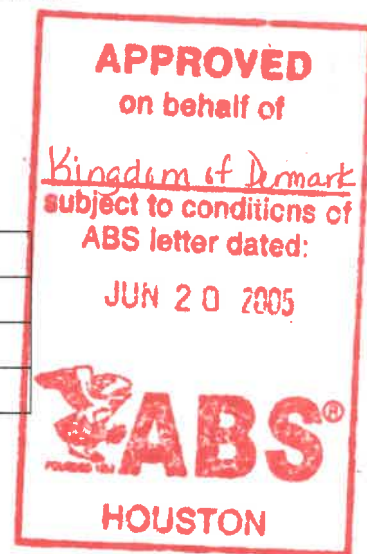


**Technical File
for 3500B Marine
Auxiliary Engine
@ 1500 & 1800 RPM
(Engine Family 3500A1500&1800)**

Member Engine

Engine Model	3512B
Engine Serial No.	8EM00429
Performance Spec.	0K-2460
Year of Engine Build	2002



**Do Not Discard
This Document is to be kept on board.**

**This document satisfies
the requirements of the
IMO Technical Code on
Control of Emission of
Nitrogen Oxides from
Marine Diesel Engines.**

**Technical File Approval No.
ABS HS-NTC 1013-0001-00035**

1013

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Table of Contents

Engine Part Number Table*	3
Installation Requirements	6
Engine Performance	6
Engine Emissions	6
On-board Nox Verification procedure	7
Engine Parameter Check Method	7
1. Check Engine Parameters:	8
2. Identify Emission-Related Engine Components:.....	8
3. Record Changes to Emissions Related Components:	11
4. Identify Adjustable Features :.....	11
Appendix A: IMO Certification Test Report – D2	12
Engine Information*	12
Engine Family Information*	13
Test Cell Information*	14
Ambient and Gaseous Emissions Data*	15
Engine Test Data*	16
Appendix A: IMO Certification Test Report – E2	17
Engine Information*	17
Engine Family Information*	18
Test Cell Information*	19
Ambient and Gaseous Emissions Data*	20
Engine Test Data*	21



3500B Engine Part Number Table*

Performance Specification		0K-2421	0K-5496	0K-2406	0K-5498	0K-2110	0K-5495	0K-2405	0K-5497
Engine Ratings (Advertised)	rpm	1500	1500	1800	1800	1500	1500	1800	1800
	BkW	673	673	760	760	856	856	968	968
	(bhp)	(903)	(903)	(1019)	(1019)	(1148)	(1148)	(1298)	(1298)
Engine Ratings (Overload)	rpm	1500	1500	1800	1800	1500	1500	1800	1800
	BkW	750	750	840	840	945	945	1065	1065
	(bhp)	(1006)	(1006)	(1126)	(1126)	(1267)	(1267)	(1428)	(1428)
Engine Model	Part Number	3508B	3508B	3508B	3508B	3508B	3508B	3508B	3508B
Engine Arrangement	Part Number	173-6952	232-2465	173-6953	232-2466	173-6952	232-2465	173-6953	232-2466
Compression Ratio		14.0:1	14.0:1	14.0:1	14.0:1	14.0:1	14.0:1	14.0:1	14.0:1
Static Timing ¹	Deg.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Piston	Part Number	144-0720 233-2431	144-0720 233-2431	144-0720 233-2431	144-0720 233-2431	144-0720 233-2431	144-0720 233-2431	144-0720 233-2431	144-0720 233-2431
Cylinder Head	Part Number	154-1612	154-1612	154-1612	154-1612	154-1612	154-1612	154-1612	154-1612
Camshaft – Rear LH	Part Number	127-5402	127-5402	127-5402	127-5402	127-5402	127-5402	127-5402	127-5402
Camshaft – Front LH	Part Number	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Camshaft – Rear RH	Part Number	127-5403	127-5403	127-5403	127-5403	127-5403	127-5403	127-5403	127-5403
Camshaft – Front RH	Part Number	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Aftercooler	Part Number	111-5059	111-5059	111-5059	111-5059	111-5059	111-5059	111-5059	111-5059
Turbocharger Basic Group	Part Number	119-5998	119-5998	113-5180	113-5180	119-5998	119-5998	113-5180	113-5180
Injector	Part Number	162-8809	162-8809	150-4456	150-4456	162-8809	162-8809	150-4456	150-4456
	Part Number	229-0194	229-0194	229-0193	229-0193	229-0194	229-0194	229-0193	229-0193
	Part Number	250-1306	250-1306	250-1314	250-1314	250-1306	250-1306	250-1314	250-1314
Personality Module Software	Part Number	185-2973	231-9943	205-6960	231-9944	185-2973	231-9943	191-8358	231-9944
	Part Number	205-6959	254-8114	229-0272	254-8115	205-6959	254-8114	205-6960	254-8115
	Part Number	229-0271	260-3779		260-3780	229-0271	260-3779	229-0272	260-3780

