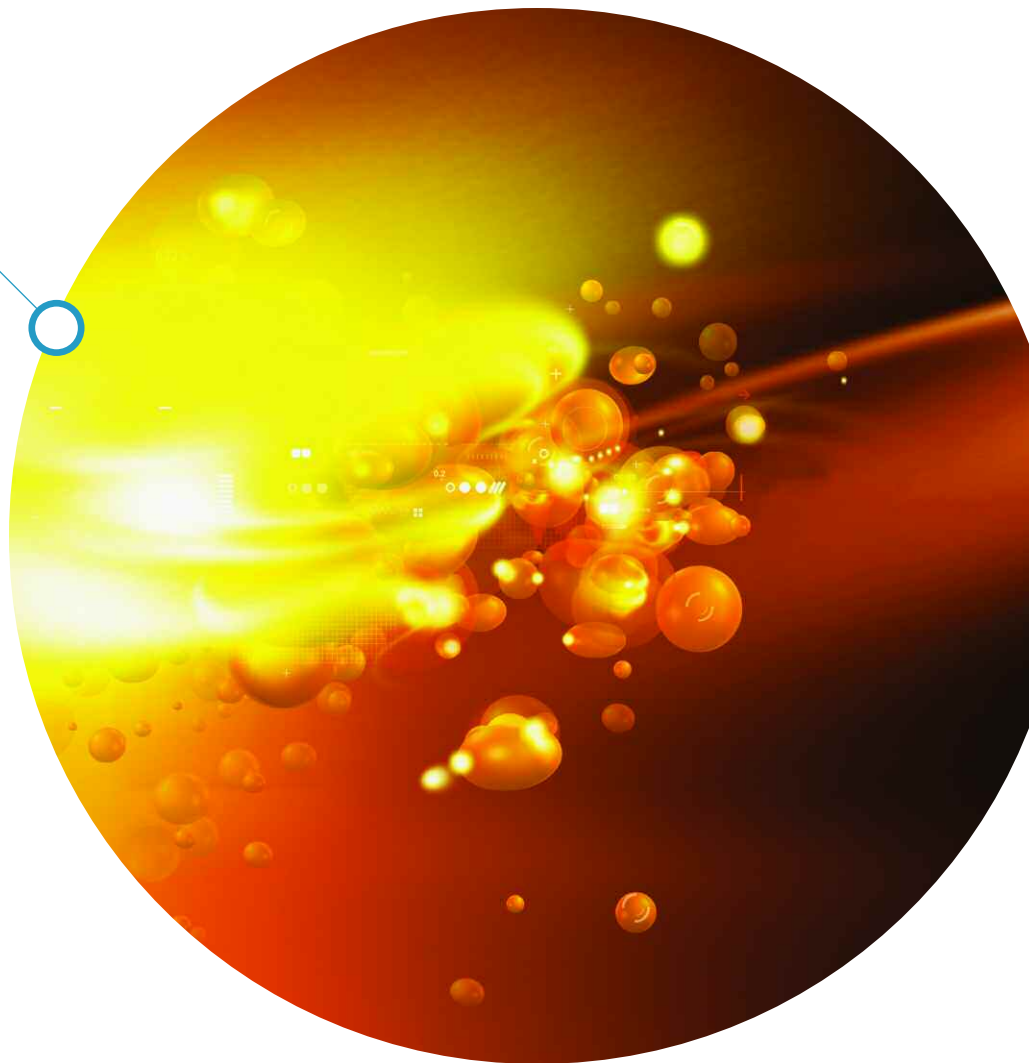


Signum

Oil Analysis



Enhanced to
more effectively
manage your
maintenance
program



The improved Web site is a resource for decision makers needing immediate access to critical information and an efficient way to share it with colleagues.



Analyze

Assess the results of your oil analysis to understand equipment and lubricant conditions.



Direct

Determine and direct a course of action based on results and customized recommendations.



Retrieve

Download sample results from Web site or email and access summary/management reports via email.



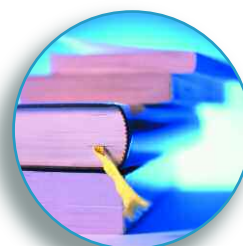
Collaborate

Manage fleet oil analysis performance and share information easily with your colleagues and ExxonMobil Marine Lubricants representatives.



