TLA/RNT :
REAL-TIME WEAR MONITORING

TLA/RNT method allows performing real-time wear measurements on mechanical systems.

TLA-RNT methodology allows continuous wear measurements on running mechanical systems such as powertrains, transmissions and hydraulic systems. It offers wear results with very high sensitivity in the range of one nanometer per hour (1 nanometer = 1/1000 of a micron).

TLA-RNT equipment operating principle is based on the use of the Thin Layer Activation (TLA) technology (also called RNT for Radio Nuclide Technique), which is based on the production of radiotracers on the surface of critical wear parts. The extreme sensitivity of the methodology and its accuracy allows shortening significantly test durations compared to conventional wear measurement procedures.

Our TLA-RNT solution is easily adapted to any mechanical system, from small tribology test rigs to heavy duty engines or transmissions. The equipment offers real-time results and short response times in the range of seconds.

The heart of our TLA equipment is a measuring chamber where oil is circulated. A very sensitive probe detects the signal emitted by wear debris that accumulates in the lubricant (or in the oil filter) when wear occurs. A high-resolution MCA (Multi Channel Analysis) is used to differentiate the signal emitted by labelled parts undergoing wear (up to 4 parts made of different materials), controlled by a user-friendly software that offers real-time wear results.

TLA/RNT methodology is also convenient for real-time wear measurement on very hard coatings (such as DLCs), for which very low wear rates are usually involved as well as very low thicknesses in the range of several microns.

CONTACT US

PHONE:
+32 (0) 69 64 06 04

E-MAIL:
infos@deltabeam.net

ADDRESS:
Rue Mont d'Orcq, 3
7503 Froyennes
Belgium

WEBSITE:
www.deltabeam.net

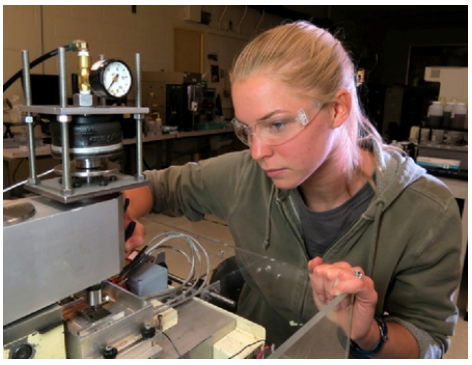
OPERATING PRINCIPLE

The TLA (Thin Layer Activation) / RNT (Radio Nuclide Technique) method applies to the development of mechanical systems and lubricants. It allows performing real-time wear measurements without dismantling parts (i.e. gears, camshafts, cylinder sleeves, piston rings, valves & seats, bearings, turbocharger bearings, etc.).

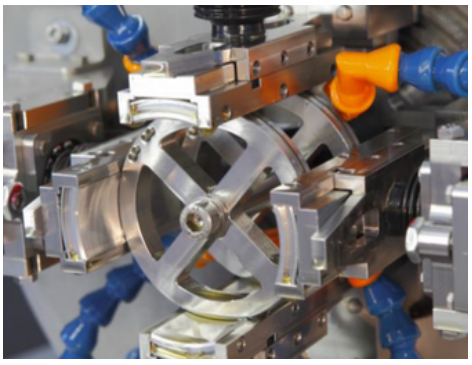
The methodology is applied in 2 steps:

Step #1: Labelling (activation) of wear parts

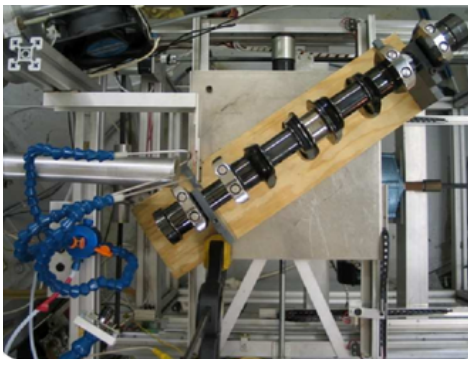
A particle accelerator is used to produce a thin layer of radiotracers at the surface of wear parts. After treatment, labeled areas emit gamma rays that are used to monitor the wear debris issuing from the labeled surface(s).