Note ¹: Engine timing is electronically controlled by the engine Electronic Control Module (ECM). There are no adjustments that can be made to change engine timing.

*** Note; Replacement part may change**

The part numbers of the components listed above were valid in June 2002, but may change over time. They may not necessarily be the specific part numbers that this engine was shipped with. See also section "Record Changes to Emission Related Components".

3500B Engine Part Number Table*

Performance Specification		0K-3240	0K-5490	0K-2460	0K-5492	0K-3621	0K-2426	0K-5489	0K-2401
Engine Ratings (Advertised)	rpm	1500	1500	1800	1800	1800	1500	1500	1800
	BkW	1020	1020	1125	1125	1125	1257	1257	1424
	(bhp)	(1368)	(1368)	(1509)	(1509)	(1509)	(1686)	(1686)	(1910)
Engine Ratings (Overload)	rpm	1500	1500	1800	1800	1800	1500	1500	1800
	BkW	1125	1125	1240	1240	1240	1385	1385	1566
	(bhp)	(1509)	(1509)	(1663)	(1663)	(1663)	(1857)	(1857)	(2101)
Engine Model	Part Number	3512B	3512B	3512B	3512B	3512B	3512B	3512B	3512B
Engine Arrangement	Part Number	174-4946	232-2503	174-4947	232-2504	220-2115	174-4946		174-4947
Compression Ratio		14.0:1	14.0:1	14.0:1	14.0:1	14.0:1	14.0:1	14.0:1	14.0:1
Static Timing ¹	Deg.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Piston	Part Number	144-0720 223-2431	144-0720 223-2431	144-0720 223-2431	144-0720 223-2431	144-0720 223-2431	144-0720 223-2431	144-0720 223-2431	144-0720 223-2431
Cylinder Head	Part Number	154-1612	154-1612	154-1612	154-1612	154-1612	154-1612	154-1612	154-1612
Camshaft – Rear LH	Part Number	127-5407	127-5407	127-5407	127-5407	127-5407	127-5407	127-5407	127-5407
Camshaft – Front LH	Part Number	127-5408	127-5408	127-5408	127-5408	127-5408	127-5408	127-5408	127-5408
Camshaft – Rear RH	Part Number	127-5406	127-5406	127-5406	127-5406	127-5406	127-5406	127-5406	127-5406
Camshaft – Front RH	Part Number	127-5409	127-5409	127-5409	127-5409	127-5409	127-5409	127-5409	127-5409
Aftercooler	Part Number	116-7012	116-7012	116-7012	116-7012	116-7012	116-7012	116-7012	116-7012
Turbocharger Basic Group	Part Number	188-4630	188-4630	183-2822 188-4621	188-4621	188-4621	183-5173 188-4630	188-4630	183-2822 188-4621
		162-8809	162-8809	150-4456	150-4456	150-4456	162-8809	162-8809	150-4456
		229-0194	229-0194	229-0193	229-0193	229-0193	229-0194	229-0194	229-0193
Injector	Part Number	250-1306	250-1306	250-1314	250-1314	250-1314	250-1306	250-1306	250-1314
Personality Module Software		205-6947	231-9981	185-2999	231-9982		185-2994	231-9981	185-2999
		229-0269	254-8122	205-6946	254-8123	220-2131	205-6947	254-8122	205-6946
			260-3787	229-0270	260-3788		229-0269	260-3787	229-0270

Note ¹: Engine timing is electronically controlled by the engine Electronic Control Module (ECM). There are no adjustments that can be made to change engine timing.