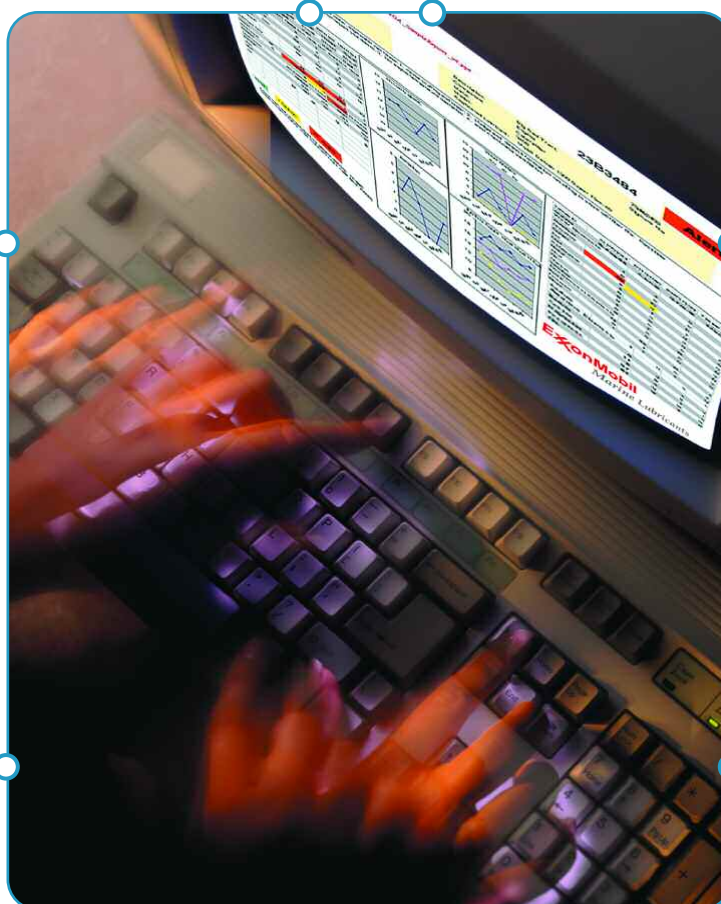
Print

Spend less time on administrative tasks by printing labels for your sample bottles.



Learn

Access a wealth of information online in our knowledge library.



Our enhanced oil analysis program's sample reports contain a wealth of helpful information and are in a format that is easy to read. Reports will be sent to you via the Web, by fax, or email.

This comprehensive oil analysis program offers everything you would expect from the world's leading supplier of marine lubricants.



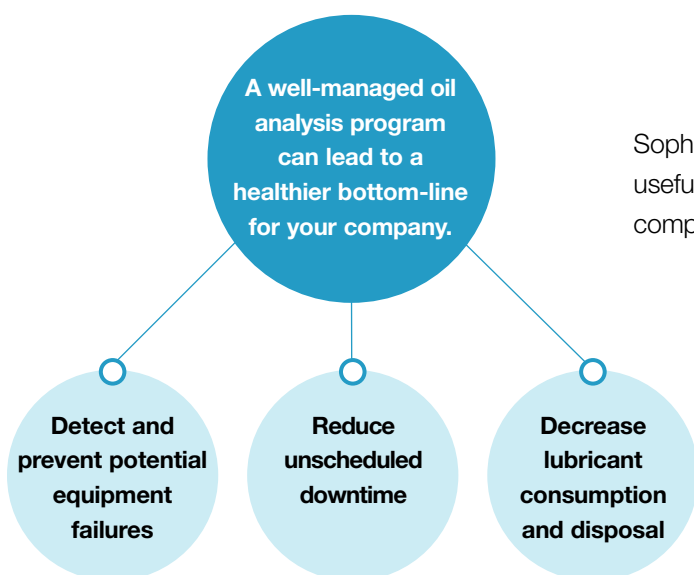
Now the information you need to manage your fleet's oil analysis and lubrication maintenance is online at the Signum Web site, www.exxonmobilmarinelubes.com.

Signum Oil Analysis can help you increase fleet productivity and decrease maintenance costs.

