FLORIDA DETROIT DIESEL-ALLISON
A Stewart & Stevenson Company

Trial Invoice

REMIT TO:
Stewart & Stevenson P.O. Box 301063 Dallas TX 75303-1063

Correspondence Only: P.O. Box 2968 Houston, TX 77262 Phone: (713) 884-3200 EMAIL: credit@ssss.com

BILL TO:	SHIP TO:
YT GRANDER AMBITION 1320 TIDAL POINTE BLVD JUPITER, FL-33477	YT GRANDER AMBITION 1550 Ave C Viking Yacht Service Center WEST PALM BCH, FL-33404-5638

SUBMITTED TO		CONTACT BY	SERVICE REQUEST NUMBER
RON LAYTON		PHONE: (609) 425-0443	490215
Service Order	**Job Name**	**DELIVERY DATE**	**PAYMENT TERM**
464243	WPB485307		COD
SALES PERSON		**LOCATION**	**CUSTOMER PO#**
Kelly, Daniel		WEST PALM BEACH - WPB	Credit Card
DEALER CODE		**CUSTOMER NUMBER**	**INVOICE NUMBER**
		115529	
INVOICE DATE		**DUE DATE**	**JOB OPEN DATE**
20-APR-23			10-APR-23

SERVICE ANYTIME, ANYWHERE	SALES SERVICE PARTS	RENTING-LEASING	PERIODIC MAINTENANCE

Equipment Details	**Vehicle OEM:** **VIN:** VKY82028F516 **Unit:** GRANDER AMBITION **Equipment Mileage:** 1 **Hours:** 57 **Licensed(On Hwy/Off Hwy):** Off	**Vehicle OEM Model:** **Equipment SN:** 545101682 **Equipment In Service Date:** 18-NOV-19 **Model:** MTU SERIES 2000

Complaint: Performance Evaulation Sea Trial W/Fluid Analysis
(P)545101681
(S)545101682

Service Narratives:	04.11.2023 Engine Hours 56 Travel to the boat with the equipment and catch up with the boat as they are pulling it out of the water to check the hull. Get a latter and get onboard. check the engines and hookup to the engines and connect. Download the information from them and save on the laptop. Get ready to sea trial. When the boat went back into the water get back onboard and set a recording of the data from the engines. Run the boat up and down the intra-coastal and record the data, run up through the full RPM range. Test the engine room controls and return to the dock and take oil samples from all of the units. Pack up, load up, and return and start filing reports and printing out the data. Drop off the oil samples for testing. Les Bauer KIR35061 **** Outside Generic Work >> Fluid Analysis ****

QUANTITY	ITEM NUMBER	DESCRIPTION	UOM	UNIT PRICE	EXTENDED PRICE

CASH

We appreciate the opportunity to serve your needs.

Customer Copy

Parts Total :	$0.00

We appreciate the opportunity to serve your needs.

Customer Copy

Labor :			
	ENVIRONMENTAL		$1,496.00
	SUPPLIES		$75.00
	TRUCKCHARGE		$68.00
	Outside Generic Work		$18.00
			$147.00
		SUB TOTAL	$1,804.00
	County: $17.86 State: $107.16		
		TAX	$125.02
		TOTAL	$1,929.02

CUSTOMER'S AGREEMENT

ALL INVOICE DISCREPANCIES MUST BE REPORTED, IN WRITING, TO STEWART & STEVENSON WITHIN (10) DAYS OF RECEIPT. WE CANNOT ACCEPT MERCHANDISE RETURNED WITHOUT OUR PERMISSION. A MINIMUM HANDLING CHARGE OF 15% OF THE INVOICE PRICE WILL BE MADE ON ALL RETURNED MERCHANDISE. PURCHASER AGREES TO THE ADDITIONAL TERMS OF SALE INCLUDED HEREIN.

AUTHORIZED BY **DATE**

Standard Terms and Conditions are included herein by reference and available at: www.stewartandstevenson.com/terms-of-sale

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Customer Copy

FLORIDA DETROIT DIESEL-ALLISON
A Stewart & Stevenson Company

Acknowledgement

Branch - S&S FDDA - West Palm Beach

Report Run Date: 04/10/23
Report Run Time: 13:58:58
Open Date: 04/10/23
Customer Number: 115529
Call Taken By: Kelly, Daniel
Service Tech:

Service Order Number 464243 **Job Number** WPB485307

W.O (Service Request) Number 490215

Customer YT GRANDER AMBITION
PO Number Credit Card
Phone Number 609-425-0443
Caller Name RON LAYTON-YT GRANDER AMBITION-919072
Department WPB

Work Performed Address

1550 Ave C Viking Yacht Service Center
WEST PALM BCH PALM BEACH
FL US 33404-5638

TRIP

Payment Terms: COD

Customer Authorization to Begin Work - Customer Signature Required - Hereby Accepting the Additional Terms of Sale Included Herein.

I hereby authorize the below repair work to be done along with the necessary material and hereby grant you and/or your employee's permission to operate the vehicle or engine herein described on streets, highways or elsewhere for the purpose of testing and/or inspection if required. An express mechanic's lien is hereby acknowledged on the above vehicle or engine to secure the amount of repairs thereto. Repairer is not responsible for the loss or damage to articles left with or in the vehicle or engine in case of fire, theft or any other cause beyond its control.

Authorized Customer Representative: (Please Print)	Signature	Date:
RONALD LAYTON		4.11.23

Equipment Make: TOGNUM	Equipment Model:	Description: MTU Diesel Engine Series 2000	
Serial Number: 545101682	Unit Number: STBD	Parent S/N: VKY82028F516	Parent Unit No: GRANDER AMBITION
In Service Date: 11/18/2019	MI/HR: 1/	Parent Make/Model: /VIK - CRUISER	

Problem Summary: Performance Evaulation Sea Trial W/Fluid Analysis
(P)545101681
(S)545101682

Service Notes:

SCHEDULE CONTACT:

SITE CONTACT:

TIME CONSTRAINTS:

SITE SPECIFIC INFO:

INVOICING NOTE:

Technician Instructions:

	Travel Labor			Mileage			Location Labor			Lunch		
Date:	Start	End	Hours	Start	End	Miles	Start	End	Hours	Start	End	Hours
		Total:			Total:			Total:			Total:	

Technician:	Date:

Customer Acceptance of Work Performed - Customer Signature Required - Hereby Accepting the Additional Terms of Sale Included Herein.

Authorized Customer Representative: (Please Print)	Signature	Date:
Ronald Layton		4/11/23

Standard Terms and Conditions are included herein by reference and available at: www.stewartandstevenson.com/terms-of-sale

PALM BEACH POWER

FLORIDA DETROIT DIESEL-ALLISON
Your Total Power Solution™

5725 COLUMBIA CIRCLE
MANGONIA PARK, FLORIDA 33407
(561) 842-2113
1-800-844-2113
FAX (561) 848-2996

DESCRIPTION OF REPAIRS

WORK ORDER WPB 485307 YACHT NAME: Grander Ambition

4/11/2023

Travel to the boat with the equipment and catch up with the boat as they are pulling it out of the water to check the hull. Get a latter and get onboard. check the engines and hookup to the engines and connect. Download the information from them and save on the laptop. Get ready to sea trial. When the boat went back into the water get back onboard and set a recording of the data from the engines. Run the boat up and down the intra-coastal and record the data, run up through the full RPM range. Test the engine room controls and return to the dock and take oil samples from all of the units. Pack up, load up, and return and start filing reports and printing out the data. Drop off the oil samples for testing.

