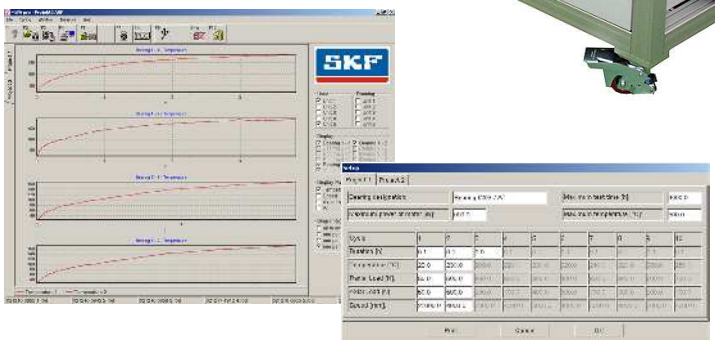
SKF Grease Test Rig ROF+

Test rig to assess grease performance at high temperatures and speeds

LFF 47B



General description

Lubricating greases developed for high-temperature or high-speed bearing applications or a combination of both should offer what they promise. The challenge is to check that these promises are fulfilled. Current test methods give inadequate results. This is why, many years ago, SKF developed its own grease test rigs in order to determine the most suitable grease qualities to ensure the best possible performance for SKF high-quality bearings.

Purpose of the test

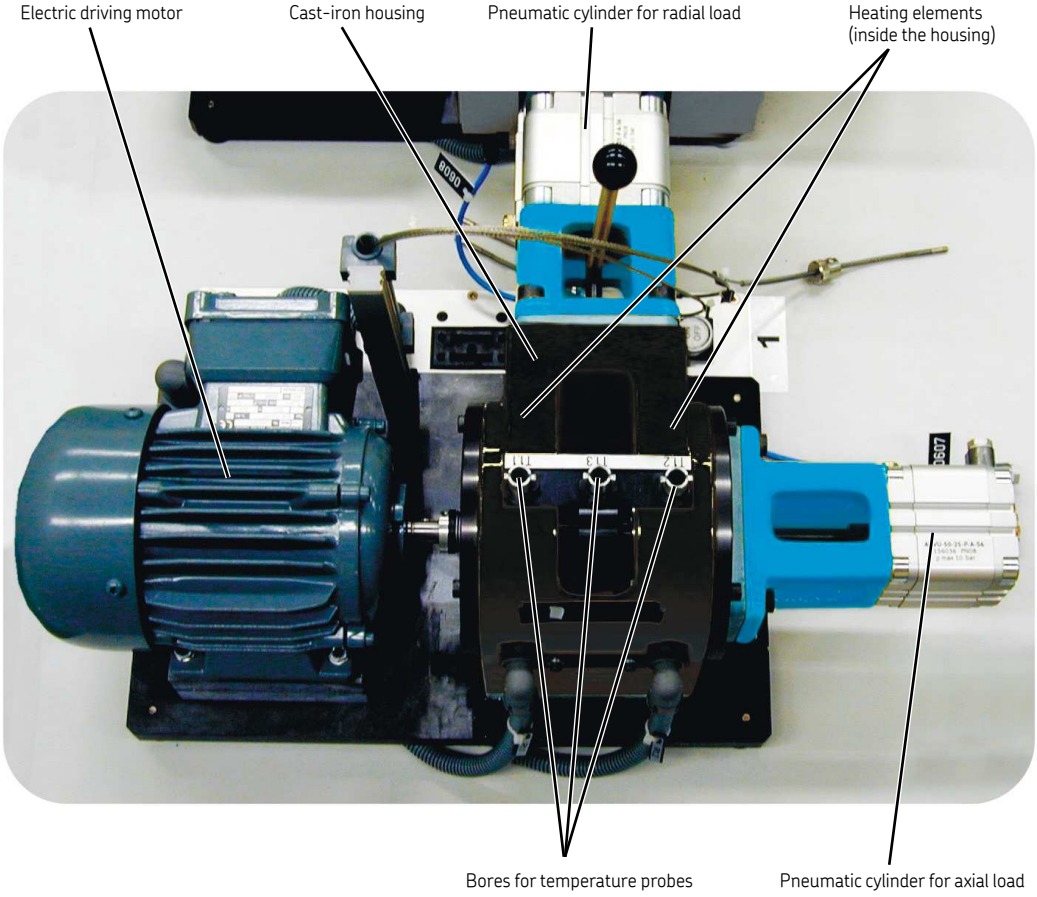
The purpose of the test is to measure the ability of a grease to lubricate at various speeds, various temperatures and various loads. Grease quality is measured by recording the number of running hours before the grease ceases to lubricate and, as a consequence, the bearings fail. The longer the number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

After many years of successful application, SKF's ROF grease test rig was due for an upgrade. Demand for flexibility in terms of test parameters and more extensive failure detection is rising.