ExxonMobil has enhanced Signum Oil Analysis to make it even more of a resource. It offers:

- **Improved Web Site.** We have added new features to the Signum Oil Analysis Web site to help you manage oil analysis results and maintenance activities with greater ease and efficiency.
- **Application-Specific Tests.** Our laboratory testing regimen is the result of years of experience researching and developing marine lubricants. We match the most appropriate battery of tests to each specific equipment application.
- **Superior Alert System.** Receive robust condition trending that goes beyond single condition alarms from an alert system that also cross-references your results from multiple tests.
- **Easy-to-Read, More Useful Sample Reports.** Expect to receive timely and accurate information when and how you need it, and expert insights about the condition of your fleet's engines, shipboard equipment and oil.
- **Comprehensive Summaries.** Identify trends not typically seen when viewing individual sample reports with summaries that enable you to see the health of your fleet detailed by alarm, equipment type, product in use, application and vessel.

Sophisticated testing, technical expertise, a global database, and useful online features help make Signum the marine industry's most comprehensive oil analysis program.



Need assistance? Contact our

Technical Help Desk

Monday - Friday, 8:00 am to 5:00 pm,
in the local Help Desk time zones.
PLEASE NOTE GMT GUIDELINES.



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To help ensure the accuracy of our customers' oil analysis results, ExxonMobil has implemented quality assurance and control processes for testing conducted at Signum Oil Analysis laboratories.



Our team of experienced marine lubricants professionals can help you interpret analysis reports and develop a responsible course of action.

Our enhanced Signum Oil Analysis program provides the information and expertise you need to succeed.

Your vessel's lubricants contain valuable information about the condition and performance of its engines and equipment. Signum Oil Analysis can help you fully understand the information. It offers the technology and expertise you may need to run a well-managed oil analysis program.

We improved the Signum Oil Analysis Web site to make it easier for you to monitor the performance of your fleet's lubricants, engines and equipment. This is part of our ongoing commitment to simplify the way we do business around the world. Now, with just one secure Web site, you can manage your oil analysis results and maintenance program.

Signum Oil Analysis:

- Meets the requirements of the major classification societies.
- Features a database containing years of statistical history, allowing us to provide precise statistical limits for your oil based on equipment application, manufacturer, model, licensee and the product in use.
- Offers an "Onboard Test Kit" for water, viscosity and TBN and an "Onboard Quick Test Kit" for water and viscosity.

Contact your local ExxonMobil Marine Lubricants representative to review the enhanced Signum Oil Analysis program. Learn how it has the potential to lower the total lifetime cost of lubricating your fleet's engines and equipment.

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ExxonMobil
Marine Lubricants

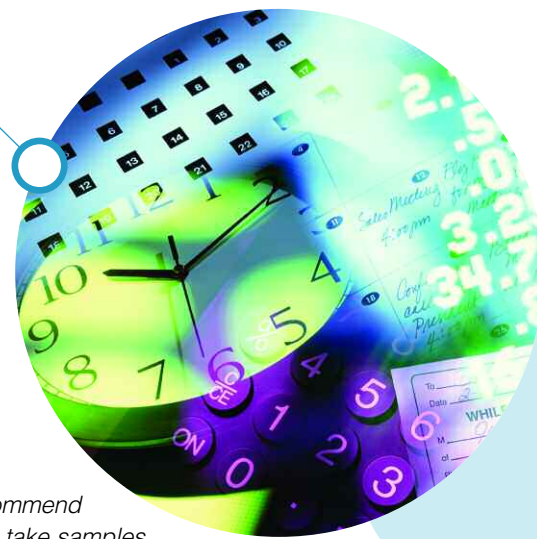
sampling interval

Establishing an appropriate sampling interval is an important step in building a value-added oil analysis program.

Sampling frequency should be adjusted based on your fleet's unique operating conditions and its maintenance goals. The equipment tables are intended to provide only initial guidance.

Enhanced Signum Oil Analysis can help you maintain consistent sampling intervals.

Your local ExxonMobil Marine Lubricants representative can discuss options with you for optimizing your equipment's oil change periods.



We recommend that you take samples at the normal oil change period recommended by the equipment manufacturer or established calendar/hours.

Marine Propulsion Equipment *

Sample Point	Frequency
High-Speed Diesel Engines	250-500 hours
Medium-Speed Diesel Engines	1000-2000 hours
Slow-Speed Engines System Oil	1000-2000 hours
Gas Turbines	250-500 hours
Steering Gear Hydraulics	500-2000 hours
Reduction Gears	250-500 hours
Cam Shaft Systems	250-500 hours
Thrusters	500-1000 hours
Stern Tubes	1000-2000 hours

Marine Supporting Equipment *

Sample Point	Frequency
Auxiliary Engines	500-1000 hours
Turbochargers	1000-2000 hours
Compressors (Air/Refrigeration)	3 to 6 months
Purifiers	1000-2000 hours
Deck Hydraulics	3 to 6 months
Deck Gear Drives	3 to 6 months

* Sampling frequency should be governed with OEM guidelines.