Les Bauer

KJR35061

FLORIDA DETROIT DIESEL-ALLISON
Your Total Power Solution™

4-CYCLE – ENGINE SURVEY
COLD ENGINE CHECKS

YACHT NAME: Grander Ambitions
WORK ORDER # WPB485307

ITEM	PORT ENGINE	STARBOARD ENGINE
FRESH WATER SYSTEM	Good	Good
RAW WATER SYSTEM	Good	Good
OIL SYSTEM	Good Sample Taken	Good Sample Taken
FUEL SYSTEM	Good	Good
EXHAUST SYSTEM	Good	Good
ELECTRCIAL SYSTEM	Good Battery Low	Good Battery Low
MARINE GEAR	Good Sample Taken	Good Sample Taken
HOSES	Good	Good
CLAMPS	Good	Good
MISCELLANEOUS		

Time for right cursor:12:26:40 1 = Stbd 2 = Port

Sensor	Unit	Left	Right	Difference
[0]1 1.0100.001 P-Lube Oil after Filter	bar		8.04000	
[1]1 1.0101.001 P-Coolant	bar		0	
[2]1 1.0102.001 P-Fuel	bar		8.53875	
[3]1 1.0103.001 P-Charge Air	bar		4.30187	
[4]1 1.0104.001 P-HD (Common Rail)	barHD		2174	
[5]1 1.0106.001 P-CrankCase	mbar		-9.10	
[6]1 1.0108.001 P-Ambient Air	bar		1.01800	
[7]1 1.0109.001 P-Lube Oil before Filter	bar		0	
[8]1 1.0120.001 T-Coolant	degC		81.09	
[9]1 1.0121.001 T-Charge Air	degC		37.84	
[10]1 1.0122.001 T-Fuel	degC		75.49	
[11]1 1.0123.001 T-Intake Air	degC		32.79	
[12]1 1.0125.001 T-Lube Oil	degC		78.55	
[13]1 1.0126.001 T-Exhaust A	degC		712.23	
[14]1 1.0127.001 T-Exhaust B	degC		718.92	
[15]1 1.0154.001 P-Oil Filter Difference	bar		0	
[16]1 1.0159.001 P-Oil Refill Pump	bar		0	
[17]1 1.0222.001 P-Lubeoil ETC A	bar		0	
[18]1 1.0700.041 Bypass Throttle Position Demand	%		54.744	
[19]1 1.1005.012 Engine Power	kW		1939.200	
[20]1 1.1005.021 Rated Power	kW		1939.000	
[21]1 1.1020.200 Requested Torque 0-120%	%		101.600	
[22]1 1.1020.202 Act. Torque in Relation to DBR	%		100.000	
[23]1 1.1020.507 Duration Main Injection (Time)	ms		1.755	
[24]1 1.1020.600 Pilot Fuel Mass per Cycle	mg/H		0	
[25]1 1.1020.601 Main Fuel Mass per Cycle	mg/H		354.10	
[26]1 1.1020.602 Post Fuel Mass per Cycle	mg/H		0	
[27]1 1.1020.604 Fuel Volume Temp-Corr (Total)	mm3/H		449.23	
[28]1 1.1041.001 I-PWM Out 1	A		1.231	
[29]1 1.1041.101 I-PWM Out 3	A		1.194	
[30]1 1.1041.251 I-PWM Out 6	A		0.001	
[31]1 1.1041.301 I-PWM Out 7	A		0.003	
[32]1 1.1041.351 I-PWM Out 8	A		0.369	
[33]1 1.1041.401 I-PWM Out 9	A		0.003	
[34]1 1.1041.451 I-PWM Out 10	A		0.004	
[35]1 1.1075.042 Max. Torque LDA	Nm		11802.8	
[36]1 1.1075.046 Max. Torque DBR corrected	Nm		7665.4	
[37]1 1.1075.050 Torque Limit Corr. (T-Air)	Nm		0	
[38]1 1.1075.056 Max. Torque MCR corrected	Nm		7665.4	
[39]1 1.1075.061 Charge Air Mass	mg/H		10748.10	
[40]1 1.1075.065 Torque Limitation Code	digit		1	
[41]1 1.1075.121 LDA torque calculated	Nm		11802.8	
[42]1 1.1075.136 Air Efficiency	pts		0.772	
[43]1 1.1075.137 LDA Torque Quotient	pts		0.649	
[44]1 1.1100.415 BOI transition factor stat/trans	pts		0	
[45]1 1.1100.502 Transient BOI Correction	deg		0	
[46]1 1.1100.503 BOI Norm	deg		13.407	
[47]1 1.1100.506 Norm Air Mass	mg/H		10888.77	
[48]1 1.1100.507 Delta Air Mass Ratio Trans./Norm	pts		0.984	
[49]1 1.1100.512 AirMassRatio Trans./Norm filt.	pts		0.978	
[50]1 1.1100.516 Steady State BOI Correction	deg		0.210	
[51]1 1.1100.517 Delta BOI Correction	deg		0.210	
[52]1 1.1100.518 Air Mass Ratio Transient	pts		0.006	
[53]1 1.1100.523 BOI final	deg		13.617	
[54]1 1.1100.553 BOI Trans Start Active			0	
[55]1 1.1200.501 Corrected Fuel Mass (Total)	mg/H		354.10	
[56]1 1.1200.503 Norm Fuel Mass (Efficiency-Map)	mg/H		354.46	
[57]1 1.1200.504 Specific Fuel Consumption	g/kWh		211.013	
[58]1 1.1300.100 P-Railfuel Demand (Map)	barHD		2181	
[59]1 1.1300.147 P-Railfuel Correction Trans	barHD		0	