*** Note; Replacement part may change**

The part numbers of the components listed above were valid in June 2002, but may change over time. They may not necessarily be the specific part numbers that this engine was shipped with. See also section “Record Changes to Emission Related Components”.

3500B Engine Part Number Table*

Performance Specification		0K-5491	0K-3115	0K-5485	0K-2495	0K-5484	0K-2417	0K-5486
Engine Ratings (Advertised)	rpm	1800	1500	1500	1500	1500	1800	1800
	BkW	1424	1566	1566	1717	1717	1901	1901
	(bhp)	(1910)	(2100)	(2100)	(2303)	(2303)	(2549)	(2549)
Engine Ratings (Overload)	rpm	1800	1500	1500	1500	1500	1800	1800
	BkW	1566	1725	1725	1890	1890	2091	2091
	(bhp)	(2101)	(2313)	(2313)	(2534)	(2534)	(2804)	(2804)
Engine Model	Part Number	3512B	3516B	3516B	3516B	3516B	3516B	3516B
Engine Arrangement	Part Number	232-2504	174-3190	232-2520	174-3190	232-2520	174-3191	232-2521
Compression Ratio		14.0:1	14.0:1	14.0:1	14.0:1	14.0:1	14.0:1	14.0:1
Static Timing ¹	Deg.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Piston	Part Number	144-0720 223-2431	144-0720 223-2431	144-0720 223-2431	144-0720 223-2431	144-0720 223-2431	144-0720 223-2431	144-0720 223-2431
Cylinder Head	Part Number	154-1612	154-1612	154-1612	154-1612	154-1612	154-1612	154-1612
Camshaft – Rear LH	Part Number	127-5407	127-8257	127-8257	127-8257	127-8257	127-8257	127-8257
Camshaft – Front LH	Part Number	127-5408	127-8258	127-8258	127-8258	127-8258	127-8258	127-8258
Camshaft – Rear RH	Part Number	127-5406	127-8256	127-8256	127-8256	127-8256	127-8256	127-8256
Camshaft – Front RH	Part Number	127-5409	127-8259	127-8259	127-8259	127-8259	127-8259	127-8259
Aftercooler	Part Number	116-7012	111-5059	111-5059	111-5059	111-5059	111-5059	111-5059
Turbocharger Basic Group	Part Number	188-4621	113-4779	113-4779	113-4779	113-4779	4P2582	4P2582
Injector	Part Number	150-4456	162-8809	162-8809	162-8809	162-8809	150-4456	150-4456
		229-0193	229-0194	229-0194	229-0194	229-0194	229-0193	229-0193
Personality Module Software	Part Number	250-1314	250-1306	250-1306	250-1306	250-1306	250-1314	250-1314
		231-9982	209-9734	231-9963	209-9734	231-9963	191-8357	231-9964
		254-8123	224-3082	254-8118	224-3082	254-8118	213-9334	254-8119
		260-3788		260-3783		260-3783	229-0268	260-3784

Note ¹: Engine timing is electronically controlled by the engine Electronic Control Module (ECM). There are no adjustments that can be made to change engine timing.

*** Note; Replacement part may change**

The part numbers of the components listed above were valid in June 2002, but may change over time. They may not necessarily be the specific part numbers that this engine was shipped with. See also section "Record Changes to Emission Related Components".

Installation Requirements

The following installation requirements must be met at rated load and speed to enable the engine to comply with the nitrogen oxides (NO_x) emission limits of regulation 13 of Annex VI of MARPOL 73/78:

Max. Jacket Water Outlet Temperature	99 °C (210 °F)
Min. Coolant Flow to Aftercooler	
Using 50/50 Glycol mix	530 lpm (140 gpm)
Using straight water	473 lpm (125 gpm)
Max. Aftercooler Water Inlet Temperature	60 °C (140 °F)
Maximum Air Inlet Restriction	6.2 kPa (25" Water)
Maximum Exhaust Backpressure	6.7 kPa (27" Water)



Engine Performance

The rated speed and rated power of the engine is included on the engine information nameplate. This nameplate is located on the engine cylinder block forward of the front left cylinder head.

Engine Emissions

Emissions data measurement is consistent with the procedures described in Resolution 2 of the 1997 MARPOL Conference "Technical Code on Control of Emissions of Nitrogen Oxides from Marine Diesel Engines". This engine's exhaust emissions are in compliance with the International Maritime Organization's Regulation 13 of Annex VI to the MARPOL 73/78 Convention. The NO_x limits for the 1800 rpm rated speed engines in this family is 10.05 g/kw-hr.

