

# Spectrometer Metals Guide

Wear Metals							
Metal	Reciprocating Engines	Transmissions	Gear Systems	Hydraulics	Rotary Compressors	Reciprocating Compressors	Turbines/ Centrifugal Compressors
<b>Iron (Fe)</b>	Cylinder Liners, Rings, Gears, Crankshaft, Camshaft, Rods, Valve Train, Oil Pump Gear, Wrist Pins, Cast Iron	Gears, Disks, Housing, Bearings, Brakes Bands, Shafts	Gears, Shafts, Bearings, Cast Iron	Rods, Cylinders, Gears, Shafts, Pistons	Gears, Shafts, Bearings, Casting	Shafts, Pistons, Crossheads, Packing Glands, Gears, Housing Cast Iron, Valves	Shafts, Gears, Bearings, Valves
<b>Chrome (Cr)</b>	Rings, Liners, Exhaust Valves, Shaft Plating, Stainless Steel Alloy	Roller Bearings, Needle Bearings, Shafts	Roller Bearings, Needle Bearings, Shafts	Rods, Cylinders, Gears, Shafts, Pistons	Shafts, Bearings	Shaft Plating, Ring Plating	Shafts, Bearings
<b>Aluminum (Al)</b>	Pistons, Thrust Bearings, Turbo Bearings, Main/Rod Bearings in Cat Engines	Pumps, Thrust Washers, Casting Aluminum, Aluminum Oxides from Dirt (Silica) Contamination	Pumps, Thrust Washers, Casting Aluminum, Aluminum Oxides from Dirt (Silica) Contamination	Bearings, Thrust Plates, Pistons	Case Casting, Impellers/Screws	Aluminum Oxides from Dirt (Silica), Pistons, Bearings Crossheads, Retainers	Thrust, Aluminum Oxides from Dirt (Silica), Heat Exchanger Core
<b>Nickel (Ni)</b>	Alloy in Valves, Crankshaft, Camshaft, Contaminant in Marine Bunker Fuels	Steel Alloy form Bearings, Shafts	Steel Alloy from Bearings, Shafts	Valves, Spools, Shafts	Shafts, Bearings	Valves, Pins, Shafts, Gears	Shafts, Bearings
<b>Copper (Cu)</b>	Main/Rod Bearings (Also look for Lead), Brass/Bronze Bushings (Also Look for Tin and/or Zinc), Oil Cooler Core Tubing	Clutch Plates, Brass/ Bronze Bushings (Also Look for Tin and/or Lead & Zinc), Oil Cooler Core Tubing	Brass/Bronze Bushings (Also Look for Tin and/or Lead & Zinc), Cage Metal from Roller Bearings, Oil Cooler Core Tubing	Bearings, Bushings, Thrust Washers, Oil Cooler Tubing	Bearings, Bushings, Thrust Plate, Oil Cooler Tubing	Bearings, Bushings, Thrust Washers, Oil Cooler Tubing	Bearings, Bushings, Thrust Plate, Oil Cooler Tubing
<b>Lead (Pb)</b>	Overlay metal in Main/Rod Bearings, Sometimes Solder, Aftermarket Additive	Clutch Plates, Brass/ Bronze Bushings (Also Look for Tin and/or Lead & Zinc)	Brass/Bronze Bushings (Also Look for Copper, Tin & Zinc), Cage Metal from Roller Bearings, Oil Cooler Core Tubing	Bearings, Bushings (Babbitt) (Also Look for Tin, Antimony & Copper)	Bearings, Bushings (Babbitt) (Also look for Tin, Antimony & Copper)	Bearings, Bushings (Babbitt) (Also look for Tin, Antimony & Copper)	Bearings, Bushings (Babbitt) (Also look for Tin, Antimony & Copper)
<b>Tin (Sn)</b>	Bearings (Babbitt) (Also Look for Lead, Antimony and Copper), Bronze Bushings Flashing from Pistons, Solder from Tin-Lead Solder	Brass/Bronze Bushings (Also Look for Tin and/or Lead & Zinc)	Bearings, Bushings (Babbitt) (Also Look for Lead, Antimony & Copper) Solder from Tin-Lead Solder	Bearings (Babbitt) (Also Look for Lead, Antimony, Copper & Bronze), Bushings Flashing from Pistons, Solder form Tin-Lead Solder	Bearings (Babbitt), Bushings, Solder from Tin-Lead Solder	Bearings, Bushings (Babbitt) (Also Look for Lead, Antimony & Copper), Flashing from Pistons, Solder from Tin-Lead Solder	Bearing (Babbitt), Bushings, Solder from Tin-Lead Solder
<b>Cadmium (Cd)</b>	Environmental Contaminant	Sometimes an Alloy Metal, Environmental Contaminant	Sometimes an Alloy Metal, Environmental Contaminant	Alloy form Cadmium Aluminum Bearings, Environmental Contaminant	Alloy form Cadmium Aluminum Bearings, Environmental Contaminant	Alloy form Cadmium Aluminum Bearings, Environmental Contaminant	Alloy form Cadmium Aluminum Bearings, Environmental Contaminant
<b>Silver (Ag)</b>	Silver in Wrist Pin Bushings in EMD 567 & 745 Engines, Some Solder from Cooler Core Joints	Trace Element in some Needle Bearings, Solder form Oil Cooler Core Joints	Not usually found in Gear Systems, Possibly from Solder	Solder, Trace Element	Solder, Trace Element	Solder, Trace Element	Solder, Trace Element
<b>Titanium (Ti)</b>	Valves, Piston Pins, Bearings, Shafts	Shafts, Gears, Bearings, Paint or Coatings	Shafts, Gears, Bearings, Paint or Coatings	Valves, Piston Pins, Bearings, Shafts	Shafts, Gears, Bearings, Paint or Coatings	Valves, Piston Pins	Shafts, Gears, Bearings, Paint or Coatings
<b>Vanadium (V)</b>	Alloy Metal, Contaminant in Marine Bunker Fuels	Usually not found in Transmissions, Possibly Environmental Contaminant	Usually not found in Gear Systems, Possibly Environmental Contaminant	Alloy Metal	Alloy Metal	Alloy Metal	Alloy Metal