Time for right cursor:12:26:40

Sensor	Unit	Left	Right	Difference
[60]1 1.1300.148 P-Railfuel Correction Stat	barHD		0	
[61]1 1.1300.370 pHD Transient Start Active			0	
[62]1 1.1300.415 HD switch trans-station	pts		0	
[63]1 1.1301.128 Coil Current Demand	A		1.235	
[64]1 1.1600.042 p5 Demand Total	bar		4.26906	
[65]1 1.1600.053 p5 ctrlvar Governor	%		37.540	
[66]1 1.1600.164 Lambda Actual Value	pts		-1.000	
[67]1 1.1600.244 P5 demand Limit max active			0	
[68]1 1.1600.268 P5 ctrlvar total	%		37.540	
[69]1 1.1600.409 p5 ctrlvar stat	%		0	
[70]1 1.1600.410 p5 Trans ctrlvar	%		0	
[71]1 1.1600.453 p5 Trans start activ	digit		0	
[72]1 1.1600.605 p5 demand trans	bar		4.26906	
[73]1 1.1600.659 p5 limit active			0	
[74]1 1.1600.735 p5 Demand T0	bar		4.26906	
[75]1 1.1600.736 p5 Delta Demand T0	bar		-0.08093	
[76]1 1.1600.781 p5 Demand Map ETC	bar		4.35000	
[77]1 1.1604.149 Transient Exit	digit		-1	
[78]1 1.2500.044 Engine Speed (ECU)	rpm		2417.0	
[79]1 1.3000.012 Cylinder Cutout active			0	
[80]1 1.3010.001 ETC 1 Speed	krpm		79.3126	
[81]1 1.3010.003 ETC 2 Cut In			1	
[82]1 1.3010.004 ETC 3 Cut In			1	
[83]1 1.3010.005 Umblasen active			0	
[84]1 1.3010.009 Umblasen active ETC 3			0	
[85]1 1.3010.026 ETC 2 Speed Switchpoint	krpm		48.0000	
[86]1 1.3010.027 ETC 3 Speed Switchpoint	krpm		63.0000	
[87]1 1.3010.031 Number Of Active Chargers	digit		3	
[88]1 1.8009.002 Engine Operating Hours	h		57	
[89]1 1.8009.009 Spec. Fuel Consumption	g/kWh		Missing Data	
[90]1 1.8009.011 Actual Fuel Consumption	l/h		505.464	
[91]1 2.0280.001 Speed Demand ECU	rpm		2450.0	
[92]1 2.1000.040 Torque Limitation Active			1	
[93]1 2.1000.048 Maximum Requested Torque	Nm		7665.4	
[94]1 2.1000.049 Requested Torque	Nm		7665.4	
[95]1 2.1060.003 Effective Engine Speed Demand	rpm		2450.0	
[96]1 2.1060.007 CAN Speed Demand Analog	rpm		550.0	
[97]1 2.1060.011 Speed Demand Source	digit		9	
[98]1 2.1060.040 Rated Speed	rpm		2455.0	
[99]1 2.1060.200 Actual Droop %	%		0	
[100]1 2.7000.004 Engine Load Reserve	%		0	
[101]1 2.7001.001 Stop Activated			0	
[102]1 2.7001.007 ESI Input activated			0	
[103]1 2.7001.008 External Stop Activated			0	
[104]1 2.8009.015 Fail Code	digit		0	
[105]2 1.0100.001 P-Lube Oil after Filter	bar		8.14500	
[106]2 1.0101.001 P-Coolant	bar		0	
[107]2 1.0102.001 P-Fuel	bar		8.44500	
[108]2 1.0103.001 P-Charge Air	bar		4.39950	
[109]2 1.0104.001 P-HD (Common Rail)	barHD		2176	
[110]2 1.0106.001 P-CrankCase	mbar		-8.47	
[111]2 1.0108.001 P-Ambient Air	bar		1.01400	
[112]2 1.0109.001 P-Lube Oil before Filter	bar		0	
[113]2 1.0120.001 T-Coolant	degC		81.22	
[114]2 1.0121.001 T-Charge Air	degC		37.68	
[115]2 1.0122.001 T-Fuel	degC		71.09	
[116]2 1.0123.001 T-Intake Air	degC		28.80	
[117]2 1.0125.001 T-Lube Oil	degC		79.40	
[118]2 1.0126.001 T-Exhaust A	degC		671.94	
[119]2 1.0127.001 T-Exhaust B	degC		672.49	

Time for right cursor:12:26:40

Sensor	Unit	Left	Right	Difference
[120]2 1.0154.001 P-Oil Filter Difference	bar		0	
[121]2 1.0159.001 P-Oil Refill Pump	bar		0	
[122]2 1.0222.001 P-Lubeoil ETC A	bar		0	
[123]2 1.0700.041 Bypass Throttle Position Demand	%		30.748	
[124]2 1.1005.012 Engine Power	kW		1938.640	
[125]2 1.1005.021 Rated Power	kW		1939.000	
[126]2 1.1020.200 Requested Torque 0-120%	%		100.550	
[127]2 1.1020.202 Act. Torque in Relation to DBR	%		100.000	
[128]2 1.1020.507 Duration Main Injection (Time)	ms		1.707	
[129]2 1.1020.600 Pilot Fuel Mass per Cycle	mg/H		0	
[130]2 1.1020.601 Main Fuel Mass per Cycle	mg/H		352.32	
[131]2 1.1020.602 Post Fuel Mass per Cycle	mg/H		0	
[132]2 1.1020.604 Fuel Volume Temp-Corr (Total)	mm3/H		445.27	
[133]2 1.1041.001 I-PWM Out 1	A		1.203	
[134]2 1.1041.101 I-PWM Out 3	A		1.191	
[135]2 1.1041.251 I-PWM Out 6	A		0.004	
[136]2 1.1041.301 I-PWM Out 7	A		0.003	
[137]2 1.1041.351 I-PWM Out 8	A		0.273	
[138]2 1.1041.401 I-PWM Out 9	A		0.003	
[139]2 1.1041.451 I-PWM Out 10	A		0.007	
[140]2 1.1075.042 Max. Torque LDA	Nm		11965.7	
[141]2 1.1075.046 Max. Torque DBR corrected	Nm		7585.7	
[142]2 1.1075.050 Torque Limit Corr. (T-Air)	Nm		0	
[143]2 1.1075.056 Max. Torque MCR corrected	Nm		7585.7	
[144]2 1.1075.061 Charge Air Mass	mg/H		10997.68	
[145]2 1.1075.065 Torque Limitation Code	digit		1	
[146]2 1.1075.121 LDA torque calculated	Nm		11965.7	
[147]2 1.1075.136 Air Efficiency	pts		0.769	
[148]2 1.1075.137 LDA Torque Quotient	pts		0.633	
[149]2 1.1100.415 BOI transition factor stat/trans	pts		0	
[150]2 1.1100.502 Transient BOI Correction	deg		0	
[151]2 1.1100.503 BOI Norm	deg		13.470	
[152]2 1.1100.506 Norm Air Mass	mg/H		10894.55	
[153]2 1.1100.507 Delta Air Mass Ratio Trans./Norm	pts		1.008	
[154]2 1.1100.512 AirMassRatio Trans./Norm filt.	pts		0.993	
[155]2 1.1100.516 Steady State BOI Correction	deg		0	
[156]2 1.1100.517 Delta BOI Correction	deg		0	
[157]2 1.1100.518 Air Mass Ratio Transient	pts		0.015	
[158]2 1.1100.523 BOI final	deg		13.470	
[159]2 1.1100.553 BOI Trans Start Active			0	
[160]2 1.1200.501 Corrected Fuel Mass (Total)	mg/H		352.32	
[161]2 1.1200.503 Norm Fuel Mass (Efficiency-Map)	mg/H		352.68	
[162]2 1.1200.504 Specific Fuel Consumption	g/kWh		211.182	
[163]2 1.1300.100 P-Railfuel Demand (Map)	barHD		2193	
[164]2 1.1300.147 P-Railfuel Correction Trans	barHD		0	
[165]2 1.1300.148 P-Railfuel Correction Stat	barHD		0	
[166]2 1.1300.370 pHD Transient Start Active			0	
[167]2 1.1300.415 HD switch trans-station	pts		0	
[168]2 1.1301.128 Coil Current Demand	A		1.209	
[169]2 1.1600.042 p5 Demand Total	bar		4.32477	
[170]2 1.1600.053 p5 ctrlvar Governor	%		71.326	
[171]2 1.1600.164 Lambda Actual Value	pts		-1.000	
[172]2 1.1600.244 P5 demand Limit max active			0	
[173]2 1.1600.268 P5 ctrlvar total	%		71.326	
[174]2 1.1600.409 p5 ctrlvar stat	%		0	
[175]2 1.1600.410 p5 Trans ctrlvar	%		0	
[176]2 1.1600.453 p5 Trans start activ	digit		0	
[177]2 1.1600.605 p5 demand trans	bar		4.32477	
[178]2 1.1600.659 p5 limit active			0	
[179]2 1.1600.735 p5 Demand T0	bar		4.32477	