On-board Nox Verification procedure

Engine Parameter Check Method

Introduction:

The engine parameter check method that follows shall be used by the surveyor to verify that the engine, as installed on board the ship, complies with the nitrogen oxides (NOx) emission limits of Regulation 13 Annex VI of MARPOL 73/78. This method is to be used for the initial certification survey, periodic and intermediate surveys.

Procedures:

The procedures listed below are detailed on the following pages. They can be used to demonstrate compliance with the NOx emissions limits.

Steps of Engine Parameter Check Method:

1. Check Engine Parameter
2. Identify Emission-Related Engine Components
3. Record Changes to Emissions Related Components
4. Identify Adjustable Features



1. Check Engine Parameters:

There are no adjustable engine parameters related to NOx emissions that are physically capable of being adjusted without taking the engine outside of the manufacturers limits. Other than the parameters programmed in the ECM (Electronic Control Module), all programmable features are set at the factory. Therefore a section to record adjustable parameters becomes unnecessary.

2. Identify Emission-Related Engine Components:

The table below lists the components that influence the engine's NOx emissions for this engine model. The list under section Engine Part Numbers Table of this document shows the part numbers of those components as shipped from Caterpillar Inc. factories.

These part numbers can be identified through the personality module part number and the engine rating, which is also listed in this same table of this Technical File.

The personality module part number and the engine rating can be found on the Information Plate or film on this engine.

Note to surveyor:

See also section "Record Changes to Emission Related Components"

Note to Caterpillar dealers:

Part numbers for the components influencing the NOx can also be found in the Technical Marketing Information (TMI) system by viewing the engine test specification number.

Compare the observed part number with the part number from the tables on pages 3, 4, and 5 to insure that the part numbers are correct for these emissions related components.



Emission Related Component List:

Component Description:	Location on engine of component part No.:
Piston (See note 1)	On the bottom of the piston pin bore.
Cylinder Head	Stamped into the rear face of the cylinder head.
Camshaft	Stamped on the center of the camshaft.
Aftercooler	Etched on the aftercooler core housing on the rear right hand side.
Turbocharger	On nameplate of turbocharger.
Personality module software	On Information Plate of engine or use the Electronic Technician (ET) Service Tools.
Injector	Etched on top of injector tappet.

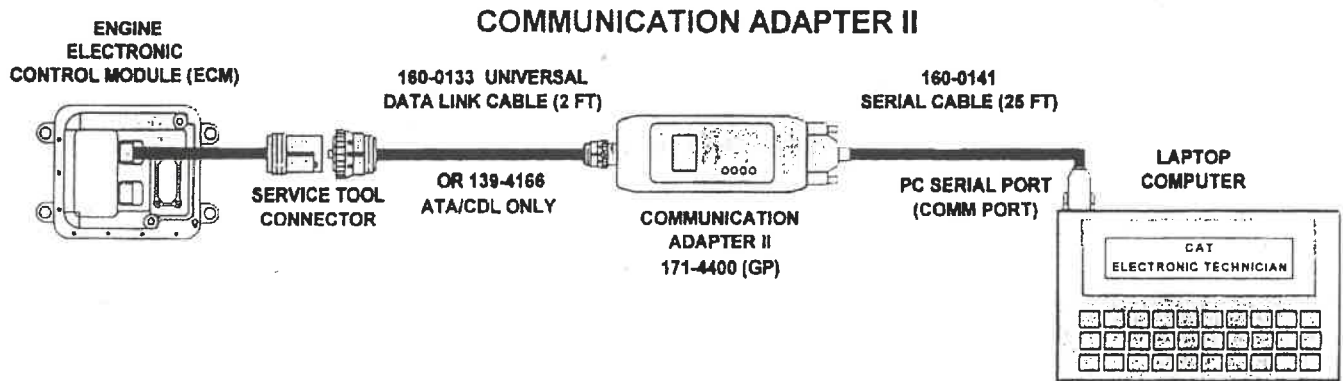
Note 1:

Part number not accessible without significant engine disassembly. Therefore it is not necessary to be checked by the surveyor.