By Courtesy of Tetra Ilmenau GmbH



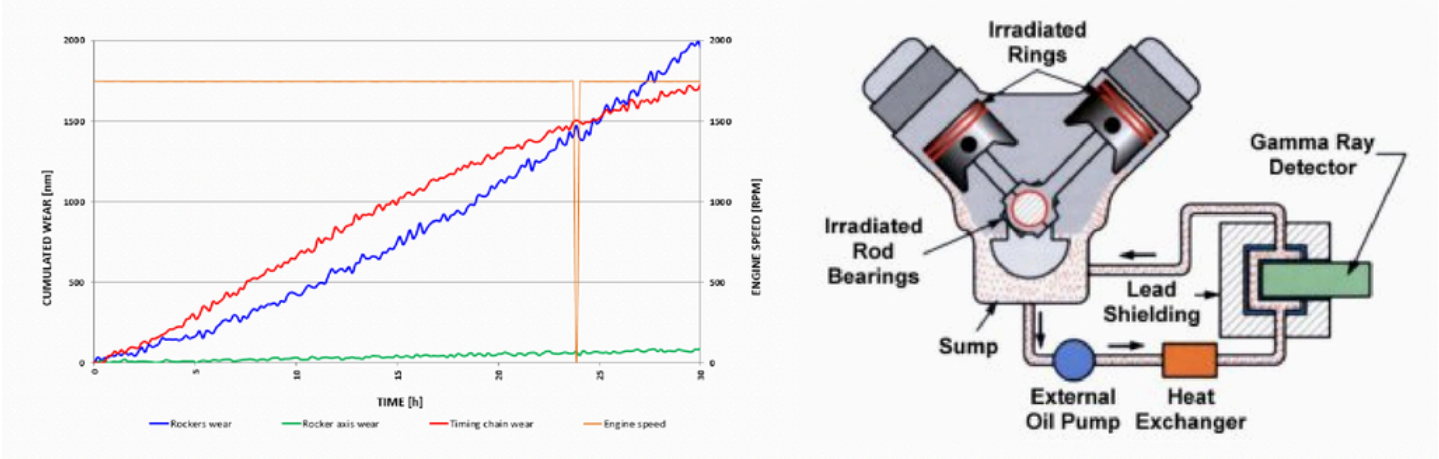
Piston simulator machine



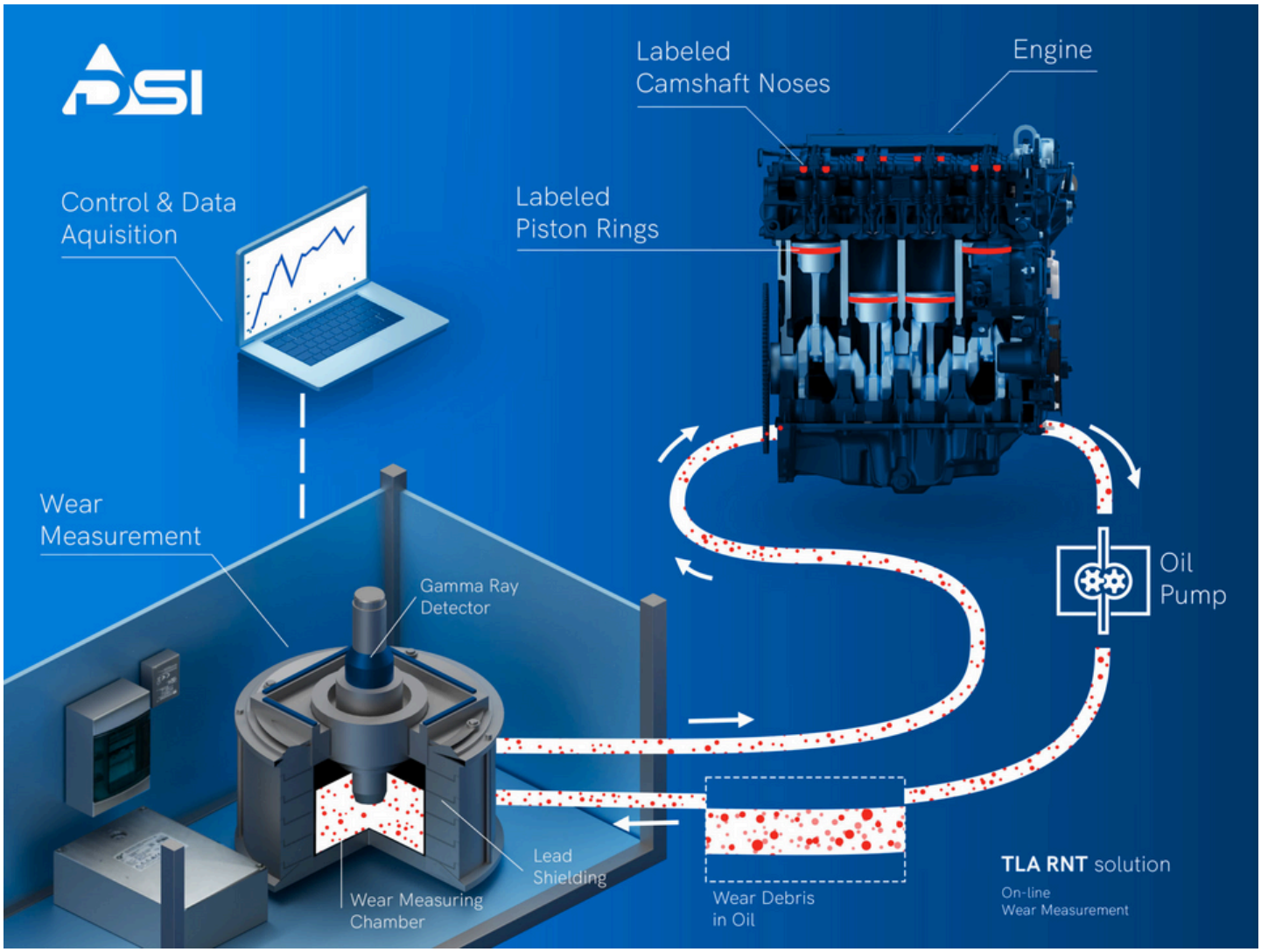
Irradiation of a DLC-coated crankshaft

Step #2: On-line wear measurement

When wear occurs, debris are released in the lubricant, inducing an increase of radioactivity (gamma-rays) in the oil. A radiation probe is installed in the measuring chamber where the oil is circulated continuously. The probe is able to detect extremely small wear rates in the range of one nanometer per hour.



Principle of a TLA-RNT measurement □ On-line wear measurement (i.e. piston rings)



HIGH RESOLUTION SPECTROSCOPY SYSTEM

TLA-RNT equipment uses a Multi-Channel Analyzer (MCA) that allows differentiating gamma-rays coming from different isotopes. The equipment allows monitoring simultaneously wear debris coming from 4 different parts installed in a mechanical system.

FLOW-THROUGH CHAMBER

The oil is circulated through the TLA measuring chamber where the volumic radioactivity is measured. An additional measuring chamber equipped with an oil filter can also be used to measure the accumulation of wear debris in the oil filter.

SOFTWARE

TLA-RNT equipment includes a user-friendly software (B-Wear) that performs a multitude of control and analysis functions to effect TLA/RNT experiments.