Time for right cursor:12:26:40

Sensor	Unit	Left	Right	Difference
[180]2 1.1600.736 p5 Delta Demand T0	bar		-0.02522	
[181]2 1.1600.781 p5 Demand Map ETC	bar		4.35000	
[182]2 1.1604.149 Transient Exit	digit		-1	
[183]2 1.2500.044 Engine Speed (ECU)	rpm		2441.5	
[184]2 1.3000.012 Cylinder Cutout active			0	
[185]2 1.3010.001 ETC 1 Speed	krpm		80.2675	
[186]2 1.3010.003 ETC 2 Cut In			1	
[187]2 1.3010.004 ETC 3 Cut In			1	
[188]2 1.3010.005 Umblasen active			0	
[189]2 1.3010.009 Umblasen active ETC 3			0	
[190]2 1.3010.026 ETC 2 Speed Switchpoint	krpm		48.0000	
[191]2 1.3010.027 ETC 3 Speed Switchpoint	krpm		63.0000	
[192]2 1.3010.031 Number Of Active Chargers	digit		3	
[193]2 1.8009.002 Engine Operating Hours	h		56	
[194]2 1.8009.009 Spec. Fuel Consumption	g/kWh		Missing Data	
[195]2 1.8009.011 Actual Fuel Consumption	l/h		480.961	
[196]2 2.0280.001 Speed Demand ECU	rpm		2450.0	
[197]2 2.1000.040 Torque Limitation Active			1	
[198]2 2.1000.048 Maximum Requested Torque	Nm		7585.7	
[199]2 2.1000.049 Requested Torque	Nm		7585.7	
[200]2 2.1060.003 Effective Engine Speed Demand	rpm		2450.0	
[201]2 2.1060.007 CAN Speed Demand Analog	rpm		550.0	
[202]2 2.1060.011 Speed Demand Source	digit		9	
[203]2 2.1060.040 Rated Speed	rpm		2455.0	
[204]2 2.1060.200 Actual Droop %	%		0	
[205]2 2.7000.004 Engine Load Reserve	%		0	
[206]2 2.7001.001 Stop Activated			0	
[207]2 2.7001.007 ESI Input activated			0	
[208]2 2.7001.008 External Stop Activated			0	
[209]2 2.8009.015 Fail Code	digit		0	

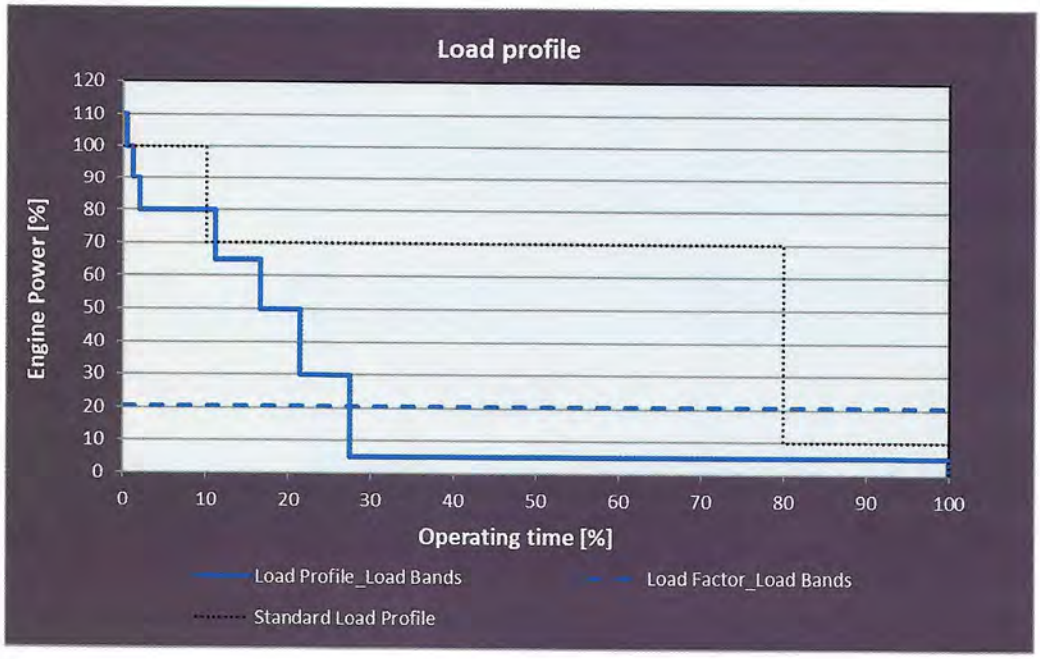
LAMA Report

Application:	Grander Ambition		
Engine type:	16V2000M96L	Total runtime [h]:	56.37
Engine number:	545101682	Overload operation (yes/no):	Yes
Governor type:	ECU-9 Diesel	Engine optimized:	EPA Tier 3
editor (W-data-file):	370115_BAUER		
readout date (ECU):	11.04.23		
Version:	LAMA_G4.0pro_ALPHA		
Rated power [kW]:	1939		
Rated speed [1/min]:	2455	Cold idle [1/min]:	
Idle speed [1/min]:	550	Hot idle [1/min]:	
kW per cylinder [kW]:	121.2	Droop (DDEC only):	

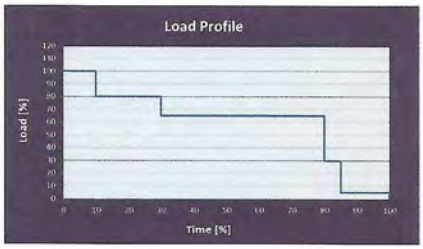
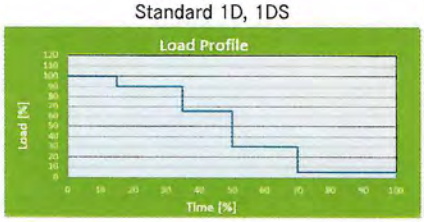
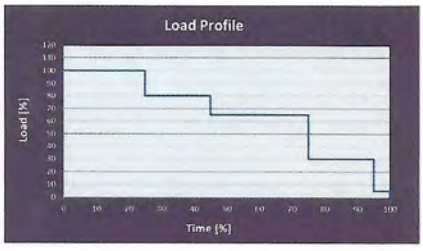
Load Bands

from [%]	to [%]	time [%]	time [h]
0	5	72.6	40.9
5	30	6.0	3.4
30	50	4.8	2.7
50	65	5.4	3.0
65	80	9.2	5.2
80	90	0.8	0.5
90	100	0.7	0.4
100	110	0.5	0.3
	Σ:	100.0	56.4