Verification procedure for the Electronic Engine Software:

1. Hook up the laptop computer (with ET) to the engine Electronic Control Module (ECM) as shown in the diagram below.



2. Start the Electronic Technician (ET) program on the computer.
3. Select the desired ECM from the displayed list. If the engine has only one ECM, only one ECM option will be displayed.
4. The display screen will show the engine model, engine location, and engine serial number. Displayed below this information will be a list of two columns, the first column lists the "Parameter". The second column lists the value for that parameter. The fourth parameter listed is the "Personality Module Part Number". This is the engine software. The corresponding value is the software part number.



Appendix A: IMO Certification Test Report – D2

Parent Engine

Engine Information*

Emissions Test Report No.: 3512B-4		Sheet 1/5
Engine		
Manufacturer	Caterpillar Inc., Peoria, Illinois, USA	
Engine Type	3512B	
Family or Group identification	3500A1500&1800	
Serial number	8EM00451	
Rated speed	1800 rpm	
Rated power	1424 kW	
Intermediate speed	N/A rpm	
Maximum torque at intermediate speed	N/A Nm	
Static injection timing	N/A deg CA BTDC	
Electronic injection timing	yes	
Variable injection timing	yes	
Variable turbocharger geometry	no	
Bore	170 mm	
Stroke	190 mm	
Nominal compression ratio	14.0	
Mean effective pressure at rated power	1834 kPa	
Maximum cylinder pressure at rated power	16700 kPa	
Cylinder number and configuration	Number: 12 cyl. , V:12	
Auxiliaries	2 pumps	
Specified ambient conditions:		
Maximum sea water temperature	60 °C	
Maximum charge air temperature	70 °C	
Cooling system spec. intermediate cooler	yes	
Cooling system spec. charge air stages	1 stage	
Low/high temperature cooling system set points	N/A °C	
Maximum inlet depression	-3.7 kPa	
Maximum exhaust back pressure	6.7 kPa	
Fuel oil specification	IMO DMX Fuel	
Fuel oil temperature	30 °C	
Lubricating Oil specification	CH4 10W30 CAT PT#5P2586	
Application/Intended for:		
Customer		
Final application/installation, Ship	Ship	
Final application/installation, Engine	Auxiliary	
Emissions test result:		
Cycle	D2	
NOx	7.03 g/kW-hr	
Test identification	3512B ABS Certification Test	
Date/time	December 17, 2002, 11:37 am	
Test site/bench	Test Cell 515, Lafayette, Indiana, USA	
Test number	3512-4	
Surveyor	Richard T. McCombs – ABS	
Date and Place of report	December 17, 2002 @ LEC	
Signature		

* If applicable

Engine Family Information*

Emission Test Report No.: 3512B-4	Sheet 2/5
Engine Family Information (Common specifications)	
Combustion cycle	4 stroke cycle
Cooling medium	Water
Cylinder configuration	V8, V12, V16
Method of aspiration	Pressure charged
Fuel type to be used on board	Distillate
Combustion chamber	Open chamber
Valve port configuration	Cylinder head
Valve port size and number	4 valves per cylinder Intake dia.: 56 mm Exhaust dia.: 56 mm
Fuel system type	Electronic Unit Injector
Miscellaneous features:	
Exhaust gas recirculation	No
Water injectiton/emulsion	No
Air injection	No
Charge cooling system	Yes
Exhaust after-treatment	No
Exhaust after-treatment type	N/A
Dual fuel	No
Engine Family Information (Selection of parent engine for test bed test)	
Family Identification	3500A1500&1800
Method of pressure charging	Turbocharged
Charge air cooling system	Seawater Aftercooled
Criteria of the Selection (specify)	Maximum D2 weighted NOx
Number of cylinder (parent)	12
Max. rated power per cylinder (parent)	120 kW
Rated speed	1800 rpm
Injection timing (range), electronically controlled	2 to 22 °BTDC
Max. fuel parent engine	4846 g/min
Selected parent engine	3512B, Performance Specification 0K-2401
Application	Auxiliary

* If applicable

Test Cell Information*

Emissions Test Report No.: 3512B-4					Sheet 3/5
Exhaust Pipe					
Diameter				495	Mm
Length				62	M
Insulation			Yes	23	M
Probe Location			1-2 m from engine		
Remark					