With the enhanced Signum Oil Analysis program you will know whether you are changing the oil more often than is necessary — or not often enough.

wear metals and contaminants

A basic understanding of wear metals and contaminants can help you better understand and extract value from Signum Oil Analysis.

Signum Oil Analysis provides recommendations and interpretation based on your specific equipment parameters.

The tables at right and below summarize some key sources of wear metals and contaminants from typical marine applications.

For a more detailed evaluation of your particular application, please consult your ExxonMobil Marine Lubricants representative.



The metals content of a sample is essential information for knowing how your oil is performing.

Typical Contaminant Sources

Contaminant	Potential Sources
Silicon	Abrasive Dirt, Sealant, Defoamant, Fuel Catalyst
Boron	Cooling Water Treatment
Sodium	Salt Water, Anti-freeze
Potassium	Cooling Water Treatment
Acid	Oil Degradation (TAN)
Oxidation	Thermal Degradation of Oil
Water	Coolant, Condensation
Glycol	Anti-freeze
Fuel Dilution	Fuel System, Blow-by
Soot	Incomplete Combustion, Blow-by
Magnesium	Sea Water Contamination
Zinc (EMD only)	Antiwear Additive, Galvanized Metal Materials
Insolubles	Products of Combustion or Foreign Contamination
Vanadium	Heavy Fuel Contamination
Asphaltenes	Heavy Fuel Oil

Typical Wear Metal Sources

Metal	Potential Sources
Iron	Cylinders, Gears, Rings, Crankshafts, Camshaft, Liners, Bearings, and Liner Plating
Chromium	Rings, Bearings
Lead	Bearing Overlays
Copper	Hydraulic Pumps, Bearing Cages, Bushings, Bronze Components
Tin	Bearing Plating, Compressor Pistons, Bushings
Aluminum	Pistons, Bearing and Pump Housings, Blower and Compressor Impellers
Nickel	Valves, Fuel Catalyst (when Silicon is high)
Silver (EMD Engines only)	Bearing and Bushing Plating

Testing for the presence of metals helps determine component wear levels and if harmful contamination is entering the oil.

onboard testing

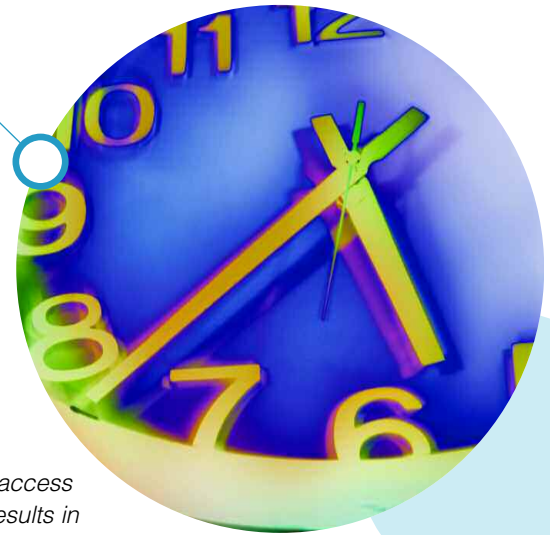
Signum Oil Analysis offers shipboard engineers immediate access to key analysis results via onboard testing.

We understand that there may be times you will not want to wait for a comprehensive oil analysis report.

- The enhanced Signum Oil Analysis program's "Onboard Test Kit" allows shipboard engineers to test samples for alkalinity retention (TBN), water contamination and changes in viscosity. It includes a digital test cell for easier reading.
- Our oil analysis program also provides an "Onboard Quick Test Kit" for fast, accurate water and viscosity testing.

Your local ExxonMobil Marine Lubricants representative will review Signum Oil Analysis Onboard Testing with you in detail.

To order Signum Oil Analysis sample bottle kits and onboard test kits, contact your customer service representative.



Having access to key results in "real-time" can provide the information shipboard engineers need to identify and correct problems before they become serious and costly.

Signum Oil Analysis is a highly effective way to ensure peace of mind.



With the Signum Oil Analysis Onboard Test Kit, shipboard engineers have the results of key tests in a matter of seconds.

Enhanced Signum Oil Analysis tests an oil sample's physical properties, chemical composition and metals to provide the data you need to help manage an effective oil analysis program.