	load profile
Load Factor:	**21 %**
Load Indicator:	**4 %**



1.3 Allocation matrix - Application group 1D, 1DS

Load profile		Load factor %	Load indicator %	101 to 106 kW/cyl.	107 to 112 kW/cyl.	113 to 123 kW/cyl.		
Load %	Time %							
110 (100-110)	–	0 to 40	≤ 8	12,000	9,500	8,000	–	
100 (90-100)	5							
90 (80-90)	–							
80 (65-80)	15							
65 (50-65)	–							
50 (30-50)	20							
30 (5-30)	40							
Idle Speed (0-5)	20							
110 (100-110)	–	41 to 61	≤ 13	9,500	7,500	6,000	–	
100 (90-100)	10							
90 (80-90)	–							
80 (65-80)	20							
65 (50-65)	50							
50 (30-50)	–							
30 (5-30)	5							
Idle Speed (0-5)	15							
110 (100-110)	–	41 to 61	≤ 23	6,500	5,500	4,000	–	Standard 1D, 1DS 
100 (90-100)	15							
90 (80-90)	20							
80 (65-80)	–							
65 (50-65)	15							
50 (30-50)	–							
30 (5-30)	20							
Idle Speed (0-5)	30							
110 (100-110)	–	62 to 68	≤ 28	4,500	3,500	2,500	–	
100 (90-100)	25							
90 (80-90)	–							
80 (65-80)	20							
65 (50-65)	30							
50 (30-50)	–							
30 (5-30)	20							
Idle Speed (0-5)	5							

1.10 Cyclical maintenance tasks 8000 HRS

Qualification	Interval [HRS]	Limit	Item	Maintenance tasks	Option	Task
Engine						
QL1	-	1 DAY	ENGINE OPERATIONAL MONITORING	Check engine oil level		WM00285
QL1	-	1 DAY	ENGINE OPERATIONAL MONITORING	Visually inspect for leaks and general condition of engine		WM00286
QL1	-	1 DAY	ENGINE OPERATIONAL MONITORING	Check maintenance indicator of air filter	X	WM00287
QL1	-	1 DAY	ENGINE OPERATIONAL MONITORING	Check relief bore of coolant pump		WM00288
QL1	-	1 DAY	ENGINE OPERATIONAL MONITORING	When engine is running, check for abnormal running noises, exhaust gas color and vibrations		WM00289
QL1	-	1 DAY	ENGINE OPERATIONAL MONITORING	Drain water and contaminants from fuel prefilter	X	WM00290
QL1	-	1 DAY	ENGINE OPERATIONAL MONITORING	Check position of contamination indicator of fuel prefilter	X	WM00291
QL1	-	1 YR	ENGINE MOUNTING	Check general condition of rubber mounts (visual inspection)		WM00050
QL1	-	1 YR	ENGINE MOUNTING	Check securing screws for secure seating		WM00136
QL1	-	1 YR	AIR SUPPLY SYSTEM	Check air filter, replace as necessary	X	WM00822
QL1	-	2 YR	LUBE OIL SYSTEM	Replace oil filter at every engine oil change, or when the time limit (years) is reached, at the latest		WM00067
QL1	-	3 YR	AIR SUPPLY SYSTEM	Replace air filter	X	WM00076
QL1	-	3 YR	COOLANT SYSTEM	Replace valve cover		WM00124
QL1	-	5 YR	ENGINE MOUNTING	Measure height of rubber element		WM00126
QL1	500	2 YR	FUEL SYSTEM (LOW PRESSURE)	Fuel prefilter, replace filter	X	WM00084
QL1	500	2 YR	FUEL SYSTEM (LOW PRESSURE)	Replace easy-change fuel filter		WM00086
QL1	1000	2 YR	AUXILIARY POWER TAKE-OFF	Check belt condition, replace if necessary. Adjust tension.	X	WM00170
QL1	1000	18 YR	VALVE GEAR	Check valve clearance, adjust if necessary. ATTENTION! First adjustment after 1,000 operating hours on a new engine and after 1,000 operating hours following each cylinder head overhaul.		WM00094
QL1	2000	18 YR	GENERATOR	Check condition of coupling	X	WM00052
QL1	4000	18 YR	FUEL SYSTEM (HIGH PRESSURE)	Replace fuel injection valve/injector		WM00090
QL1	4000	18 YR	RUNNING GEAR	Inspect cylinder liner with endoscope		WM00110
QL1	4000	18 YR	GOVERNOR	Reset parameters for drift correction (CDC) and enter injector coding (IIG)		WM00154
QL1	8000	3 YR	CRANKCASE BREATHER	Replace oil separator (impactor)		WM00106
QL1	8000	18 YR	HP FUEL LINE HP LINE	Replace HP line		WM00172
QL3	4000	18 YR	EXHAUST TURBOCHARGER	Replace compressor wheel of exhaust turbocharger		WM00079
QL3	4000	18 YR	EXHAUST TURBOCHARGER	Overhaul or replace exhaust turbocharger		WM00970
QL3	8000	6 YR	HOSE	Replace hose line		WM00006
QL3	8000	6 YR	RUBBER SLEEVE	Replace rubber sleeve		WM00008
QL3	8000	18 YR	FUEL SYSTEM (HIGH PRESSURE)	Replace HP fuel sensor		WM00011
QL3	8000	18 YR	COOLANT SYSTEM	Check HT thermostat housing and replace thermal actuator		WM00056
QL3	8000	18 YR	COOLANT SYSTEM	Clean seawater cooler		WM00057
QL3	8000	18 YR	EXHAUST SYSTEM	Replace exhaust pipe bellows		WM00072
QL3	8000	18 YR	DIVERTER VALVE	Check function of diverter valve	X	WM00075