Measurement equipment					
	Manufacturer	Model	Measurement	Calibration	
			Ranges	Span gas conc.	Deviation
Analyser					
NOx Analyser	Pierburg	CLD-PM2000	0-1700 ppm	1595 ppm	± 1 %
CO Analyzer	Rosemount	BINOS 2000-1	0-1000 ppm	951 ppm	± 1 %
CO2 Analyzer	Rosemount	BINOS 2000	0-16 %	15.34%	± 1 %
O2 Analyzer	Seimens	OXYMAT 5E	0-25 %	23.87%	± 1 %
HC Analyzer	Pierburg	FID-PM2000	0-200 ppm	59.9 ppm C3	± 1 %
Speed	HP	CENC-TAC8	0-10000 rpm		± 1 %
Torque	BLH	U3G2	0-10000 Nm		± 1 %
Power, if applicable	N/A	N/A	N/A kW		N/A
Fuel flow	Max Machinery	285-512	0-220 ml/sec		± 1 %
Air flow	Brandt	B-NZP1042	0-50000 lbm/hr		± 2 %
Exhaust flow	N/A	N/A	N/A		N/A
Temperatures					
Coolant	Omega	HP 1413	300 °C		± 2 °C
Lubricant	Omega	HP 1413	300 °C		± 2 °C
Exhaust gas	Omega	HP 1413	800 °C		± 6 °C
Inlet air	Omega	HP 1413	300 °C		± 2 °C
Intercooled air	Omega	HP 1413	300 °C		± 2 °C
Fuel	Omega	HP 1413	300 °C		± 2 °C
Pressures					
Exhaust gas	Viatran	245AAGBLDH	-10 to 10 kPa		± 2 %
Inlet manifold	Viatran	234AMGBL	0-682 kPa		± 2 %
Atmospheric	Omega	PX961-16A5V	54.2 – 108.4 kPa		± 0.5 %
Vapor pressure					
Intake air					
Dew Point					
Intake air	Honeywell	4114	-104.7 to 100 °C		± 1.4 °C

Fuel Characteristics

Fuel type					
Fuel properties:			Fuel elemental analysis		
Density	ISO 3675	0.85 kg/l	Carbon	87.18	% mass
Viscosity	ISO 3104	2.217 mm2/s	Hydrogen	13.14	% mass
			Nitrogen	0.24	% mass
			Oxygen	<0.1	% mass
			Sulphur	0.0301	% mass
			LHV/Hu	42.5177	MJ/kg

* If applicable

Ambient and Gaseous Emissions Data*

Emissions Test Report No.: 3512B-4						Sheet 4/5
Mode		1	2	3	4	5
Power/Torque	%	100	75	50	25	10
Speed	%	100	100	100	100	100
Time at beginning of mode		11:37AM	12:00PM	12:22PM	12:42PM	1:03PM

Ambient Data						
Atmospheric pressure	kPa	98.8	98.9	98.9	98.9	99.0
Intake air temperature	°C	23.1	23.1	23.1	23.0	22.9
Intake air humidity	g/kg	3.86	3.86	3.86	4.14	4.14
Atmospheric factor (fa)		0.993	0.992	0.992	0.992	0.992

Gaseous Emissions Data:						
NOx concentration dry	ppm	1159	816	620	415	426
CO concentration dry	ppm	0.0070	0.0080	0.0100	0.0120	0.0150
CO2 concentration dry	%	7.500	6.860	6.220	4.900	3.190
O2 concentration dry	%	10.55	11.39	12.23	13.98	16.31
HC concentration wet	ppm	87.00	93.00	98.00	110.00	174.00
NOx humidity correction factor		0.889	0.889	0.889	0.893	0.893
Fuel specification factor (FFH)		1.865	1.865	1.865	1.865	1.865
Dry/wet correction factor		0.928	0.933	0.938	0.949	0.964
NOx mass flow	kg/hr	12.8760	7.6330	4.4880	2.1720	1.8210
CO mass flow	kg/hr	0.5480	0.5000	0.4910	0.4320	0.4430
CO2 mass flow	kg/hr	896.79	690.69	484.33	274.80	146.00
O2 mass flow	kg/hr	N/A	N/A	N/A	N/A	N/A
HC mass flow	kg/hr	0.3527	0.3158	0.2561	0.2047	0.2604
SO2 mass flow	kg/hr	N/A	N/A	N/A	N/A	N/A
NOx specific	g/kWhr	9.034	7.141	6.297	6.096	12.815