Test	Purpose	Importance of Test	Application
Analytical Ferrography	To detect and analyze metallic particles measuring between 10 µm and 100 µm that have been caused by destructive wear processes or fatigue.	Ferrography can: <ul style="list-style-type: none"> • Pin-point the type and source of problem • Yield quantitative and descriptive information about particles 	Engine and Non-Engine
Compatibility	To ensure that marine lubricants from ExxonMobil are compatible with competitive products during vessel switchovers.	<ul style="list-style-type: none"> • Ensures that when converting lubricants no problems due to product incompatibility occur. 	Engine and Non-Engine
Cylinder Oil Scrapedown Analysis	To detect changes in the condition of cylinders in low-speed (crosshead) marine diesel engines.	<ul style="list-style-type: none"> • Helps to safely optimize cylinder oil feed rates, can reduce wear-related maintenance and operating costs. 	Engine
Flash Point	To determine the presence of potential fuel and other combustible contaminants in the oil.	A low flash point or fuel dilution can mean: <ul style="list-style-type: none"> • Potential crankcase explosion due to contamination from volatile material • Lube oil contamination by fuel • Increase in engine deposits caused by fuel component contamination in the lube oil 	Engine
Grease Analysis	To detect significant changes in contaminant levels.	<ul style="list-style-type: none"> • Helps prevent catastrophic failures of slewing bearings on deck cranes and other critical applications which can result in loss of life and machinery. 	Non-Engine
Insolubles	To determine the quantity of insoluble material in the lube oil.	<ul style="list-style-type: none"> • The significance of a lubricant's insolubles content and required corrective action are usually assessed in relation to the changes in other parameters, such as foreign contaminants or wear. 	Non-Engine
Metals	To determine the presence and levels of metallic particles in the oil.	<ul style="list-style-type: none"> • The presence of wear metals helps determine if equipment components are wearing or if harmful contamination is entering the oil. 	Engine and Non-Engine
Oxidation	To determine whether the lubricant has oxidized and caused it to deteriorate.	Oxidation can mean: <ul style="list-style-type: none"> • Increased wear and corrosion • Shorter equipment life • Increased viscosity • Excessive deposits and plugging 	Engine and Non-Engine
Particle Count	To monitor the cleanliness of critical hydraulic and circulating oil systems.	<ul style="list-style-type: none"> • Cleanliness is a critical factor in the running of hydraulic and circulating oil systems. • Debris can interfere in the fine tolerances of the system's pumps and valves or cause premature bearing wear. 	Non-Engine
Particle Quantifier (PQ)	To determine ferrous metal fatigue failures and metal-to-metal contact not usually detectable with current spectrographic analysis.	PQ can detect at an early stage: <ul style="list-style-type: none"> • Anti-friction bearing wear • Plain bearing wear • Early indications of piston scuffing • Gear wear 	Engine and Non-Engine
Detecting Asphaltenes Contamination (DAC)	To determine the level of asphaltenes contamination that comes from raw or partially burned fuel entering the engine lube oil.	Detecting excessive asphaltenes in engine oil can help to: <ul style="list-style-type: none"> • Prevent harmful piston undercrown deposits that can lead to piston crown burning • Stop excessive sludge from forming in the engine crankcase 	Engine
Soot	To determine the soot content in an oil by percentage weight.	Soot contamination can mean: <ul style="list-style-type: none"> • Decreased engine performance • Reduced fuel economy • Excessive deposits and sludge • Shorter oil life • High blow-by 	Engine
Total Base Number (TBN)	To determine the amount of acid-neutralizing additive present in the oil.	<ul style="list-style-type: none"> • Determines oil degradation • Suggests increasing wear • Predicts corrosion • Alerts to changing fuel characteristics 	Engine
Viscosity	To determine the oil's resistance to flow at 40°C for non-engine applications and 100°C for engine applications. <ul style="list-style-type: none"> • If viscosity is low, gas chromatography is used to determine fuel dilution. 	<ul style="list-style-type: none"> • An increase in viscosity may be due to high soot or insolubles content, water contamination, or admixture with higher viscosity fuel or lubricant. • A decrease in viscosity may be due to water contamination, or admixture with lower viscosity fuel or lubricant. • Both high or low viscosity can result in premature equipment wear. 	Engine and Non-Engine
Water	To determine the water content of the oil.	<ul style="list-style-type: none"> • Water contamination can cause severe wear due to corrosion, poor film thickness, or hydrogen embrittlement. 	Engine and Non-Engine