DAY = Days
YR = Years
HRS = Hours

Qualification	Interval [HRS]	Limit	Item	Maintenance tasks	Option	Task
QL3	8000	18 YR	FUEL SYSTEM (LOW PRESSURE)	Replace pump		WM00087
QL3	8000	18 YR	FUEL SYSTEM (HIGH PRESSURE)	Replace HP pump		WM00091
QL3	8000	18 YR	VALVE GEAR	Check rocker arm and valve bridge for wear. Visually inspect swing follower with endoscope through pushrod bore		WM00093
QL3	8000	18 YR	VALVE GEAR	Visually inspect camshaft running surfaces with endoscope through pushrod bore		WM00096
QL3	8000	18 YR	LUBE OIL SYSTEM	Clean oil cooler and check for leaks		WM00133
QL3	8000	18 YR	FUEL SYSTEM (HIGH PRESSURE)	Clean fuel cooler		WM00171
QL3	8000	18 YR	COOLANT SYSTEM	Replace sealing material for installation of coolant pump(s) and thermostat(s) (only LT and HT)		WM00921
QL3	8000	18 YR	STARTING SYSTEM	Overhaul or replace starter		WM00971
QL3	8000	18 YR	COOLANT SYSTEM	Overhaul or replace coolant pump in HT circuit		WM00974
QL3	8000	18 YR	BILGE PUMP	Overhaul or replace bilge pump	X	WM00975
QL3	8000	18 YR	GENERATOR	Overhaul or replace battery-charging generator	X	WM00976
QL3	8000	18 YR	CYLINDER HEAD	Overhaul or replace cylinder head		WM00980
QL3	8000	18 YR	COOLANT SYSTEM	Overhaul or replace raw water pump		WM00996
QL4	8000	18 YR	ENGINE, GENERAL	Replace elastomer parts and seals		WM00001
QL4	8000	18 YR	ENGINE, GENERAL	Disassemble engine completely. Check engine components according to assembly instructions, replace or repair as necessary		WM00002
QL4	8000	18 YR	OIL REPLENISHING UNIT	Replace gear pump	X	WM00061
QL4	8000	18 YR	LUBE OIL SYSTEM	Check pump, replace if necessary		WM00070
QL4	8000	18 YR	FUEL SYSTEM (HIGH PRESSURE)	Replace pressure relief valve		WM00088
QL4	8000	18 YR	VALVE GEAR	Replace thrust bearing flange		WM00095
QL4	8000	18 YR	RUNNING GEAR	Replace conrod bearings		WM00099
QL4	8000	18 YR	RUNNING GEAR	Replace crankshaft bearings		WM00103
QL4	8000	18 YR	GEAR TRAIN	Check tooth flanks in gear train for wear (visual inspection), replace bushing		WM00104
QL4	8000	18 YR	RUNNING GEAR	Replace cylinder liners		WM00108
QL4	8000	18 YR	CAMSHAFT	Replace camshaft bearings		WM00111
QL4	8000	18 YR	SENSOR TECHNOLOGY AND WIRING HARNESS	Replace wiring harness		WM00137
QL4	8000	18 YR	AUXILIARY POWER TAKE-OFF	Replace bearing		WM00162
QL4	8000	18 YR	RUNNING GEAR	Replace pistons		WM00168
QL4	8000	18 YR	DIVERTER VALVE	Replace diverter valve	X	WM00213
QL4	8000	18 YR	RUNNING GEAR	Replace vibration damper		WM00439
QL4	8000	18 YR	RUNNING GEAR	Check conrod, replace as necessary		WM00451
QL4	8000	18 YR	ENGINE MOUNTING	Replace resilient mounts of engine		WM01009
Preheater						
QL1	-	1 YR	PREHEATING	Preheater, check for function and leaks	X	WM00222
QL1	-	3 YR	PREHEATING	Preheater, replace thermostat (electric)	X	WM00148
QL1	8000	18 YR	PREHEATING	Overhaul or replace preheating unit	X	WM00979
Coupling						
QL1	-	1 MON	BENDING / TORSIONALLY RESILIENT COUPLING AND STEEL-SPRING COUPLING	Check coupling (visual inspection), replace as necessary	X	WM00881
QL4	8000	18 YR	BENDING / TORSIONALLY RESILIENT COUPLING	Replace coupling or coupling element(s)		WM00925

DAY = Days
YR = Years
HRS = Hours

Qualifi-cation	Interval [HRS]	Limit	Item	Maintenance tasks	Option	Task
Fuel treatment system						
QL1	-	1 DAY	FUEL TREATMENT PLANT	Check coolant drain valve	X	WM00790
QL1	1000	1 MON	FUEL TREATMENT PLANT	Differential pressure gauge, check alarm function	X	WM00017
QL1	1000	1 YR	FUEL TREATMENT PLANT	Fuel pump, check pump performance	X	WM00015
QL1	1000	1 YR	FUEL TREATMENT PLANT	Replace filter element	X	WM00140
QL1	1000	2 YR	FUEL TREATMENT PLANT	Check function of rod electrode	X	WM00013
Drive shaft						
QL1	500	18 YR	DRIVE SHAFT	Lubricate lubrication points of drive shaft, driving end	X	WM00046
QL4	8000	18 YR	DRIVE SHAFT	Overhaul drive shaft, driving end	X	WM00047

DAY = Days
YR = Years
HRS = Hours
MON = Months

PALM BEACH POWER	Machine ID: AMBITION	Component ID: 545101681	M✓C
Phone:	Machine Year : NA	Component Make: MTU	MOTORCHECK LAB
Email:		Component Model: 16V2000 M96L	2000 N FLORIDA MANGO RD UNT 104
Fax: ___-___-____	Component Description:	Component Year: NA	WEST PALM BEACH FL 33409
		Component Type : DIESEL ENGINE	561-684-7799
		Component Location: PORT MAIN	
		Sump Capacity: 32 Gallons	

Sample ID	Date Taken	Hours on Component	Hours on Oil	Oil Weight	Oil Brand	Oil Type	Oil Changed	Date Analyzed	User Sample ID
284	4/13/2023	56	56	15W40	MTU	UNKNOWN	No	4/13/2023	
Comments	ENGINE WEAR RATES NORMAL FOR BREAK-IN/OVERHAUL PERIOD. ENGINE WEAR RATES NORMAL FOR FIRST OIL CHANGE. SAMPLE APPEARS FREE OF EXTERNAL CONTAMINATION. ANALYSIS INDICATES PROPER PERFORMANCE OF THE LUBRICANT AND UNIT.								

	Wear Metals(ppm)							Contaminant Metals (ppm)			Multi-Source Metals (ppm)					Additives (ppm)				
Sample ID	Iron	Chromium	Aluminum	Copper	Lead	Tin	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Nickel	Manganese	Boron	Magnesium	Calcium	Barium	Phosphorus	Zinc
284	<2	<2	<2	3	<2	<2	X	6	<2	20	X	34	X	X	X	X	X	X	X	X

	Contaminants				Physical Properties								
Sample ID	Fuel	Soot	Water	Glycol	Nitration	TBN	Oxidation	V40C	V100C	VIndex	V40C Limit	V100C Limit	Visc Mode
284	-	0.2	<0.1	-	3.9	9.1	5.7	110	14.5	134	92 - 124	12.5 - 16.3	C

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X = Not Applicable for Test Type

NOTE: HOURS OR MILES ON UNIT AND/OR HOURS OR MILES ON OIL: "0" = HOURS/MILES UNKNOWN. UNKNOWN HOURS OR MILES ON UNIT OR ON OIL *LIMITS THE ACCURACY OF THE TEST RESULTS*

*Accuracy of recommendations is dependent on representative oil samples and completely correct data on both unit and oil. This analysis is intended as an aid in predicting mechanical wear, no guarantee expressed or implied, is made against failure of this component. Motor/Check (Oil Lac LLC.) liability in any case is limited to the cost of the reported analysis.

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Fax: (561) 684-6402

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PALM BEACH POWER **Phone:** **Email:** **Fax:** ___-___-____	**Machine ID:** AMBITION **Machine Year :** NA **Component Description:**	**Component ID:** 545101682 **Component Make:** MTU **Component Model:** 16V2000 M96L **Component Year:** NA **Component Type :** DIESEL ENGINE **Component Location:** STARBOARD MAIN **Sump Capacity:** 32 Gallons	M✓C **MOTORCHECK LAB** 2000 N FLORIDA MANGO RD UNIT 104 WEST PALM BEACH FL 33409 561-684-7799

Sample ID	Date Taken	Hours on Component	Hours on Oil	Oil Weight	Oil Brand	Oil Type	Oil Changed	Date Analyzed	User Sample ID
285	4/13/2023	56	56	15W40	MTU	UNKNOWN	No	4/13/2023	
Comments	ENGINE WEAR RATES NORMAL FOR BREAK-IN/OVERHAUL PERIOD. ENGINE WEAR RATES NORMAL FOR FIRST OIL CHANGE. SAMPLE APPEARS FREE OF EXTERNAL CONTAMINATION. ANALYSIS INDICATES PROPER PERFORMANCE OF THE LUBRICANT AND UNIT.								

