

Metals Analysis Guide

WEAR METALS AND CONTAMINANTS

Metal	Engines	Transmissions	Gear Systems	Hydraulics	Compressors
SILICON	Silicon is typically associated with dirt contamination. This contamination can result from any condition that allows dirt to enter a component oil system. Other sources of silicon include seals, oil and coolant additives and greases.				
IRON <i>alloying element or cast metal</i>	Gears and shafts; block; cylinder liners; valve train; connecting rods, rings and oil pump; some bearings; pumps; housings; some pistons; some accessory systems.	Gears and shafts; bearings; brakes and disks; pumps and shift spools; PTO; housing.	Shafts and gears; bearings; housing.	Rotors, vanes, pistons, and rods; housing and bores; gears and shafts; valves.	Gears and shafts; case; valves; cylinder liners; crossheads; rings and screws or turbines; bearings; some oil-cooler tubing.
COPPER <i>alloying element</i>	Bearings; wrist pin and valvetrain bushings; Some main and accessory bearing retainers; other bushings and thrust washers; oil-cooler tubing. Also may be present as an oil additive or a crossover contaminant from a leaking transmission seal; some oil-control valves.	Discs; bearings; bushings and thrust washers; retainers and separators; oil-cooler tubing.	Bearings; bushings, retainers, and thrust washers; oil-cooler tubing.	Bearings and bushings; swash plate cups; valves; some pistons; some pump cylinders; oil-cooler tubing.	Bearings; bushings, thrust washers and retainers; oil-cooler tubing.
ALUMINUM <i>alloying element or cast metal</i>	Aluminum oxides present in the environment, typically associated with silicon (dirt) contamination.				
	Pistons; bearings; bushings; blocks, main and accessory cases and housings; some oil-cooler tubing; some retainers; seals; baffles.	Some cases; impellers; bushings and retainers.	Bearings; bushings, retainers, and thrust washers; oil-cooler tubing.	Some pump housings.	Case; impellers, some pistons and crossheads; retainers.
CHROMIUM <i>alloying element or plating</i>	Liners and rings; shafts; valve train; bearings; shafts and gears; seals.		Bearings; shafts; seals.	Rods; valves.	Liners and rings; shafts; valve train.
LEAD & TIN <i>alloy or flashing</i>	Bearings; some pistons, bushings and thrust washers.		Bearings; shafts; seals.	Pump thrust plate; bushings.	Bearings; bushings.
	<ul style="list-style-type: none"> Lead may still be found (rarely) in industrial paints and primers. Tin may be present as an oil additive, usually in conjunction with lubricants containing molybdenum compounds. 				
NICKEL <i>alloying element or plating</i>	Gears and shafts; valve train; bearings.		Gears and shafts; bearings.	Gears and shafts, bearings.	
SILVER <i>plating; tracer</i>	Some bearings and bushings; oil cooler solder; seals. <i>Silver is also occasionally used as a physical "tracer" to indicate that wear has progressed to a certain point. In this application, silver is either plated directly onto a part surface or incorporated into a layer under the surface. The wear condition of the part can then be related to the amount of the tracer deposited in the oil. This usage is most often found in aerospace applications.</i>				
MOLYBDENUM <i>alloy or flashing</i>	Typically found only in certain aerospace and heavy-duty commercial or industrial steels. May also be present in fuels as heavy crude residual material.				

WEAR METALS AND CONTAMINANTS *(continued)*

Metal	Engines	Transmissions	Gear Systems	Hydraulics	Compressors
MAGNESIUM <i>alloying element</i>	Cases and housings.				
TITANIUM <i>alloying element</i>	Some shafts, bearings, and gears. Typically found only in certain aerospace and heavy-duty commercial or industrial steels.				
ANTIMONY <i>alloying element</i>	Certain types of journal-bearing overlays.				
ZINC <i>alloying element</i>	Brass fittings (with copper); galvanized surfaces.				
VANADIUM <i>alloying element</i>	Typically found only in certain aerospace and heavy-duty commercial or industrial steels. May also be present in fuels as heavy crude residual material.				

ADDITIVE METALS

MOLYBDENUM	Extreme pressure additive or solid lubricant in specialty oils and greases; corrosion inhibitor in some conventional coolants or supplemental additives.
MAGNESIUM	Detergent, dispersant, alkalinity increaser.
SODIUM	Corrosion inhibitor in oils and coolants.
BORON	Detergent, dispersant; anti-oxidant in oils and coolants.
BARIUM	Corrosion and rust inhibitors; detergent; anti-smoke additive in fuels.
PHOSPHORUS	Anti-wear; combustion chamber deposit reducer; corrosion inhibitor in coolants.
POTASSIUM	Corrosion inhibitor; trace element in fuels; also found as a mineral salt in sea water (marine cooling systems).
CALCIUM	Detergent, dispersant, alkalinity increaser.
ZINC	Anti-wear, anti-oxidant, corrosion inhibitor.

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