ENGINE OILS	Engine	Engine w/ DAC	Scrapeddown
Viscosity @ 100°C	X	L	L
Water, Disp. (Infrared)	X	L	
Karl Fisher, Water			X
Total Base Number	X	L	L
Flash Point (SETA)	FS	L	
Oxidation	X	L	
Soot	X	L	
Fuel Dilution by Gas Chromatography	C	C	
Analytical Ferrography	C, L	C, L	C, L
Particle Quantifier	X	L	L
Detecting Asphaltene Contamination		L	
Strong Acid Number			TBNS, L
Compatibility	C, L	C, L	
Metals	X	L	L
Aluminum	X	L	L
Boron	X	L	L
Chromium	X	L	L
Copper	X	L	L
Iron	X	L	L
Lead	X	L	L
Nickel	X	L	L
Silicon	X	L	L
Sodium	X	L	L
Tin	X	L	L
Vanadium	X	L	L
Zinc	C	C, L	C, L
Potassium	X	L	L
Molybdenum	X	L	L
Silver	X	L	L

KEY	
X	Normal test
C	Condition test
FS	Fuel Specific test; Residual Fuel engines receive Flash Point (i.e., Mobilgard M series)
TBNS	Total Base Number (TBN) Specific test for scrapeddown samples only. If sample's TBN is below 10, run Strong Acid Number (SAN) test.
PS	Product Specific test; Synthetic oils receive Total Acid Number (TAN) test and Mineral oils receive Oxidation by IR test
L	Lab Specific test run only at Pernis laboratory

NOTE: The following test slates are only run at Pernis laboratory:

- 1) Engine w/ DAC
- 2) Scrapeddown
- 3) Hydraulic w/ SAN/TAN/pH
- 4) Grease

NON-ENGINE OILS	Air Compressor	Gas/ Refrigeration Compressor	Gas Turbine	Circulating	Circulating – Heat Transfer	Circulating – Stern Tube	Hydraulic	Hydraulic w/ SAN/TAN/pH	Gear Drive	Steam Turbine	Fresh Oil Tank	Grease
Viscosity @ 40°C	X		X	PS	X	PS	PS	L	PS	X	PS	
Viscosity @ 40°C Degassed		X										
Viscosity @ 100°C											PS	
Water, Hot Plate	X	X	X	X		X	X	L	X	X	X	
Karl Fischer, Water	C	C	C	C	X	C	C	C	C	C	C	L
Total Base Number											PS	
Flash Point (Closed Cup)					L							
Oxidation	PS	PS	PS	PS	X	X	PS	PS	PS	X		
Insolubles					L	L						
Analytical Ferrography	C, L	C, L	C, L	C, L		C, L	C, L	C, L	C, L	C, L		
Particle Quantifier	X	X	X	X		X	X	L	X	X		L
Particle Count (4µm, 6µm, 14µm)	X	X	X	X			X	L	X	X		
Strong Acid Number								L				
Total Acid Number	PS	PS	X	PS	L		PS	L	PS	X		
pH								L				
Micro Carbon Residue					L							
Compatibility	C, L	C, L	C, L	C, L	C, L	C, L	C, L	C, L	C, L	C, L	C, L	
Metals	X	X	X	X	X	X	X	L	X	X	X	L
Aluminum	X	X	X	X	X	X	X	L	X	X	X	L
Boron	X	X	X	X	X	X	X	L	X	X	X	L
Chromium	X	X	X	X	X	X	X	L	X	X	X	L
Copper	X	X	X	X	X	X	X	L	X	X	X	L
Iron	X	X	X	X	X	X	X	L	X	X	X	L
Lead	X	X	X	X	X	X	X	L	X	X	X	L
Nickel	X	X	X	X	X	X	X	L	X	X	X	L
Silicon	X	X	X	X	X	X	X	L	X	X	X	L
Sodium	X	X	X	X	X	X	X	L	X	X	X	L
Tin	X	X	X	X	X	X	X	L	X	X	X	L
Vanadium	X	X	X	X	X	X	X	L	X	X	X	L
Zinc											PS	
Potassium	X	X	X	X	X	X	X	L	X	X	X	L
Molybdenum	X	X	X	X	X	X	X	L	X	X	X	L
Silver	X	X	X	X	X	X	X	L	X	X	X	L

The above information is subject to change without notice.