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## Contaminant Metals

Metal	Reciprocating Engines	Transmissions	Gear Systems	Hydraulics	Rotary Compressors	Reciprocating Compressors	Turbines/ Centrifugal Compressors
<b>Silicon (Si)</b>	Dirt (Silica), Silicone form Silicon based Synthetic, Silicone Sealants, Silicates from Anti-Freeze	Dirt (Silica), Silicone form Silicon based Synthetic, Silicone Sealants, Silicates from Anti-Freeze	Dirt (Silica), Silicone form Silicon based Synthetic, Silicone Sealants, Silicates from Anti-Freeze	Dirt (Silica), Silicone form Silicon based Synthetic, Silicone Sealants, Silicates from Anti-Freeze	Dirt (Silica), Silicone form Silicon based Synthetic, Silicone Sealants, Silicates from Anti-Freeze	Dirt (Silica), Silicone form Silicon based Synthetic, Silicone Sealants, Silicates from Anti-Freeze	Dirt (Silica), Silicone form Silicon based Synthetic, Silicone Sealants, Silicates from Anti-Freeze
<b>Sodium (Na)</b>	Sodium from Salt Water, Spray Wash, Anti-Freeze Inhibitor (Coolant Leak)	Sodium from Salt Water, Spray Wash, Anti-Freeze Inhibitor (Coolant Leak)	Sodium from Salt Water, Spray Wash, Anti-Freeze Inhibitor (Coolant Leak)	Sodium from Salt Water, Spray Wash, Anti-Freeze Inhibitor (Coolant Leak)	Sodium from Salt Water, Spray Wash, Anti-Freeze Inhibitor (Coolant Leak)	Sodium from Salt Water, Spray Wash, Anti-Freeze Inhibitor (Coolant Leak)	Sodium from Salt Water, Spray Wash, Anti-Freeze Inhibitor (Coolant Leak)
<b>Potassium (K)</b>	Sodium from Salt Water, Spray Wash, Anti-Freeze Inhibitor (Coolant Leak) Additive from Potassium Borate Gear Oil	Sodium from Salt Water, Spray Wash, Anti-Freeze Inhibitor (Coolant Leak) Additive from Potassium Borate Gear Oil	Sodium from Salt Water, Spray Wash, Anti-Freeze Inhibitor (Coolant Leak) Additive from Potassium Borate Gear Oil	Sodium from Salt Water, Spray Wash, Anti-Freeze Inhibitor, Additive from potassium Borate Gear Oil	Environmental Contaminant from Pot Ash Mining, Water Contaminant, Anti-Freeze Inhibitor	Sodium from Salt Water, Spray Wash, Anti-Freeze Inhibitor	Environmental Contaminant from Pot Ash Mining, Water Contaminant, Anti-Freeze Inhibitor