It operates under Windows® and performs automatic saving of raw data on hard disk during the measurements and re-analysis of raw data with new parameters.

I/O are available to communicate with the control system of most R&D test rigs / test benches.

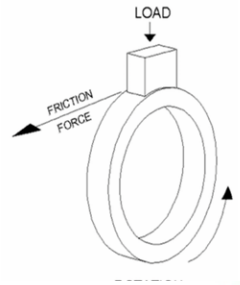
B-Wear TLA equipment is also equipped with its own data acquisition system and, as an option, additional analog/digital inputs are available for acquiring external signals issuing from the test rig itself.

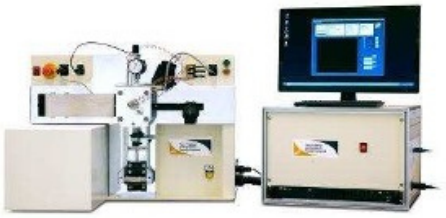
Another feature of B-Wear is the possibility to display wear rates in real-time. A special function allows performing linear fits in wear data to calculate the rate and the standard deviation.

EXAMPLE: UPGRADE OF A FALEX BLOCK-ON-RING MACHINE

TEST SPECIFICATION

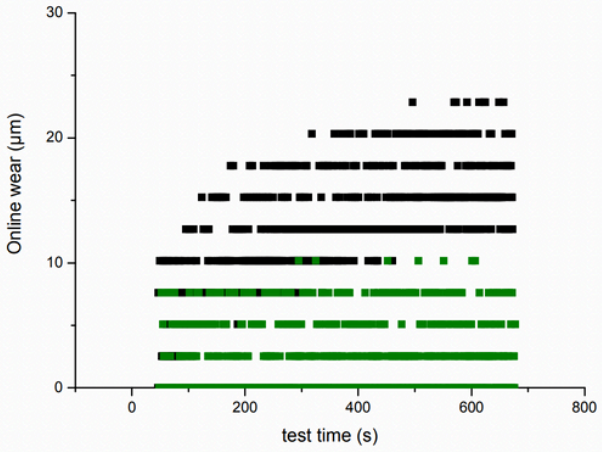
Simulation of sliding journal bearing (e.g. Crankshaft) TAN code 1519
Realistic contact pressures (1-10 MPa)
Block material: brass
Ring material: SAE steel ring S-25
Isotopes for TLA measurement: Zn-65 (block) and Co-57 (ring)
Lubricant: using B-Wear flow through measuring chamber + pump
Engine base oil with and w/o GMO-type friction modifier
Test performed at constant speed/load





