

Oil Sampling is common practice. Combined with good routine maintenance an oil sample program may warn you of ongoing wear issues in a component. For example an engine that over a series of samples shows increasing levels of metals in its samples could indicate the need to look for premature wear in the component. This is not the case with *Hat Express*. Below are results of the oils samples taken at each oil change of Hat Expresses Main Engines. Detroit recommends oil be changed following every 200 and 250 hours of operation. At each oil change we draw samples of the oil and send it to Detroit Diesel's lab for analysis. They send us the results and advise us of any issues. Notice in the lower left of the report there are codes for "NORMAL", "CAUTION", "ABNORMAL" and "SEVERE".

With the exception Soot the port engine's results have always been in the normal range. The Starboard main engine also has Soot issues and has had a couple of other abnormal readings. The 28 Nov 2011 sample was taken in conjunction with the discovery of water in the oil and the 5 Feb 10 sample was taken in conjunction with the coolant water pump failure which also introduced water into the oil. Other than those two samples there have been no other significant abnormalities with the Starboard engine's samples.

A word about SOOT. You will notice that both main engines have high soot levels in their samples. Soot is caused by incomplete combustion and can come from a range of sources. Some is caused simply by the age of the engines and normal wear, but soot can also be caused by running the engines at idle or low speeds. So we're in a bit of a "catch 22". If we run the engines at 1,000 rpm the boat does around 11 knots and burns about 11 gallons per side per hour. But running the boat at this low speed is probably one of the main contributors to our soot levels. But it saves fuel. In order to reduce the soot levels and the potential damage we must run the vessel at its designed speed of 1800 RPM. But that will result in fuel consumption of around 60 gallons per side per hour. You can learn more about soot in diesel engines by reading this article - http://home.servcofs.com/images/E0038501/EnergyInsider1_11.pdf

The June 2011 samples were taken after *Hat Express* began showing increased black smoke, yet with the exception of elevated soot, no other abnormalities were found that would indicate specific follow on tests or repairs.

We know very little about the long term maintenance history of *Hat Express*. We purchased her "as is, where is". We can tell by some physical clues (access holes cut in frames and the paint color of various parts) that both her engines have had at least partial in-frame overhauls, but at what level and when, we do not know. If you want to look at cleaner copies of the sample records they are posted in the archive section of our web site's document library as:

HE SME Nov 2011.pdf - Starboard Main Engine
HE PME Nov 2011.pdf - Port Main Engine
HE SRG Nov 2011.pdf - Starboard Reduction Gear
HE PRG Nov 2011.pdf - Port Reduction Gear



DETROIT DIESEL

GENUINE PARTS

UIN: 00D5080

Diesel Engine
HATEXPRESS

Unit No.

Unit:

Make

Model

Serial No.

Site

Compartment:

Port Diesel Engine

Detroit Diesel

SERIES 92

16VF014036

Capacity

Customer:

HAT ISLAND COMMUNITY

Everett WA 98201

USA

DIAGNOSIS

All wear rates normal. Soot content excessive. Soot causes abrasive wear and thickens oil. Other contaminant levels acceptable. Viscosity within specified operating range.

Action: Check source of soot/solids (poor combustion/operation/restricted air intake/over-fueling/extended oil drain interval). Resample next service interval to further monitor.

ANALYST: Ed.Matthews



LEGEND

SEVERE ABNORMAL CAUTION NORMAL

1-800-DDC-0952

DATE SAMPLED

28-Nov-11

16-Jun-11

15-Dec-10

08-Jul-10

05-Feb-10

15-Aug-09

DATE RECEIVED

28-Nov-11

27-Jun-11

28-Dec-10

09-Jul-10

24-Feb-10

31-Aug-09

DATE REPORTED

29-Nov-11

27-Jun-11

29-Dec-10

12-Jul-10

26-Feb-10

31-Aug-09

LAB NO. 40110180601 40110144149 40110102499 40110061805 40110028826 40109060143

SIF NO. 11335957 10746256 10124476 9914855 9395988 8745271

TIME ON UNIT Hrs 6869 218 6409 254 5938 200

TIME ON OIL Hrs 218 241 254 200 208 200

OIL BRAND Chevron Delo 100 SAE 40

OIL TYPE Delo 100 SAE 40

OIL GRADE SAE 40

OIL ADDED

FILTER

OIL CHANGED

WO NUMBER

Not Provided

Metals (ppm)

Iron (Fe)	45	45	47	69	88	99
Chromium (Cr)	2	1	3	3	4	7
Lead (Pb)	1	<1	1	1	1	1
Copper (Cu)	2	4	4	6	9	17
Tin (Sn)	12	13	13	13	12	18
Aluminum (Al)	4	7	3	5	5	9
Nickel (Ni)	<1	<1	<1	<1	<1	<1
Silver (Ag)	<1	<1	<1	<1	<1	<1
Titanium (Ti)	<1	<1	<1	<1	<1	<1
Vanadium (V)	<1	<1	<1	<1	<1	<1

Contaminants (ppm)