## Multi-Source Metals

Metal	Reciprocating Engines	Transmissions	Gear Systems	Hydraulics	Rotary Compressors	Reciprocating Compressors	Turbines/ Centrifugal Compressors
<b>Molybdenum (Mo)</b>	Friction Modifier Additive in Oils, Grease Contamination, Molybdates from Some Coolants	Friction Modifier Additive in Oils, Grease Contamination, Molybdates from Some Coolants	Friction Modifier Additive in Oils, Grease Contamination, Molybdates from Some Coolants	Friction Modifier Additive in Oils, Grease Contamination, Molybdates from Some Coolants	Alloy or Plating from Rings, Retainer Pins, Friction Modifier Additive in Oils, Grease Contamination, Molybdates from Some Coolants	Alloy or Plating from Rings, Retainer Pins, Friction Modifier Additive in Oils, Grease Contamination, Molybdates from Some Coolants	Alloy or Plating from Rings, Retainer Pins, Friction Modifier Additive in Oils, Grease Contamination, Molybdates from Some Coolants
<b>Antimony (Sb)</b>	Alloy Metal in Babbitt Bearings, Bushings, Trace Element Used in Some Oils	Alloy Metal in Babbitt Bearings, Bushings, Trace Element Used in Some Oils	Alloy Metal in Babbitt Bearings, Bushings, Trace Element Used in Some Oils	Alloy Metal in Babbitt Bearings, Bushings, Trace Element Used in Some Oils	Alloy Metal in Babbitt Bearings, Bushings, Trace Element Used in Some Oils	Alloy Metal in Babbitt Bearings, Bushings, Trace Element Used in Some Oils	Alloy Metal in Babbitt Bearings, Bushings, Trace Element Used in Some Oils
<b>Manganese (Mn)</b>	Steel Alloy Metal in Gears, Some Shafts	Steel Alloy Metal in Gears, Some Shafts	Steel Alloy Metal in Gears, Some Shafts	Steel Alloy Metal in Gears, Some Shafts	Steel Alloy Metal in Gears, Some Shafts	Steel Alloy Metal in Gears, Some Shafts	Steel Alloy Metal in Gears, Some Shafts
<b>Lithium (Li)</b>	Contact with Grease	Contact with Grease	Contact with Grease	Contact with Grease	Contact with Grease	Contact with Grease	Contact with Grease

