that grease life is higher than the upper limit.
Testing with more than 5 groups will tighten these confidence limits (give a higher accuracy).

WEIBEST software is available from SKF to carry out these statistical calculations.

Applicability to Service Conditions

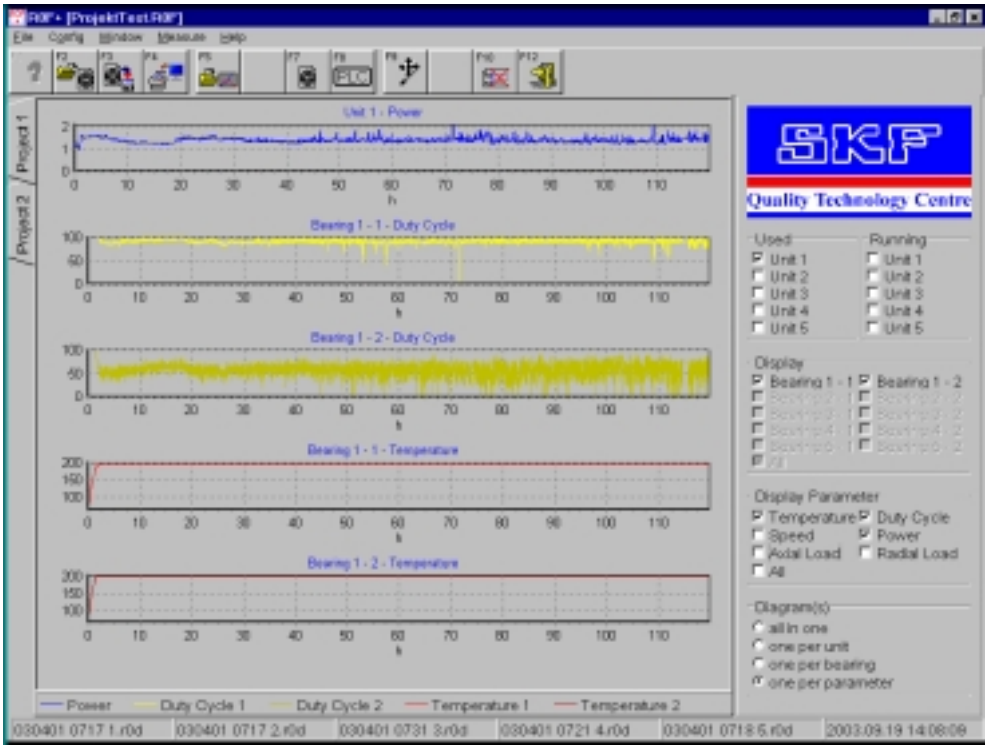
From the results obtained, a calculation can be made how bearings will behave in practice. Also the important parameter, the relubrication interval can be calculated.

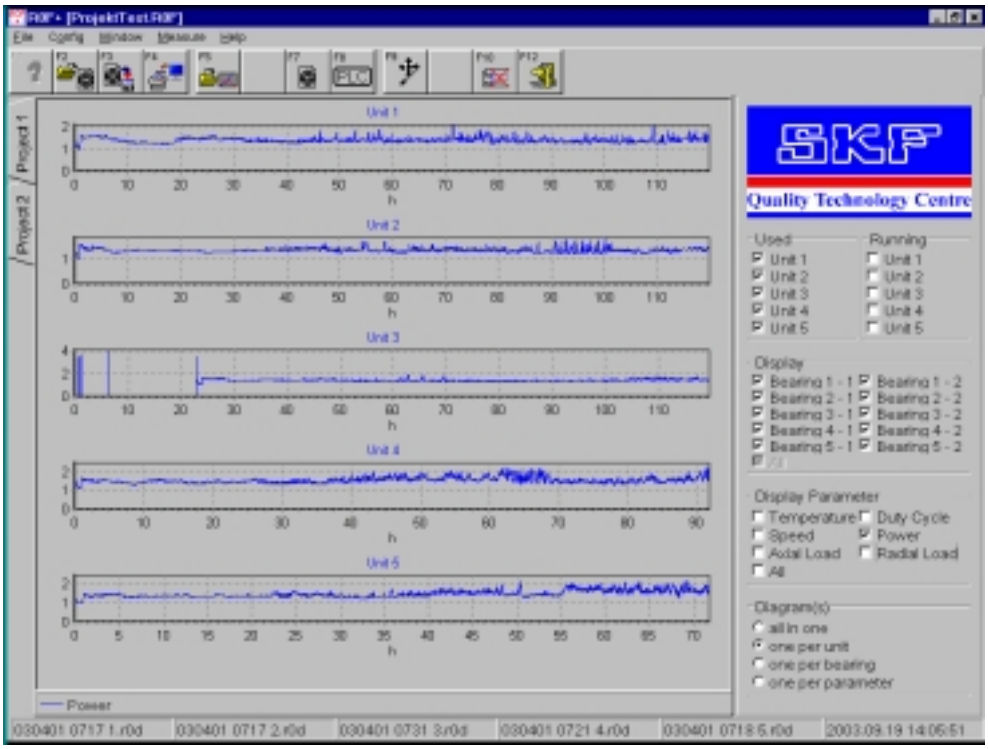
As relubrication intervals are linked to bearing failure, precise knowledge of the grease behaviour is of extreme importance.

Test Cost

The test bearings are normal production bearings. They are the only component that has to be renewed for each test. The machine controls itself and no personnel involvement is necessary during the test. The total cost therefore is extremely low.

