



Tti Testing Laboratories

OVER 30 YEARS OF EXCELLENCE IN QUALITY ASSURANCE



PETROLEUM DIVISION · OIL CONDITION MONITORING

Before the **alarm**

Find engine trouble in the oil while it is still a planned repair.

Tti Labs tests the oil in gas, diesel and HFO engines, gearboxes, hydraulics and compressors. Each report tells you exactly what to check.

Power · Industry · Fleets

OGRA-approved third party

ISO/IEC 17025 accredited · Since 1995



01 The problem

03 Is the oil fit?

05 What you get

11 786 001

02 The early warning

04 Which part is wearing

06 How it works

www.ttilabs.net



SURFACE DEGRADATION

~70%

of machinery's loss of usefulness comes from surface degradation: mechanical wear (about 50%) and corrosion (about 20%). Oil analysis tracks exactly these processes.

E. Rabinowicz, MIT, as reported by Noria / Machinery Lubrication.



THE PROBLEM

Every engine failure has a history. The oil records most of it.

A powerhouse manager answers for three things: availability, cost per kWh and engine life. Oil chemistry is not on that list. Yet a bearing rarely fails in a day. Wear, acid, dust and coolant build up for hundreds of running hours first.

Fixed-hour oil changes and alarms only tell you what has already happened. Oil analysis reads what is happening now. It warns you in time to order the parts and choose the day of the stop.

What one unplanned failure costs

Rs 40 lakh+

to repair one bearing failure on a 1.5 MW engine. A crankshaft costs far more.

15–20 days

with that engine out of service while parts and specialists arrive.

Rs 108–127 per kWh

in diesel alone, to cover the gap during load-shedding.

14x

One avoided failure pays for about 14 years of monitoring.

160 samples a year at Rs 4,500

Rs 7.2 lakh

Bearing failure: repair

Rs 40 lakh

Lost generation, about 15 days

Rs 60 lakh

One failure

Rs 1 crore

Example: ten 1.5 MW gas engines, each sampled every 500 running hours.

Example figures for a 1.5 MW gas engine. Diesel at Rs 400–424 per litre and 0.27–0.30 litres per kWh, fuel only. Your own repair quotes and tariff will differ; we run the numbers with you.

OIL ANALYSIS • EARLY WARNING

The oil speaks first.

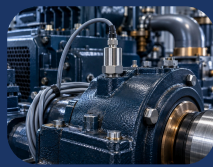
Every failure follows the same path. Long before vibration, heat or an alarm, the oil carries the evidence: wear metals, acid, dust and coolant. Sample every 250–500 running hours, and the trend gives you time to plan.



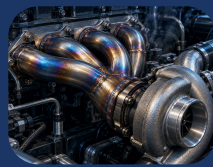
P • Wear begins
A defect starts to develop.



Oil analysis
Wear metals, acid, coolant, dust.



Vibration
Damage is now mechanical.



Noise and heat
An operator can hear or feel it.



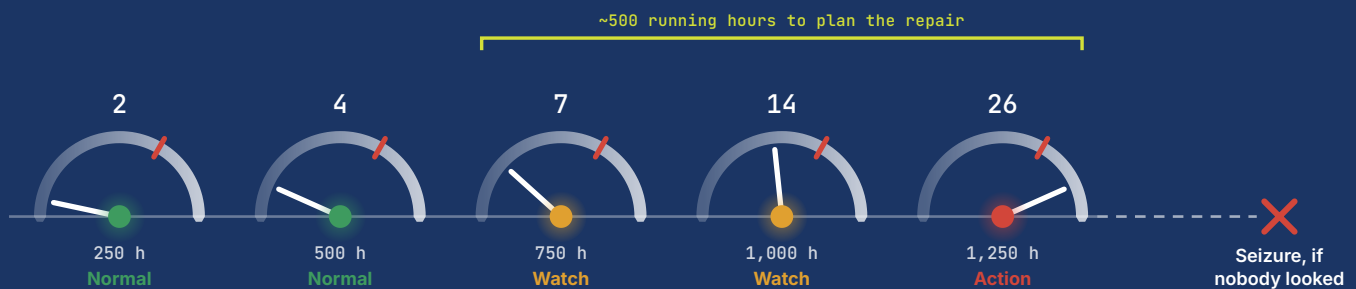
Alarm or trip
The engine stops itself.



F • Failure
Weeks out, cores to repair.

Time to plan: order parts, choose the day of the stop.

