Countries:	AUSTRALIA, CANADA, UNITED STATES, MEXICO, PUERTO RICO, SOUTH AFRICA	**Document ID**:	IK1200776
Availability:	ISIS, FleetISIS	**Revision**:	4
Major System:	ENGINES	**Created**:	6/27/2012
Current Language:	English	**Last Modified**:	3/7/2014
Other Languages:	Español,	**Author**:	Daniel Modesto
Viewed:	3374		

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Title: Understanding Used Oil Analysis

Applies To: MaxxForce 5, 7, DT, 9, 10, 11, 13,15 engine models

DESCRIPTION

The engine service manual identifies the proper oil drain interval for your engine and should be followed, whether oil miles or accumulated hours, depending on the application. Applications such as school buses, urban buses, and garbage packers may reach oil drain interval in hours before miles. Many owners use the drain as an opportunity to obtain oil samples. Oil analysis is a tool that can be used to assess an engine's health and maximize its life. This document communicates the abnormal and critical levels for pertinent oil characteristics. A normally operating engine will end a drain interval at or below the abnormal levels. An occasional excursion above abnormal levels may occur. In the instance that oil analysis characteristics exceed the critical level during a regular oil drain interval, reconfirm the maintenance interval per the criteria (fuel economy, average speed, etc.) in the service manual,and adjust if necessary.

Issue Overview

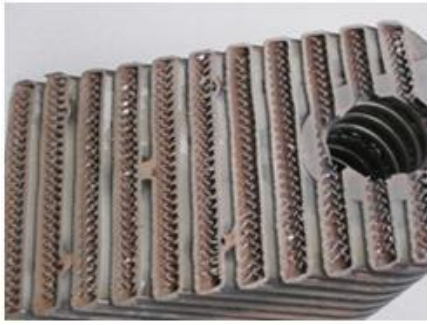
International is aware of a condition where high copper (Cu) has been found in engine oil samples, usually in the first few service intervals. The condition is caused by a reaction between engine oil formulation and the copper braze coated surfaces inside the oil cooler. This is a normal phenomenon with copper brazed oil coolers. There is no cause for concern with the high readings as long as there are not also accompanying high readings of lead (Pb) or Tin (Sn), as copper used in oil cooler brazing is nearly pure and not alloyed with other metals. Engine oil copper levels will diminish as those surfaces become conditioned over time and miles.

This phenomenon can also occur if there is an oil formulation change, such as a change of brand and/or viscosity grade used in an engine. Again, this is normal, as the cooler needs to be conditioned to the new formulation.

Maintenance Practice

International's recommendation is to monitor the oil copper level over the first few service intervals and thereafter. Levels as high as 250 ppm copper in MaxxForce 11/13 and as high as 400 ppm copper in MaxxForce 15 are normal during the conditioning period. The copper levels will then decrease at a rate that is dependent on oil formulation. High copper by itself without abnormal lead or tin levels is attributable to the oil cooler.

Cutaway of oil cooler showing copper braze coated surfaces inside:



Engine Oil Guidlines Summary

- The engine oil guidelines below should not be treated as a sole reason for disassembly of the engine. Excursions past the critical levels can be justification for further investigation into engine performance and maintenance practices of the engine or vehicle. In these instances consult your local International® Truck or IC Bus® dealer for further guidance. In most cases servicing of the oil and filter is recommended.
- Sodium (Na) and potassium (K) content above abnormal and critical levels is a potential indicator of coolant contamination. If either reaches critical levels, consult your local International® Truck or IC Bus® dealer.
- Due to testing inaccuracy in fuel dilution measurement, viscosity, not fuel dilution, should be the primary indicator for additional engine diagnosis, beyond servicing of oil, for excursions of either parameter. Fuel dilution should only be used as a means of determining the cause of low viscosity levels. Abnormal and criticalminimum viscosity limitsdiffer byoil viscosity grade so that both unacceptably low viscosity levels and unacceptably high fuel dilution levels are indentified.
- Total Base Number (TBN) is a measure of the oils ability to neutralize acids. As acids are formed in the engine, the TBN is depleted when neutralizing these acids. When TBN falls below the minimum recommended level, internal corrosion may occur. If TBN falls below the minimum over the course of a drain interval, consult the product data sheet for your oil to obtain the TBN level of new oil. MaxxForce® Diesel Engines are developed for operation with new oil at a TBNalevel of 10 or higher. In the case where TBN falls below the criteria, a shortened oil drain or a minimum 10 TBNalevel for new oil is highly recommended.
- Included in this document are guidelines for assessing engine oil condition. Used oil wear metals limits have been omitted due to the fact that these are highly dependent on application, service, time/mileage on oil, etc. See your local International® Truck or IC Bus® dealer if assistance in interpretation of oil analysis is needed.