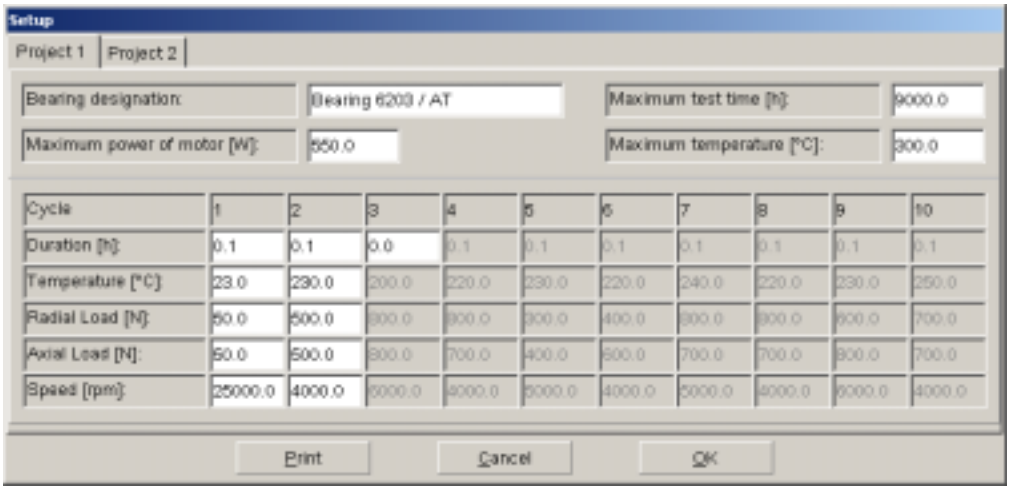
Main Screen with different Display possibilities





Screens

Measurement Setup Window



Comparsion R0F to R0F+ Test Rig

	R0F	R0F+
The input parameters for test are:		
Bearing type	6204 2Z/C3 VM104 (6204 2Z/C3 S2 VM104)	6204 2Z/C3 S2 VM104 6203 2Z/C3 S2 VM104 6202 2Z/C3 S2 VM104 608 2Z/C3 S2 VM104
Shield	2Z, 2 shields delivered separately	2Z, 2 shields delivered separately
Grease	grease type	grease type
Speed	5600, 10000, 15000 or 20000 rpm (ndm > 200000)	5000 - 25000 rpm (variable between these limits) (ndm > 200000)
Temperature	ambient - 170 (230) °C	ambient - 230°C.
Radial load	50 N	50 - 900 N/bearing Fr is controlled pneumatically and can automatically be varied during the test cycle.
Axial load	100 N (6204: C/P = 60)	100 - 1100 N/bearing (6204: 8 < C/P < 60) Fa is controlled pneumatically and can automatically be varied during the test cycle.

Comparsion R0F to R0F+ Test Rig

	R0F	R0F+
Output parameters are:		
	bearing condition determined after dismounting	
	grease condition determined after dismounting	
	running time	
	--	temperature
	--	power consumption of temperature controller (duty cycle)
	--	power consumption of the electrical motor
General:		
	During the test, the temperature is monitored constantly. A rise of 10 degrees above the set level is the criterium for stopping the test (failure detection). Speed and load cannot be varied during the test. They are set by hand before start of the test.	A combination of several signals will give a consistent end signal and more insight in the failure process.

Other Test Machines

Over the years SKF has developed a number of grease testing machines like:

- the SKF TMG/EMCOR Grease Testing Machine to test the corrosion inhibiting properties of greases: a ISO, DIN, IP/BS, NFT and SIS standardized method
- the SKF TMG/V2F Grease Testing Machine to test the mechanical stability of greases
- the SKF TMG/R2F Grease Testing Machine for testing mechanical-dynamic behaviour of roller bearing greases
- the SKF BEQUIET+ Grease Noise Testing Machine to assess the noise characteristics of a grease.

All test methods are linked very closely to practice.

Technical Data

Mechanics	
Working range - test bearings	6204 2Z/C3 S2 VM104 6203 2Z/C3 S2 VM104 6202 2Z/C3 S2 VM104 608 2Z/C3 S2 VM104 2Z, 2 shields delivered separately

Technical Data

Mechanics	
Spindle speed	5000 ... 25000 rpm
Test temperature	up to 230°C
Radial load	50 ... 900 N/bearing
Axial load	100 ... 1100 N/bearing
Drive	3 phase motor, 0.525 kW, 25000 min $^{-1}$, KAISER
Total energy required (mechanical system and electrical system)	Electrical system: 3 x 400 V/50 Hz/7.5 kVA or 3 x 480 V/60 Hz/7.5 A Pneumatic system: min. 6 bar/87 psi
Valve control voltage	24 V=
Dimensions	Height:1185 mm Width: 2200 mm Depth: 800 mm
Weight	Appr. 470 kg
Paint	Cadmium yellow RAL 1021
Electric/Electronics Notebook	
Operating system	Windows 2000
Processor	$\geq$ 1 GHz CPU speed
Display resolution	$\geq$ 1280 x 1024
Interface	PCMCIA slot

For more information on your specific application, please contact our engineers at QTC.

QTC, the "Quality Technology Centre" in Steyr, develops, manufactures and markets systems, which are used to ensure the quality in these special fields:

- Roundness and Form Analysis
- Noise and Vibration Control
- Optical Inspection
- Nondestructive Material Testing
- Dimensional Measurement
- Washing
- Laser Marking
- Grease Testing
- Demagnetization
- Cleanliness
- Assembly
- Packaging

QTC supplies the latest technology and highly innovative equipment to customers worldwide and is also the Competence Centre for measuring and quality-related equipment for the SKF Group on a global scale.

QTC, Quality Technology Centre, is located in Steyr - Austria.
You are always welcome to visit us.
The best way to reach us is a flight to Linz via Vienna, Frankfurt or Zurich.
We will, of course, arrange the pick up at the airport.