	Wear Metals(ppm)							Contaminant Metals (ppm)			Multi-Source Metals (ppm)					Additives (ppm)				
Sample ID	Iron	Chromium	Aluminum	Copper	Lead	Tin	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Nickel	Manganese	Boron	Magnesium	Calcium	Barium	Phosphorus	Zinc
285	<2	<2	<2	7	<2	<2	X	5	<2	21	X	37	X	X	X	X	X	X	X	X

	Contaminants				Physical Properties								
Sample ID	Fuel	Soot	Water	Glycol	Nitration	TBN	Oxidation	V40C	V100C	VIndex	V40C Limit	V100C Limit	Visc Mode
285	-	0.2	<0.1	-	3.6	9.1	5.3	110	14.5	135	92 - 124	12.5 - 16.3	C

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PALM BEACH POWER **Phone:** **Email:** **Fax:** ___-___-____	**Machine ID:** AMBITION **Machine Year :** NA **Component Description:**	**Component ID:** 50036080 **Component Make:** ZF GEAR **Component Model:** 3070 **Component Year:** NA **Component Type :** GEARBOX **Component Location:** PORT **Sump Capacity:** 6 Gallons	M✓C **MOTORCHECK LAB** 2000 N FLORIDA MANGO RD UNIT 104 WEST PALM BEACH FL 33401 561-684-7799

Sample ID	Date Taken	Hours on Component	Hours on Oil	Oil Weight	Oil Brand	Oil Type	Oil Changed	Date Analyzed	User Sample ID
287	4/13/2023	56	56	SAE 30	UNKNOWN	UNKNOWN	No	4/13/2023	
Comments	GEAR UNIT WEAR RATES NORMAL. SAMPLE APPEARS FREE OF EXTERNAL CONTAMINATION. ANALYSIS INDICATES PROPER PERFORMANCE OF THE LUBRICANT AND UNIT.								

	Wear Metals(ppm)							Contaminant Metals (ppm)			Multi-Source Metals (ppm)					Additives (ppm)				
Sample ID	Iron	Chromium	Aluminum	Copper	Lead	Tin	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Nickel	Manganese	Boron	Magnesium	Calcium	Barium	Phosphorus	Zinc
287	6	<2	<2	10	<2	<2	X	7	<2	10	X	35	X	X	X	X	X	X	X	X

	Contaminants				Physical Properties								
Sample ID	Fuel	Soot	Water	Glycol	Nitration	TBN	Oxidation	V40C	V100C	VIndex	V40C Limit	V100C Limit	Visc Mode
287	X	X	<0.1	X	X	X	2.6	102	10.9	90	86 - 116	9.3 - 12.5	C

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PALM BEACH POWER	Machine ID: AMBITION	Component ID: 50036081	M✓C
Phone:	Machine Year : NA	Component Make: ZF GEAR	MOTORCHECK LAB
Email:		Component Model: 3070	2000 N FLORIDA MANGO RD UNIT 104
Fax: ___-___-____	Component Description:	Component Year: NA	WEST PALM BEACH FL 33409
		Component Type : GEARBOX	561-684-7799
		Component Location: STARBOARD	
		Sump Capacity: 6 Gallons	

Sample ID	Date Taken	Hours on Component	Hours on Oil	Oil Weight	Oil Brand	Oil Type	Oil Changed	Date Analyzed	User Sample ID
289	4/13/2023	56	56	SAE 30	UNKNOWN	UNKNOWN	No	4/14/2023	
Comments	GEAR UNIT WEAR RATES NORMAL. SAMPLE APPEARS FREE OF EXTERNAL CONTAMINATION. ANALYSIS INDICATES PROPER PERFORMANCE OF THE LUBRICANT AND UNIT.								

	Wear Metals(ppm)							Contaminant Metals (ppm)			Multi-Source Metals (ppm)					Additives (ppm)				
Sample ID	Iron	Chromium	Aluminum	Copper	Lead	Tin	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Nickel	Manganese	Boron	Magnesium	Calcium	Barium	Phosphorus	Zinc
289	4	<2	<2	6	<2	<2	X	5	4	14	X	34	X	X	X	X	X	X	X	X

	Contaminants				Physical Properties								
Sample ID	Fuel	Soot	Water	Glycol	Nitration	TBN	Oxidation	V40C	V100C	VIndex	V40C Limit	V100C Limit	Visc Mode
289	X	X	<0.1	X	X	X	2.6	102	10.9	90	86 - 116	9.3 - 12.5	C

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PALM BEACH POWER **Phone:** **Email:** **Fax:** ___-___-____	**Machine ID:** AMBITION **Machine Year :** NA **Component Description:**	**Component ID:** L140740137 **Component Make:** ONAN **Component Model:** 32 MDKBU **Component Year:** NA **Component Type :** DIESEL ENGINE **Component Location:** PORT GENERATOR **Sump Capacity:** 15 Quarts	**M✓C** **MOTORCHECK LAB** **2000 N FLORIDA MANGO RD UNIT 104** **WEST PALM BEACH FL 33409** **561-684-7799**

Sample ID	Date Taken	Hours on Component	Hours on Oil	Oil Weight	Oil Brand	Oil Type	Oil Changed	Date Analyzed	User Sample ID
282	4/13/2023	3066	100	15W40	UNKNOWN	UNKNOWN	No	4/13/2023	
Comments	ALL ENGINE WEAR RATES NORMAL. SAMPLE APPEARS FREE OF EXTERNAL CONTAMINATION. ANALYSIS INDICATES PROPER PERFORMANCE OF THE LUBRICANT AND UNIT.								

	Wear Metals(ppm)							Contaminant Metals (ppm)			Multi-Source Metals (ppm)					Additives (ppm)				
Sample ID	Iron	Chromium	Aluminum	Copper	Lead	Tin	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Nickel	Manganese	Boron	Magnesium	Calcium	Barium	Phosphorus	Zinc
282	<2	<2	<2	<2	<2	<2	X	6	<2	<2	X	23	X	X	X	X	X	X	X	X

	Contaminants				Physical Properties								
Sample ID	Fuel	Soot	Water	Glycol	Nitration	TBN	Oxidation	V40C	V100C	VIndex	V40C Limit	V100C Limit	Visc Mode
282	-	0.2	<0.1	-	3.8	10.0	6.5	111	14.5	134	92 - 124	12.5 - 16.3	C

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KEY:

ABNORMAL | SEVERE | D = DETECTED | - = NOT DETECTED | X = NOT TESTED / NOT APPLICABLE | NA = NOT AVAILABLE | C = CALCULATED | M = MEASURED

PALM BEACH POWER **Phone:** **Email:** **Fax:** ___-___-____	**Machine ID:** AMBITION **Machine Year :** NA **Component Description:**	**Component ID:** E140684203 **Component Make:** ONAN **Component Model:** 32 MDKBU **Component Year:** NA **Component Type :** DIESEL ENGINE **Component Location:** STARBOARD GENERATOR **Sump Capacity:** 15 Quarts	M✓C **MOTORCHECK LAB** 2000 N FLORIDA MANGO RD UNIT 104 WEST PALM BEACH FL 33409 561-684-7799

Sample ID	Date Taken	Hours on Component	Hours on Oil	Oil Weight	Oil Brand	Oil Type	Oil Changed	Date Analyzed	User Sample ID
283	4/13/2023	3430	100	15W40	UNKNOWN	UNKNOWN	No	4/13/2023	
Comments	ALL ENGINE WEAR RATES NORMAL. SAMPLE APPEARS FREE OF EXTERNAL CONTAMINATION. ANALYSIS INDICATES PROPER PERFORMANCE OF THE LUBRICANT AND UNIT.								