## Additive Metals

Metal	Reciprocating Engines	Transmissions	Gear Systems	Hydraulics	Rotary Compressors	Reciprocating Compressors	Turbines/ Centrifugal Compressors
<b>Boron (B)</b>	Additive Common in Engine Oils, Some Gear Oils	Additive Common in Engine Oils, Some Gear Oils, and Dexron Fluids	Additive Common in Engine Oils, Some Gear Oils, and Dexron Fluids	Additive Common in Engine Oils, Some Gear Oils	Additive Common in Engine Oils, Some Gear Oils	Additive Common in Engine Oils, Some Gear Oils	Additive Common in Engine Oils, Some Gear Oils
<b>Magnesium (Mg)</b>	Detergent/Dispersant Additive, Alloy, Environmental Contaminant	Detergent/Dispersant Additive, Alloy, Environmental Contaminant	Detergent/Dispersant Additive, Alloy, Environmental Contaminant	Detergent/Dispersant Additive, Alloy, Environmental Contaminant	Detergent/Dispersant Additive, Alloy, Environmental Contaminant	Detergent/Dispersant Additive, Alloy, Environmental Contaminant	Detergent/Dispersant Additive, Alloy, Environmental Contaminant
<b>Calcium (Ca)</b>	Detergent/Dispersant Additive, Calcium from Water Contamination, Lime Dust	Detergent/Dispersant Additive, Calcium from Water Contamination, Lime Dust	Detergent/Dispersant Additive, Calcium from Water Contamination, Lime Dust	Detergent/Dispersant Additive, Calcium from Water Contamination, Lime Dust	Detergent/Dispersant Additive, Calcium from Water Contamination, Lime Dust	Detergent/Dispersant Additive, Calcium from Water Contamination, Lime Dust	Detergent/Dispersant Additive, Calcium from Water Contamination, Lime Dust
<b>Barium (Ba)</b>	Not Commonly found in Engine Oils, Contaminant in Drilling Applications	Contaminant in Drilling Applications, Additive in Some Synthetic Oils	Contaminant in Drilling Applications	Not Commonly found in Hydraulic Oils, Contaminant in Drilling Applications	Demulsifying Agent, Additive Common in Compressor Oil, Some Transmission Fluids & Gear Oils, Contaminant in Drilling Applications	Demulsifying Agent, Additive Common in Compressor Oil, Some Transmission Fluids & Gear Oils, Contaminant in Drilling Applications	Demulsifying Agent, Additive Common in Compressor Oil, Some Transmission Fluids & Gear Oils, Contaminant in Drilling Applications
<b>Phosphorus (P)</b>	Anti-Wear Additive ZDDP (ZincDialkyl-DithioPhosphate), Phosphate Ester, Phosphate Inhibitor found in Coolants	Anti-Wear Additive ZDDP (ZincDialkyl-DithioPhosphate), Phosphate Ester, Phosphate Inhibitor found in Coolants	EP Additive, Anti-Wear Additive ZDDP (Zinc-DialkylDithioPhosphate), Phosphate Ester, Phosphate Inhibitor found in Coolants	Anti-Wear Additive ZDDP (ZincDialkyl-DithioPhosphate), Phosphate Ester, Phosphate Inhibitor found in Coolants	EP Additive, Anti-Wear Additive ZDDP (Zinc-DialkylDithioPhosphate), Phosphate Ester, Phosphate Inhibitor found in Coolants	EP Additive, Anti-Wear Additive ZDDP (Zinc-DialkylDithioPhosphate), Phosphate Ester, Phosphate Inhibitor found in Coolants	EP Additive, Anti-Wear Additive ZDDP (Zinc-DialkylDithioPhosphate), Phosphate Ester, Phosphate Inhibitor found in Coolants
<b>Zinc (Zn)</b>	Alloy in Brass, Anti-Wear Additive ZDDP, Galvanized Steel from Filter Canisters	Alloy in Brass, Anti-Wear Additive ZDDP, Galvanized Steel from Filter Canisters	Alloy in Brass, Anti-Wear Additive ZDDP, Galvanized Steel from Filter Canisters	Alloy in Brass, Anti-Wear Additive ZDDP, Galvanized Steel from Filter Canisters	Alloy in Brass, Anti-Wear Additive ZDDP, Galvanized Steel from Filter Canisters	Alloy in Brass, Anti-Wear Additive ZDDP, Galvanized Steel from Filter Canisters	Alloy in Brass, Anti-Wear Additive ZDDP, Galvanized Steel from Filter Canisters