The main improvements made were:

- Improved flexibility of the input parameters, such as continuously-variable speed and higher and controllable radial and axial loads.
- More extensive failure detection through the monitoring of more measuring signals during the tests. The energy required for controlling the temperature can allow much more information to be obtained about the time and cause of failure.

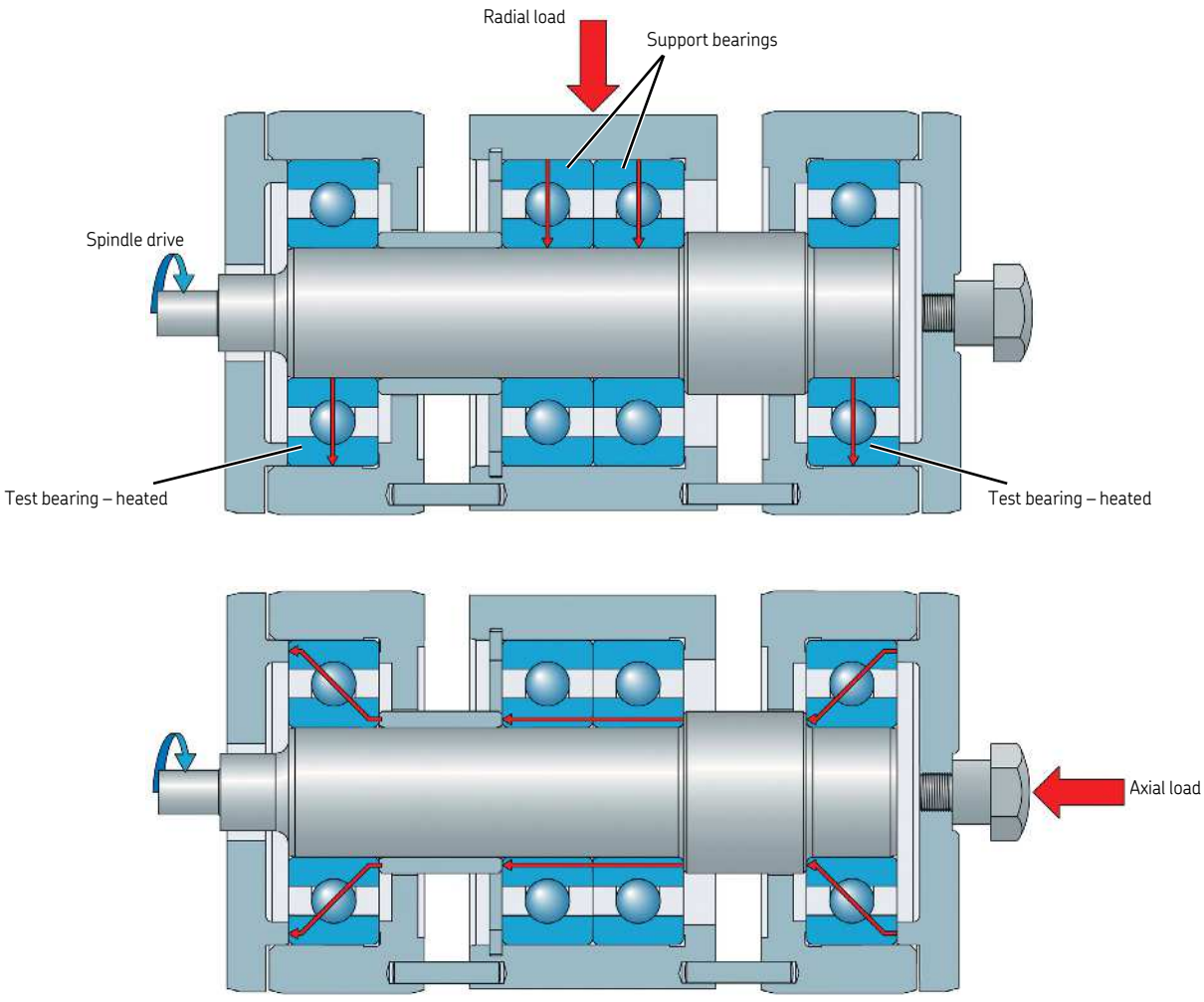
Machine description



The SKF Grease Test Rig ROF+ essentially consists of two parts – a mechanical test unit and a PC with control and evaluation software. The mechanical unit contains of five cast-iron housings. Each housing contains two bearings, mounted on a shaft, the total number of test bearings being ten.

Various test bearings can be used (see technical data). The shields are delivered separately. The shaft is rotated by an electrical motor. The cast-iron housing contains two heating elements. Each half of the housing has a probe to check and regulate the temperature. For control and evaluation, a PC with the new ROF+ software is used.