* If applicable



Engine Test Data*

Emissions Test Report No.: 3512B-4					Sheet 5/5
Mode	1	2	3	4	5
Power/Torque %	100	75	50	25	10
Speed %	100	100	100	100	100
Time at beginning of mode	11:37AM	12:00PM	12:22PM	12:42PM	1:03PM

Engine Data					
Speed rpm	1800	1800	1800	1800	1800
Auxiliary power kW	0	0	0	0	0
Dynamometer setting Nm	7554	5666	3777	1889	755
Power kW	1425.1	1068.9	712.6	356.3	142.1
Mean effective pressure bar	18.36	13.77	9.18	4.59	1.83
Fuel rack mm	21.53	16.86	13.08	9.35	7.00
Uncorrected spec. fuel consumption g/kWhr	204.0	210.4	222.7	255.8	345.2
Fuel flow kg/hr	290.8	224.9	158.7	91.2	49.1
Air flow kg/hr	8180.0	6870.0	5302.0	3797.0	3078.0
Exhaust flow (gexhw) kg/hr	8471.0	7095.0	5460.0	3888.0	3127.0
Exhaust temperature °C	464	441	415	349	250
Exhaust back pressure mbar	67.70	46.60	26.20	9.60	4.80
Cylinder Coolant temperature out °C	95	94	93	92	91
Cylinder Coolant temperature in °C	89.0	89.0	89.0	89.0	89.0
Cylinder Coolant pressure bar	2.73	2.72	2.72	2.71	2.69
Aftercooler Coolant temperature in °C	60.6	60.8	61.0	60.8	60.3
Temperature intercooled air °C	71.8	68.7	66.3	64.0	62.8
Lubricant temperature °C	100	99	97	96	95
Lubricant pressure bar	3.82	3.92	4.03	4.15	4.24
Inlet depression mbar	36.6	26.1	15.1	7.8	5.4

* If applicable

Appendix A: IMO Certification Test Report – E2

Parent Engine

Engine Information*

Emissions Test Report No.: 3512B-5		Sheet 1/5
Engine		
Manufacturer	Caterpillar Inc., Peoria, Illinois, USA	
Engine Type	3512B	
Family or Group identification	3500A1500&1800	
Serial number	8EM00451	
Rated speed	1800 rpm	
Rated power	1424 kW	
Intermediate speed	N/A rpm	
Maximum torque at intermediate speed	N/A Nm	
Static injection timing	N/A deg CA BTDC	
Electronic injection timing	yes	
Variable injection timing	yes	
Variable turbocharger geometry	no	
Bore	170 mm	
Stroke	190 mm	
Nominal compression ratio	14.0	
Mean effective pressure at rated power	1834 kPa	
Maximum cylinder pressure at rated power	16700 kPa	
Cylinder number and configuration	Number: 12 cyl. , V:12	
Auxiliaries	2 pumps	
Specified ambient conditions:		
Maximum sea water temperature	60 °C	
Maximum charge air temperature	70 °C	
Cooling system spec. intermediate cooler	yes	
Cooling system spec. charge air stages	1 stage	
Low/high temperature cooling system set points	N/A °C	
Maximum inlet depression	-3.7 kPa	
Maximum exhaust back pressure	6.7 kPa	
Fuel oil specification	IMO DMX Fuel	
Fuel oil temperature	30 °C	
Lubricating Oil specification	CH4 10W30 CAT PT#5P2586	
Application/Intended for:		
Customer	Ship	
Final application/installation, Ship	Main: Propulsion acc. to E2 (CCP, Diesel –Electric)	
Final application/installation, Engine		
Emissions test result:		
Cycle	E2	
NOx	7.54 g/kW-hr	
Test identification	3512B ABS Certification Test	
Date/time	December 17, 2002, 11:37 am	
Test site/bench	Test Cell 515, Lafayette, Indiana, USA	
Test number	3512B-5	
Surveyor	Richard T. McCombs – ABS	
Date and Place of report	December 17, 2002 @ LEC	
Signature		