	Wear Metals(ppm)							Contaminant Metals (ppm)			Multi-Source Metals (ppm)					Additives (ppm)				
Sample ID	Iron	Chromium	Aluminum	Copper	Lead	Tin	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Nickel	Manganese	Boron	Magnesium	Calcium	Barium	Phosphorus	Zinc
283	<2	<2	<2	<2	<2	<2	X	7	<2	<2	X	27	X	X	X	X	X	X	X	X

	Contaminants				Physical Properties								
Sample ID	Fuel	Soot	Water	Glycol	Nitration	TBN	Oxidation	V40C	V100C	VIndex	V40C Limit	V100C Limit	Visc Mode
283	-	0.3	<0.1	-	4.2	9.4	6.7	111	14.5	134	92 - 124	12.5 - 16.3	C

CONTINUE TO ANALYZE YOUR OIL AT MOTORCHECKLAB.COM

X = Not Applicable for Test Type
NOTE: HOURS OR MILES ON UNIT AND/OR HOURS OR MILES ON OIL: "0"= HOURS/MILES UNKNOWN, UNKNOWN HOURS OR MILES ON UNIT OR ON OIL *LIMITS THE ACCURACY OF THE TEST RESULTS*
*Accuracy of recommendations is dependent on representative oil samples and completely correct data on both unit and oil. This analysis is intended as an aid in predicting mechanical wear, no guarantee expressed or implied, is made against failure of this component. MotorVCheck (Oil Lac LLC.) liability in any case is limited to the cost of the reported analysis.

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KEY:

ABNORMAL | SEVERE | D = DETECTED | - = NOT DETECTED | X = NOT TESTED / NOT APPLICABLE | NA = NOT AVAILABLE | C = CALCULATED | M = MEASURED

M✓C™ *UNDERSTANDING YOUR REPORT*

	ENGINES	TRANSMISSIONS
ALUMINUM:	PISTONS, BEARINGS, HOUSINGS, THRUST WASHERS, BUSHINGS	TORQUE CONVERTER, THE CASE, THRUST WASHERS, HOUSINGS, GEAR AND VANE PUMPS
CHROMIUM:	COMPRESSION RINGS, LOW FRICTION BEARINGS, LINERS, CHROMATE COOLING SYSTEM	BALL AND ROLLER BEARINGS, ALLOY OF STEEL PARTS
COPPER:	BEARINGS, BUSHINGS, THRUST WASHERS, OIL COOLER, CLUTCHES, AND AN OIL ADDITIVE IN SOME GASOLINE ENGINE OILS.	CLUTCH PLATES, BRONZE BUSHINGS, OIL COOLER OXIDES, BRASS FITTINGS
IRON:	CRANKSHAFT, CYLINDERS, PISTONS, LINERS, BEARINGS, VALVE TRAIN	GEARS, BEARINGS, SHAFTS, SOME CASES, CLUTCH PLATES
LEAD:	BEARINGS, CONTAMINATION FROM LEADED GASOLINE	GEARS
TIN:	PISTON SKIRTS, BEARINGS, AND BUSHINGS.	SOME BEARING CAGES
SILICON:	AIRBORN DIRT, SEAL MATERIAL, GASKETS, USED IN SOME OIL ADDITIVES, SPRAY LUBRICANTS, WHEN FOUND WITH POTASSIUM INDICATES GLYCOL ISSUE	AIRBORN DIRT, SEALERS, GASKETS, USED IN SOME OIL ADDITIVES, SPRAY LUBRICANTS, WHEN FOUND WITH POTASSIUM INDICATES GLYCOL ISSUE, SAND-CASTED PARTS
POTASSIUM:	INDICATION OF GLYCOL OR SALTWATER INTRUSION, ADDITIVE IN SOME OILS	INDICATION OF GLYCOL OR SALTWATER INTRUSION, ADDITIVE IN SOME OILS
SODIUM:	FOUND IN SOME OIL ADDITIVES, GLYCOL, ENVIRONMENTAL COMTAMINANT OR SALT WATER	FOUND IN SOME OIL ADDITIVES, GLYCOL, ENVIRONMENTAL COMTAMINANT OR SALT WATER
WATER:	MEASURED IN % VOLUME, CAN BE INDICATION OF CONDENSATION, COOLING SYSTEM LEAK, OR OUTSIDE CONTAMINATION	
GLYCOL:	MEASURED IN % VOLUME, IN THE FORMULATION OF MOST COMMERCIAL COOLANTS	
OXIDATION:	THIS IS THE RESULTS OF OXYGEN IN THE AIR REACTING WITH THE OIL AT ELEVATED TEMPERATURES. THIS IS A NORMAL PROCESS AS THE OIL AGES. IF AN ENGINE IS OPERATED CONTINUOUSLY AT A HIGH TEMPERATURE FOR EXTENDED PERIODS, OR IF DRAIN INTERVAL IS OVER EXTENDED, OIL CHANGE IS RECOMMENDED.	
NITRATION:	FORMED DURING COMBUSTION PROCESS, LEADS TO ACCELERATED OIL DETERIORATION.	
SOOT:	NORMAL COMBUSTION BY PRODUCT OF DIESEL FUEL AND APPEARS AS CONTAMINANT IN THE OIL CAUSING AN INCREASE IN VISCOSITY. INDICATE AN INPROPER AIR/FUEL RATIO, DEFECTIVE AIR INTAKE, FAULTY INJECTORS, OR BLOW-BY	
VISCOSITY:	CALCULATED MEASUREMENT OF THE OIL'S ABILITY TO FLOW AND LUBRICATE, INDICATES IF OIL IS TOO THICK OR THIN	
TBN:	MEASUREMENT OF OIL'S ALKALINE BASE RESERVE, ADDITIVE IN OIL CAPABLE OF NEUTRALIZING ACIDIC CONTAMINANTS, WHEN TBN IS BELOW 3, IT IS AN INDICATION THE OIL IS NO LONGER SERVICEABLE	
FUEL DILUTION:	MEASURED IN % VOLUME, CAN INDICATE FAULTY COMBUSTION, RICH AIR/FUEL MIXTURE WHEN PRESENT BETWEEN 2%-5%. INJECTOR PROPBLEM OR INTERNAL FUEL LINE LEAK IS TYPICALLY INDICATED WHEN FUEL IS DETECTED AT HIGH LEVELS	