THE HISTORY WAS THERE: ONE ENGINE, FIVE SAMPLES



Lead (Pb) in the oil, mg/kg • one sample every 250 running hours • illustrative

The six stages follow the P-F interval used in reliability engineering. The warning window varies by failure mode. Sudden fractures can outrun any sampling interval. That is why engine makers pair oil analysis with filter inspection and vibration monitoring.



QUESTION ONE • OIL CONDITION

Is the oil still fit to protect the engine?

Oil ages with every running hour. It thickens, loses its acid reserve and picks up water, fuel and coolant. If the oil fails, the engine fails.

SR.	PARAMETER	WHAT IT SHOWS	METHOD
01	Viscosity at 100 °C	Thickens with oxidation and soot, thins with fuel. Is the oil still in its grade?	ASTM D445
02	Oxidation and nitration	How fast the oil is ageing. The main drain-interval decider in gas engines.	FTIR, ASTM E2412
03	Base number (TBN)	How much acid-neutralising reserve is left.	ASTM D2896 / D4739
04	Acid number (TAN)	Acid building up from combustion gases and oxidation.	ASTM D664
05	Initial pH (i-pH)	Early warning of strong acids. Critical on gas engines.	ASTM D7946
06	Water	Rust, sludge and bearing damage. Limits are 0.2–0.5% by engine maker.	ASTM D6304 C
07	Glycol (coolant)	Coolant leaking past a liner seal, gasket or cooler. Act at once.	FTIR + GC
08	Fuel dilution and soot	Diesel and HFO: injector or combustion faults that thin or load the oil.	ASTM D7593 • TGA

What the engine makers set

TBN

Change at 50% of the new-oil value.

Wärtsilä 34SG • Caterpillar gas engines

TAN

No more than 2.5 mg KOH/g above the new-oil value.

Wärtsilä • MTU S4000

i-pH

Minimum 4 to 4.5 on gas engines.

MTU • MWM

Water

Maximum 0.2% to 0.5%, by engine.

MWM • MTU • Caterpillar • Cummins



TAN > TBN. When the acid number crosses the base number, the oil can no longer neutralise the acids attacking your bearings. Change the oil now, whatever the hour meter says.

The second saving: change oil on condition

Every 1,500 h today

5.3 oil changes a year

Every 2,000 h on evidence

4.0 oil changes a year • 25% fewer



Engine running 8,000 hours a year. We extend intervals in steps, only when the trend supports it and within the engine maker's limits. Top-up oil is unchanged, so the saving on total lube spend is smaller.

The metals tell you which part is wearing

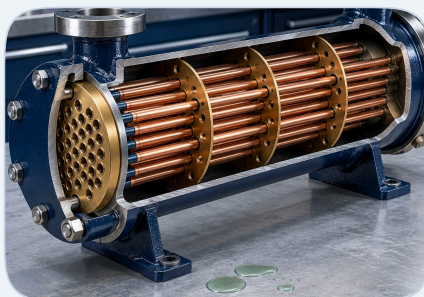
Every component leaves its own signature in the oil. Tti Labs measures wear, contaminant and additive elements by ICP spectroscopy. We read them together, trended against running hours.



14 Si

Air filter

Silicon: dust getting past the air filter.

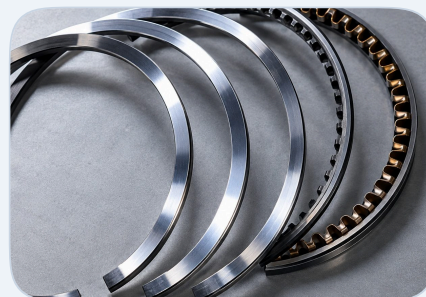


11·19 Na·K

29 Cu

Oil cooler and coolant

Sodium and potassium: coolant leaking into the oil. Copper: bearings and the oil cooler.



24 Cr

Piston rings

Chromium: piston rings.



13 Al

Pistons

Aluminium: pistons and bearings.



26 Fe

Liners, crankshaft, gears

Iron: liners, rings, crankshaft, gears.



82 Pb

50 Sn

29 Cu

Bearing shells

Lead and tin: the bearing overlay. Copper: bearings.

26 Fe Wear metal

14 Si Contaminant

READ TOGETHER, AGAINST YOUR NEW-OIL BASELINE

Pb · Sn · Cu rising together → bearing wear

Cu rising alone → often oil-cooler corrosion, not wear

Fe · Cr → ring and liner wear

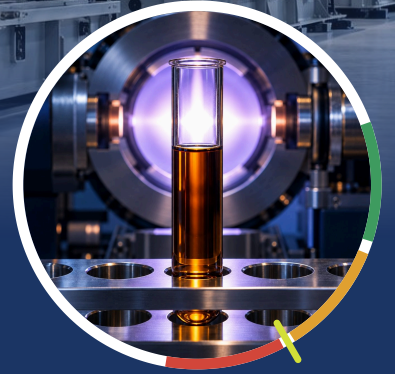
Si · Al · Fe → dust getting past the air filter

Na · K → coolant leak, even when a hot gas engine shows no water

Elements by ICP-OES, ASTM D5185. ICP sees particles below about 3 µm. Larger, severe-wear debris needs a PQ ferrous index (ASTM D8184) and filter inspection.