Silicon (Si)	5	6	6	10	17	29
Sodium (Na)	1	9	6	7	7	13
Potassium (K)	<5	<5	15	<5	<5	<5
Water (%)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Coolant	No	No	No	No	No	No

Additives (ppm)

Magnesium (Mg)	1030	1090	746	927	958	989
Calcium (Ca)	379	456	184	356	362	376
Barium (Ba)	<1	<1	<1	<1	<1	<1
Phosphorus (P)	900	957	685	996	1012	1090
Zinc (Zn)	1060	1140	753	1003	1101	1160
Molybdenum (Mo)	93	99	65	105	197	111
Boron (B)	90	103	82	115	129	94

Physical Tests

Viscosity (cSt 100C) 15.3 15.4 15.0 14.7 15.1 15.4

Fuel (%) <1 <1 <1 <1 <1 <1

Soot (%) 1.7 1.4 1.8 1.2 0.7 2.0



High Soot Levels



GENUINE PARTS

UIN: 02CB190

Reduction Gearbox

Unit No. HATEXPRESS

Unit:

Make

Model

Serial No.

Site

Compartment:

Name Port Reduction Gearbox

Make Twin Disc

Model

Serial No. 3X5119

Capacity

Customer:

HAT ISLAND COMMUNITY
Everett WA 98201
USA

DIAGNOSIS

All wear levels appear within acceptable limits for first sample. Silicon level (dirt/sealant material) satisfactory. Water content acceptable. Viscosity within specified operating range.

Action: Resample at next recommended interval to monitor and establish wear trend.

ANALYST: Ed.Matthews



LEGEND

STOP SEVERE ABNORMAL ! CAUTION ✓ NORMAL

1-800-DDC-0952

DATE SAMPLED	28-Nov-11
DATE RECEIVED	28-Nov-11
DATE REPORTED	29-Nov-11

LAB NO.	40110180603
SIF NO.	11335959
TIME ON UNIT	Hrs
TIME ON OIL	Hrs 941
OIL BRAND	Chevron
OIL TYPE	Delo 100
OIL GRADE	SAE 40
OIL ADDED	
FILTER	Not Applicable
OIL CHANGED	
WO NUMBER	

Metals (ppm)	
Iron (Fe)	46
Chromium (Cr)	<1
Lead (Pb)	2
Copper (Cu)	18
Tin (Sn)	2
Aluminium (Al)	4
Nickel (Ni)	<1
Silver (Ag)	<1
Titanium (Ti)	<1
Vanadium (V)	<1

Contaminants (ppm)	
Silicon (Si)	11
Sodium (Na)	7
Potassium (K)	<5
Water (%)	<0.05

Additives (ppm)	
Magnesium (Mg)	951
Calcium (Ca)	431
Barium (Ba)	<1
Phosphorus (P)	929
Zinc (Zn)	1010
Molybdenum (Mo)	57
Boron (B)	141

Physical Tests	
Viscosity (cSt 40C)	131.6
Solids (%)	<0.1



DETROIT DIESEL



GENUINE PARTS

UIN: 02CB191

Reduction Gearbox

Unit No. HATEXPRESS

Unit:

Make

Model

Serial No.

Site

Compartment:

Name Starboard Reduction Gearbox

Make Twin Disc

Model

Serial No. 3AF656

Capacity

Customer:

HAT ISLAND COMMUNITY
Everett WA 98201
USA

DIAGNOSIS

All wear levels appear within acceptable limits for first sample. Silicon level (dirt/sealant material) satisfactory. Water content acceptable. Viscosity within specified operating range.

Action: Resample at next recommended interval to monitor and establish wear trend.

ANALYST: Ed. Matthews



LEGEND

SEVERE ABNORMAL CAUTION NORMAL

1-800-DDC-0952

DATE SAMPLED	22-Nov-11
DATE RECEIVED	28-Nov-11
DATE REPORTED	29-Nov-11

LAB NO.	40110180604
SIF NO.	11335960
TIME ON UNIT	Hrs
TIME ON OIL	Hrs 950
OIL BRAND	Chevron
OIL TYPE	Delo 100
OIL GRADE	SAE 40
OIL ADDED	
FILTER	Not Applicable
OIL CHANGED	
WO NUMBER	

Metals (ppm)	
Iron (Fe)	33
Chromium (Cr)	<1
Lead (Pb)	8
Copper (Cu)	199
Tin (Sn)	2
Aluminium (Al)	3
Nickel (Ni)	<1
Silver (Ag)	<1
Titanium (Ti)	<1
Vanadium (V)	<1

Contaminants (ppm)	
Silicon (Si)	4
Sodium (Na)	2
Potassium (K)	<5
Water (%)	<0.05

Additives (ppm)	
Magnesium (Mg)	765
Calcium (Ca)	239
Barium (Ba)	<1
Phosphorus (P)	769
Zinc (Zn)	839
Molybdenum (Mo)	67
Boron (B)	97

Physical Tests	
Viscosity (cSt 40C)	132.6
Solids (%)	<0.1

