INTERPRETATION OF LUBE OIL SAMPLE ANALYSIS

LUBE OIL ANALYSIS	BASIS FOR ANALYSIS	NORMAL No Action Required	BORDERLINE Take Extra Oil Samples	HIGH Correct Condition	RECOMMENDED ACTION ☐ Shut Down Engine. Drain Lube Oil. Change Filters.
Fuel Leak	Viscosity & Flash Point – Check for dilution if flash point less than 400° F or oil viscosity drops 15% or more at 100° F.	0 to 2%	2 to 5%	Above 5%	Borderline – find and fix fuel leak. High – check main bearings per maintenance manual.
Water Leak	Free Water	None		Any	Resample with dry container. Find and fix leak. Check main bearings per maintenance manual.
	Chromate Inhibitor	0 to 20 ppm	20 to 40 ppm	Above 40 ppm	Find and fix water leak. Check lube oil filter tank pressure.
	Boron Inhibitor	0 to 10 ppm	10 to 20 ppm	Above 20 ppm	
Air Filtration	Silicon	0 to 5 ppm	5 to 10 ppm	Above 10 ppm	Improved air filter maintenance required.
Excessive Oxidation	TBN (D-664) TBN (D-2896) Viscosity Rise pH Pentane Insolubles			*Min. TBN: (D-664) 0.5 (D-2896) 1.0 Max. Vis. Rise 30% Min. pH 5.0 Max. Pent. Insol. 2%	Change Oil. If short oil life persists, check lube oil quality, fuel sulfur content, oil cooler efficiency, engine temperature controls, power output (governor and rack settings), engine condition (worn rings, cracked pistons, poor combustion), oil filtration, or oil pump suction leak.
Contaminated fuel (cracking catalyst)	Aluminum Magnesium		Above 5 ppm		Check fuel cleanliness. Notify fuel supplier. If engine smokes, check injector calibration and tip erosion. Check if piston rings are excessively worn.
Oil Contamination	Zinc	0 to 10 ppm	Above 10 ppm becomes more dangerous with increasing values.		Check if oil is contacting galvanized or zinc painted surfaces. Check if make up oil in stock is within specifications. Notify lube oil supplier. Check for silver bearing failures.
	Silver	0 to 1 ppm	1 to 2 ppm	Above 2 ppm	Check if oil contains zinc or is corrosive to silver. Check for broken piston cooling tubes, inefficient oil cooler, or improper temperature control. Feel sides of piston pins for signs of distress. Measure piston to head clearance with lead readings. Oil draining is not mandatory. Check strainers and bottom of oil pan for debris. Consider turbo bearing condition.
Abnormal Wear Or Corrosion (Rapid increases within normal range should be considered borderline condition)	Chromium (Not applicable if chromate coolant inhibitor is used)	0 to 10 ppm	10 to 20 ppm	Above 20 ppm	Check for rapid wear of rings & liners.
	Copper	0 to 75 ppm	75 to 150 ppm	Above 150 ppm	Measure piston to head clearance with lead readings to locate worn piston thrust washers.
	Iron	0 to 75 ppm	75 to 125 ppm	Above 125 ppm	Check for rapid wear of rings & liners.
	Lead	0 to 50 ppm	50 to 75 ppm	Above 75 ppm	Most likely lead flash is dissolving off bearings. Premature lead removal, before bearings are broken in, can lead to bearing distress. Inspect and replace upper con rod bearings in service less than 6 months if lead flash has been removed from the unloaded area of the fishback bearing surface on turbocharged engines. If con rod bearings require replacement, wrist pin bearings should also be checked and replaced if lead flash has been removed.
In Combination {	Copper Iron Lead		Two out of three elements in borderline or high range.		Check for debris under crankshaft gear indicative of gear train bushing distress. Check idler gear bearing clearances. Check main and con rod bearings per maintenance manual. Oil draining is not mandatory.

*In areas where fuel sulfur content exceeds 0.5% the TBN level should not be allowed to drop below 1.0 (D-664) or 3.0 (D-2896).

Table 5: Sources of Inorganic Elements in Oil					
Element/ Symbol	**Wear Metal**	**Additive**	**Contaminant**	**Primary Sources**	**Secondary Sources**
Aluminum/Al	X		X	pistons, journal bearings, blowers, turbo charge vans, thrusts, torque converters, pump vanes	dirt, alloy with copper in rolling element bearing cages, housings and cases
Antimony/Sb	X	X	X	journal bearings	grease, anti-scuff additive
Barium/Ba		X		additives	grease
Boron/B		X	X	additive, treated coolant water	few
Cadmium/Cd	X			journal bearings	plating
Calcium/Ca		X	X	additives	water, grease
Chromium/Cr	X			compression rings, chrome cylinders	alloyed with iron found in rolling element bearings, shafts found in hard steels
Copper/Cu	X	X		bearings, cages, bushings, thrusts, valve guides, oil coolers, bearing cages, pumps	automotive lubricant additive
Iron/Fe	X		X	cylinders, shafts, gears, rolling element bearings, housings, cases	rust, fretting corrosion
Lead/Pb	X		X	journal bearings, main bearings, platings, pumps	paint, solder, seals
Magnesium/Mg		X		additive	sea water
Manganese/Mn	X			shafts, valves, blowers	few
Molybdenum/Mo		X		additive	compression rings
Nickel/Ni	X			alloyed with iron for hard steel shafts, rolling element bearings	few
Phosphorus/P	X	X		additive	surface finish for gears
Potassium/K			X	coolant additive	few
Silicon/Si	X	X	X	sand, dirt, dust, antifoam additive	alloyed with iron (cast iron)
Silver/Ag	X			wrist pins (EMD), flashing	solder
Sodium/Na		X	X	found in some new oils, cooling additive	sea water, grease
Tin/Sn	X			journal bearings, alloyed with copper in rolling element bearing cages, flashing	solder
Titanium/Ti	X			turbine blades	paint
Vanadium/V	X			turbine blades	valves
Zinc/Zn		X	X	additive	galvanized steel, platings, grease

NOTE 65 - Bronze alloys typically contain 88% copper, 8-10% tin, and 2-4% zinc. Babbitt alloys typically contain 84-92% tin, 4-8% copper, and 4-8% antimony. Lead-based babbitts typically contain 75-80% lead, 5-10% tin, and 15% antimony.