# Lubrication test unit

## MEL-7000

## General description

MEL-7000 is a portable electronic instrument able to measure electrical capacitance between the inner and outer ring of a bearing. The capacitance between the inner and outer ring is the sum of series connection of the capacitances formed by the oil films between outer race and ball, ball and inner race. Thus MEL-7000 is able to give an indication of the lubrication condition of the bearing under test.

# Principle

The measuring system is a ratio measurement of two capacitances in series, fed by an oscillator with constant voltage amplitude and frequency. One is the reference capacitor ($C_{ref}$), the other is the capacitance to be measured ($C_{brg}$), formed by the bearing capacitance of the input cable and parasitic capacitances (see figure basic principle). In order to accommodate for small and large bearings, the user can select out of three reference capacitances (100 pF, 1 nF and 10 nF).

When the capacitance to be measured is equal to the reference capacitance, the voltage ratio is 0,5, thus resulting in an output voltage ($V_{cap}$) of half full scale (5 V). When the bearing capacitance increases (very thin film), the output voltage becomes zero.

On the other hand, if the film thickness increases, the bearing capacitance decreases to a minimum and the output voltage (Vcap) reaches full scale. In order not to damage the bearing under test by sparking, the voltage applied to the bearing is 90 mVeff peak-peak maximum.

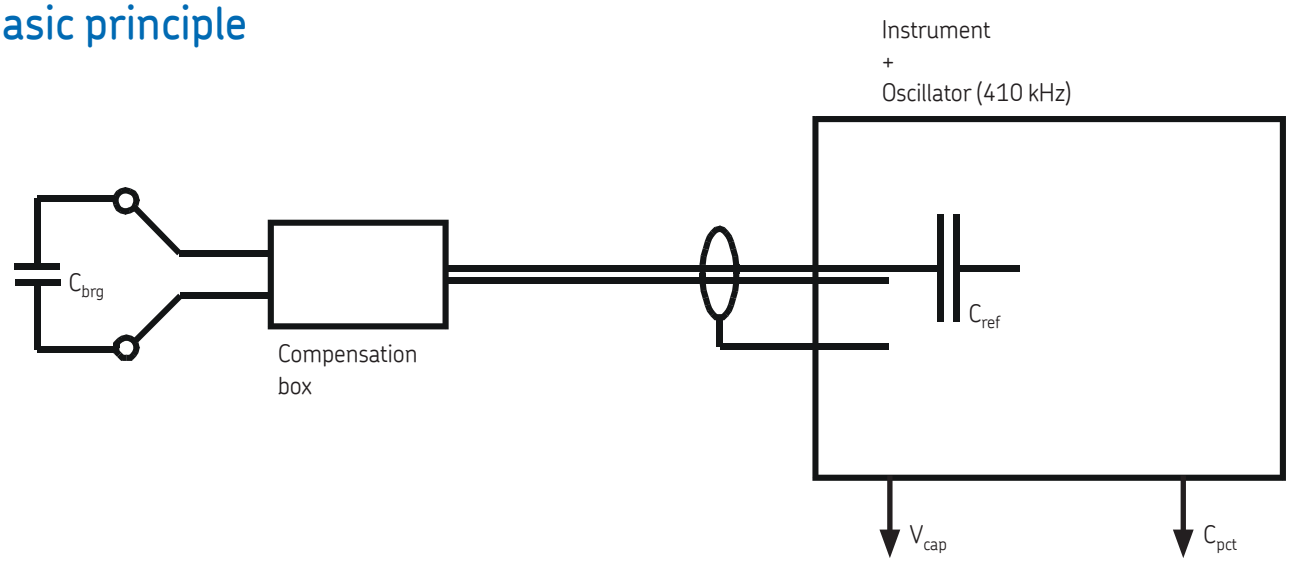
The connection of the test bearing to the instruments consists of three parts; one triaxial cable of a fixed length; a small compensation box and the final two leads connection to the bearing via banana connectors. The small compensation box contains a capacitor which compensates for the inductance of the final two connection leads. In order to achieve the most accurate measurement, this capacitor has to be adjusted every time the set up changes.

For a given lubricant, film building and film stability depend on various parameters e.g. load, speed, temperature and surface roughness. MEL-7000 must therefore be able to measure high frequency capacitance variations and for this an oscillator frequency of 410 kHz has been chosen.

The output voltage ($V_{cap}$) is fed through a low pass filter with selectable cut-off frequencies.

This signal is also compared to an adjustable reference voltage ($V_{ref}$). The comparator output is processed in order to represent the Percent Contact Time ($V_{pct}$). It is obvious that the Vpct reading is affected by the filter cut-off frequency chosen. Percent Contact Time indicates the percentage of the time at one second intervals that the capacitance value is higher than the reference level set. PCT can be used to measure, in the region of mixed lubrication, the range of metal to metal contact up to full lubricant film.

# Basic principle



# Machine description


## Specifications

MEL-7000 conditions the signal over a temperature range of +10 to +40 °C and a better accuracy than +/- 5% deviation from the full range; All units have the same performance and repeatability within +/- 1% of full scale.

## Input

Input sensitivity switchable in three ranges: 100 pF, 1 nF and 10 nF.

Measuring capacitance range from 100 pF to 200 nF:

- Capacitance can change in time with a bandwidth of 50 kHz.
- Capacitance voltage is 90 mV peak-peak maximum.
- Cable length between compensation box and conditioner three meters and mechanically flexible.
- Input circuitry is protected from static discharge or ground potential differences.

## Output

Analog DC output voltage from 0 to 10 V proportional to the input capacitance ($V_{cap}$).

Accuracy better than +/- 5% deviation from the full range. Low pass 4th order filtering adjustable at 3, 10, 30, 100 kHz and direct. Analog DC output voltage from 0 to +10 V proportional to PCT contact time.

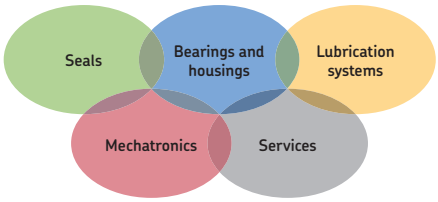
Adjustable $U_{ref}$ level from 0 to +10 V. LED dot readout for $V_{cap}$ to enable visual interpretation of the real-time signal. LED position transitions are at 0,5 V, 1,5 V ... 9,5 V:

- LED bar (dot with dimmed bar) readout for Vref that precisely corresponds with the Vcap readout.
- Digital voltmeter with switchable input of $V_{cap}$, $V_{ref}$, $V_{pct}$, indicating their average value, and Vcharge in %.

# Technical specifications

- Dimensions and weights
  - Dimensions (H × W × D): 220 × 355 × 225 mm *(8.66 × 13.98 × 8.86 in.)*
  - Weight: Approx. 5,50 kg *(66.7 lbs)*

- Requirements:
  - Electrical system:
    Battery powerd: 10 – 32 Veff AC, 50/60 Hz or 10 – 46 V DC
    Charger: 110 – 240 V AC, 50/60 Hz

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