OIL CONDITION REPORT

Every lab gives data. Tti Labs gives **direction**.



1

One colour, one decision.

Green, amber or red at the top of every report, so the shift engineer knows at a glance.

2

Trends, not snapshots.

Iron, lead, TBN and more, plotted against running hours. The trend is the warning.

3

Root cause in plain words.

Not "high silicon", but "silicon, aluminium and iron rising on unit 6: dust ingress, check the air-filter housing seal".

4

What to do, and by when.

Actions ranked by urgency, judged against your engine maker's own limits: Wärtsilä, Jenbacher, MAN, Caterpillar, Cummins, MTU.

Tti Labs • Oil condition report

Unit G-06 • 1,250 h on oil • Example

1

RED • Action required: corrosive bearing wear. Acid reserve gone, bearing metals rising. Change oil today; inspect shells within 100 h.

2



Bearing metals, mg/kg, against hours on oil. Faint needles: the samples at 250–1,000 h.

3

What we see

Lead, copper and tin rising together while iron rises only slowly: the bearing overlay. TAN has crossed TBN and i-pH is 3.9, so acid is attacking it.

What to do

1. Change oil and filters today.
2. Inspect con-rod and main shells within 100 h.
3. Test fuel gas for H₂S.
4. Resample 48 h after the change.

4



Normal (green): Keep running. Sample again on schedule.



Watch (amber): A value is moving toward its limit. We may shorten the next interval.



Action (red): Do what the report says before the next sample. You also get a WhatsApp alert.

48 hours

from receipt to report

**WhatsApp**

alert to your maintenance head on any red result



WORK WITH US

From sample to decision in four steps.

01

Kits on site.

QR-labelled bottles and a one-page sampling procedure, delivered to your plant.

02

Sample right.

Hot, running, before the filter. Same point, at your engine maker's interval.

03

Tested in 48 h.

Courier to our Lahore laboratory. ASTM methods; results within 48 hours of receipt.

04

Act and review.

WhatsApp alert on red. Trend review with your team every quarter.

HOT. RUNNING. BEFORE THE FILTER.

The label is half the analysis.

Without hours there is no trend. Write these on every bottle, at the engine, before it leaves site.

- 🔧 Site and unit ID, engine make and model
- 🔧 Oil brand and grade
- 🔧 Hours on engine and hours on this oil
- 🔧 Top-up since the last sample, in litres
- 🔧 Anything unusual: alarms, repairs, a filter change

Tti Labs • OCM

Unit G-06

Engine 41,250 h

Oil 1,250 h

Top-up 18 L

Tailored to the machine

MACHINE

TEST PACKAGE

Gas engines

Wear metals (ICP), viscosity, FTIR oxidation and nitration, TBN, TAN, i-pH, water, glycol

Diesel and HFO engines

As above, plus fuel dilution, soot and insolubles

Truck and bus fleets

Engine package, plus delivered-fuel quality on request

Gearboxes, hydraulics

Wear metals, viscosity, water, TAN, particle count (ISO 4406), ferrous debris

BUILT FOR

01 Engine power plants: furnace-oil, gas and dual-fuel IPPs

03 Gas compression: field compressors and drivers

05 Mining: haul trucks and excavators

02 Captive and standby: gensets kept ready for load-shedding

04 Truck and bus fleets: engines, plus fuel quality

06 Process industry: cement, sugar and fertiliser gearboxes and turbines



Tti Testing Laboratories

Are you catching it in time, or waiting for the alarm?

Book a Baseline Health Check

One sample from every engine on your site, results within 48 hours, and a walk-through with your team. If it shows nothing, you have a documented baseline. If it shows something, you will be glad you looked.

Independent.

We sell no oil, so we have no reason to shorten your drains or defend a brand.

Every brand.

Engines, gearboxes, hydraulics, transformers and fuel in one programme. Your data stays yours.

Credentials.

OGRA-approved third party for petroleum quality control. ISO/IEC 17025 accredited (PNAC Lab 022).

Close to you.

Laboratory in Lahore; offices in Karachi, Faisalabad and Sialkot. Testing since 1995.

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