COMPARATIVE RESULTS:

TEST RESULTS WITH STANDARD WEAR PROBE	TEST RESULTS WITH B-WEAR UPGRADE
• Resolution of wear depth: 2.5 µm • Precision on wear depth: 10 µm • Estimated total wear: 20 µm • Realistic results ?	• Precision on wear depth: 0.1 µm • Total wear: 4.5 µm and 0.8 µm (GMO) • Wear rate calculation: possible • Differentiation between block & ring: **YES**



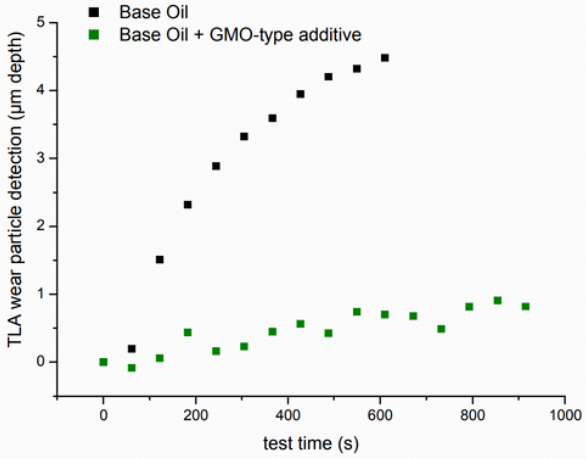


TABLE OF TLA-RNT FEATURES

Dimensions	Flow-through equipment: 800 (Length) x 650 (Width) x 1000 (Height) mm Filter equipment: 950 (Length) x 500 (Width) x 500 (Height) mm
Weight	Flow-through equipment: 350 kg Filter equipment: 250 kg
Power supply	110 / 220V
Power consumption	Flow-through equipment: 1 kW Filter equipment: < 0.5 kW
Cooling	Internal fans + Compressed air input for detector cooling
Configuration	Cart on 4 wheels
Pump specs	Flow: 0-5 L/min, controlled and regulated
Capacity	Flow-through chamber: 0.7L Filter chamber: 0.2L Total volume with hoses: < 1.2L
Hydraulic connectors and hoses	½ inch, BSP as standard, other type on request
Lead shield	70mm thick to 80mm
Inputs / Outputs	4 digital I/O and 4 analog I/O
Typical sensitivity	0.5 to 1 nanometer wear depending on oil volume and part activity

TABLE OF TLA-RNT FEATURES (ELECTRONICS AND SOFTWARE)

Processor	Last generation PC
Detector Type / Size	Flow-through equipment: NaI 4" x 4" - or 3" x 3"
High Resolution Ge Detectors	Optional
Spectrometer (MCA)	Each detector is connected to a 4096 channel digital MCA
Maximum throughput rates	Maximum Count Rate (gamma rays) 25,000 Cps
Operating environment	Windows latest release
TLA Software	"B-Wear" V1.3, controls the MCA and I/O data acquisition board, collects data, analyses on-line, displays data and graphs
Counting in defined energy windows (ROI)	Independent windows (ROIs) defined by upper and lower energy, and related to MCA channels by an energy calibration. Counts from each ROI (with or without background subtraction) analyzed according to its own parameter set
Max. number of ROIs	4-5
Real-time analysis	Data extracted from spectrum (ROIs) & I/O card, and analyzed to produce wear or other physical measurements
Depth profiles	Yes, as input data
Data storage	Data file containing all extracted and analyzed data
Regeneration of data set from spectra	Entire data file may be regenerated from spectra. User may change ROIs and all analysis parameters to reanalyze any campaign
Max. number of counting periods	Unlimited
Min. acquisition interval	2 seconds
NaI gain stabilization	Software routine follows peak to correct for fluctuations in gain when measurement is performed over long periods of time
Additional I/O system	Optional acquisition board allows user to include data from the test (RPM, torque, oil temperature, etc.) to be recorded, analyzed and displayed. A/D outputs to test bench management system also available as an option