Test load flow inside the test unit



Functional principle

In the mechanical unit the test grease is checked in ten bearings under preprogrammed temperature, speed and loading conditions.

The standard running speed is 10 000 r/min (d_m x n ~ 335 000). The test parameters 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 (F_r) is 50 to 900 N/ bearing. The axial load (F_a) is 100 to 1 100 N/ bearing.

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 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 beyond preprogrammed limits, the unit involved will be switched off automatically (Sudden Death Test). The other units will continue running.

Test results

In the SKF Grease Test Rig R0F+ greases are checked for their grease life in high-temperature and highspeed applications. The longer the running time, the better the grease. The bearings run in pairs in a housing. Consequently, 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 Plot.

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.

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.

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.

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 five groups will tighten these confidence limits (give a higher accuracy). Weibest software for carrying out these statistical calculations is available from SKF.

Applicability to service conditions

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

As lubrication 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.

Comparison of ROF and ROF+ test rig technical specifications

- The input parameters for the test are:
  - Bearing type:
    - ROF: 6204 2Z/C3 VM104 (6204 2Z/C3 S2 VM104)
    - ROF+: DGBB, SRB (see 'Working range – test bearings' for detailed designation)
  - Shield:
    - ROF: 2Z, 2 shields delivered separately
    - ROF+: 2Z, 2 shields delivered separately, only for DGBB
  - Grease:
    - ROF: Grease type
    - ROF+: Grease type
  - Speed:
    - ROF: Standard 10 000, option 6 000 or 20 000 r/min (ndm > 200 000)
    - ROF+: 5 000 to 25 000 r/min (variable between these limits) (ndm > 200 000)
  - Temperature:
    - ROF: 70 to 170 °C
    - ROF+: ambient to 230 °C.
  - Radial load:
    - ROF: 50 N
    - ROF+: 50 to 900 N/bearing
      Fr is controlled pneumatically and can automatically be varied during the test cycle.
  - Axial load:
    - ROF: 100 N (6204: C/P = 60)
    - ROF+: 100 to 1 100 N/bearing (6204: 8 < C/P < 60)
      Fa is controlled pneumatically and can automatically be varied during the test cycle.

- Output parameters are:
  - ROF:
    - Bearing condition determined after dismounting
    - Grease condition determined after dismounting
    - Running time
  - ROF+:
    - 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
  - ROF: During the test, the temperature is monitored constantly. A rise of 10 degrees above the set level is the criterion 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.
  - ROF+: A combination of several signals will give a consistent end signal and more insight in the failure process.

Technical specifications

- Mechanics:
  - Working range - test bearings:
    - DGBB
      BB1-0724 DE (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
    - SRB, 2220
  - Spindle speed: 5 000 to 25 000 r/min
  - Test temperature: Up to 230 °C
  - Radial test load: 50 to 900 N/bearing
  - Axial test load: 100 to 1 100 N/bearing
  - Drive: 3 phase motor, 1,5 kW, 25 000 r/min, KAISER
  - Paint: Blue RAL 5015, grey RAL 7024

- Electronics
  - Processor: 2,9 GHz Intel Core i5 4570S
  - Memory: 8 GB DDR RAM
  - Operating system: Windows 10 LTSB 64 bit
  - Hard disk: 240 GB SSD
  - Interface: 2 x RJ-45 LAN Port , 2 x USB 3.0, 4 x USB 2.0, 1 x HDMI output, 4 x RS-232, 1 x RS-422/485, 1 x MIC-in, 1 x Line-out, 1 x VGA output, 1 x AC power plug, 1 x AT/ATX switch, 1 x Clear CMOS, 1 x Reset button, 1 x Power switch
  - Controller: Siemens S7-1200 PLC
  - Control voltage: 24 V DC
  - Heating voltage: 230 V AC/50/60 Hz

- Tools
  - Test bearings: DGBB, SRB (see 'Working range – test bearings' for detailed designation)

- Dimensions and weights
  - Dimensions (H × W × D): 1 185 × 2 200 × 800 mm *(46.6 × 86.6 × 31.5 in.)*
  - Weight: Approx. 470 kg *(1 028 lbs)*

- Requirements
  - Electrical system: See rating plate
    3 × 400 V/50 Hz/32 A
    3 × 480 V/60 Hz/32 A
  - Pneumatic system:
    Air pressure 6 bar *(87 psi)* at least,
    Air quality, clean and dry air

- Noise level
  - 5 000 r/min: Noise level [dBA] 65
  - 10 000 r/min: Noise level [dBA] 69
  - 15 000 r/min: Noise level [dBA] 77
  - 20 000 r/min: Noise level [dBA] 84
  - 25 000 r/min: Noise level [dBA] 90

Technical specifications subject to change without notice.
For more information on your specific application, please contact our engineers at QT.

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