ABNORMAL & CRITICAL LEVELS FOR10W-30, 5W-30OILS

Abnormal Levels

Make	Models	Max Si[b] (ppm)	Max Na[b] (ppm)	Max K[b] (ppm)	Min Vis[c] (cSt)	Max Vis[c] (cSt)	Max H_2O[d] (%)	Max Soot[e] (%)	Min TBN[f] (mgKOH/g)
Navistar	All Others - Pre 2007	20	40	50	10[g]	14	0.2	4	3.5
Navistar	MaxxForce 7	20	40	50	10	15	0.2	4	3.5
Navistar	MxF 5, MxF DT, 9, &10	20	40	50	10[g]	14	0.2	4	3.5
Navistar	MxF11, 13, & 15	20	40	50	11	15	0.2	3	3.5

Critical Levels

Make	Models	Max Si[b] (ppm)	Max Na[b] (ppm)	Max K[b] (ppm)	Min Vis[c] (cSt)	Max Vis[c] (cSt)	Max H_2O[d] (%)	Max Soot[e] (%)	Min TBN[f] (mgKOH/g)
Navistar		30	100	150	9[g]	15	0.5	5	3

	All Others - Pre 2007								
Navistar	MaxxForce 7	30	100	150	10	16	0.5	5	3
Navistar	MxF 5, MxF DT, 9, &10	30	100	150	9[g]	15	0.5	5	3
Navistar	MxF11, 13, & 15	30	100	150	10	16	0.5	5	3

ABNORMAL & CRITICAL LEVELS FOR15W-40, 5W-40OILS

Abnormal Levels

Make	Models	Max Si[b] (ppm)	Max Na[b] (ppm)	Max K[b] (ppm)	Min Vis[c] (cSt)	Max Vis[c] (cSt)	Max H_2O[d] (%)	Max Soot[e] (%)	Min TBN[f] (mgKOH/g)
Navistar	All Others - Pre 2007	20	40	50	12[g]	16.5	0.2	4	3.5
Navistar	MaxxForce 7	20	40	50	12	18.5	0.2	4	3.5
Navistar	MxF 5, MxF DT, 9, &10	20	40	50	11[g]	17	0.2	4	3.5
Navistar	MxF11, 13, & 15	20	40	50	12.5	18.5	0.2	3	3.5

Critical Levels

Make	Models	Max Si[b] (ppm)	Max Na[b] (ppm)	Max K[b] (ppm)	Min Vis[c] (cSt)	Max Vis[c] (cSt)	Max H_2O[d] (%)	Max Soot[e] (%)	Min TBN[f] (mgKOH/g)
Navistar	All Others - Pre 2007	30	100	150	11[g]	17.5	0.5	5	3
Navistar	MaxxForce 7	30	100	150	10	19.5	0.5	5	3
Navistar	MxF 5, MxF DT, 9, &10	30	100	150	10[g]	18	0.5	5	3
Navistar	MxF11, 13, & 15	30	100	150	11.5	19.5	0.5	5	3

Oil Characteristic Key

Si	Maximum Silicon for Level
Na	Maximum Sodium for Level
K	Maximum Potassium for Level
Vis L	Minimum Viscosity for Level
Vis H	Maximum Viscosity for Level
H2O	Maximum Water for Level
Soot	Maximum Soot for Level
TBN	Minimum Total Base Number for Level

[a]Per ASTM D2896
[b]Per ASTM D5185
[c]Kinematic Viscosity at 100°C per ASTM D445
[d]Per ASTM D1744
[e]Per FTIR or TGA

[f]Per ASTM D4739
[g]Oil in engines with oil activated fuel systems experience shear induced viscosity loss independent of fuel dilution

RESOLUTION

Contact Engine Technical support if you have any questions.

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