* If applicable

Engine Family Information*

Emission Test Report No.: 3512B-5	Sheet 2/5
Engine Family Information (Common specifications)	
Combustion cycle	4 stroke cycle
Cooling medium	Water
Cylinder configuration	V8, V12, V16
Method of aspiration	Pressure charged
Fuel type to be used on board	Distillate
Combustion chamber	Open chamber
Valve port configuration	Cylinder head
Valve port size and number	4 valves per cylinder Intake dia.: 56 mm Exhaust dia.: 56 mm
Fuel system type	Electronic Unit Injector
Miscellaneous features:	
Exhaust gas recirculation	No
Water injectiton/emulsion	No
Air injection	No
Charge cooling system	Yes
Exhaust after-treatment	No
Exhaust after-treatment type	N/A
Dual fuel	No
Engine Family Information (Selection of parent engine for test bed test)	
Family Identification	3500A1500&1800
Method of pressure charging	Turbocharged
Charge air cooling system	Seawater Aftercooled
Criteria of the Selection (specify)	Maximum D2 weighted NOx
Number of cylinder (parent)	12
Max. rated power per cylinder (parent)	120 kW
Rated speed	1800 rpm
Injection timing (range), electronically controlled	2 to 22 °BTDC
Max. fuel parent engine	4846 g/min
Selected parent engine	3512B, Performance Specification OK-2401
Application	Propulsion

* If applicable

Test Cell Information*

Emissions Test Report No.: 3512B-5				Sheet 3/5
Exhaust Pipe				
Diameter			495	Mm
Length			62	M
Insulation		Yes	23	M
Probe Location		1-2 m from engine		
Remark				

Measurement equipment					
	Manufacturer	Model	Measurement	Calibration	
			Ranges	Span gas conc.	Deviation
Analyser					
NOx Analyser	Pierburg	CLD-PM2000	0-1700 ppm	1595 ppm	± 1 %
CO Analyzer	Rosemount	BINOS 2000-1	0-1000 ppm	951 ppm	± 1 %
CO2 Analyzer	Rosemount	BINOS 2000	0-16 %	15.34 %	± 1 %
O2 Analyzer	Seimens	OXYMAT 5E	0-25 %	23.87 %	± 1 %
HC Analyzer	Pierburg	FID-PM2000	0-200 ppm	59.9 ppm C3	± 1 %
Speed	HP	CENC-TAC8	0-10000 rpm		± 1 %
Torque	BLH	U3G2	0-10000 Nm		± 1 %
Power, if applicable	N/A	N/A	N/A kW		N/A
Fuel flow	Max Machinery	285-512	0-220 ml/sec		± 1 %
Air flow	Brandt	B-NZP1042	0-50000 lbm/hr		± 2 %
Exhaust flow	N/A	N/A	N/A		N/A
Temperatures					
Coolant	Omega	HP 1413	300 °C		± 2 °C
Lubricant	Omega	HP 1413	300 °C		± 2 °C
Exhaust gas	Omega	HP 1413	800 °C		± 6 °C
Inlet air	Omega	HP 1413	300 °C		± 2 °C
Intercooled air	Omega	HP 1413	300 °C		± 2 °C
Fuel	Omega	HP 1413	300 °C		± 2 °C
Pressures					
Exhaust gas	Viatran	245AAGBLDH	-10 to 10 kPa		± 2 %
Inlet manifold	Viatran	234AMGBL	0-682 kPa		± 2 %
Atmospheric	Omega	PX961-16A5V	54.2 - 108.4 kPa		± 0.5 %
Vapor pressure					
Intake air					
Dew Point					
Intake air	Honeywell	4114	-104.7 to 100 °C		± 1.4 °C

Fuel Characteristics

Fuel type					
Fuel properties:			Fuel elemental analysis		
Density	ISO 3675	0.85 kg/l	Carbon	87.18	% mass
Viscosity	ISO 3104	2.217 mm ² /s	Hydrogen	13.14	% mass
			Nitrogen	0.24	% mass
			Oxygen	<0.1	% mass
			Sulphur	0.0301	% mass
			LHV/Hu	42.5177	MJ/kg

* If applicable

Ambient and Gaseous Emissions Data*

Emissions Test Report No.: 3512B-5					Sheet 4/5
Mode		1	2	3	4
Power/Torque	%	100	75	50	25
Speed	%	100	100	100	100
Time at beginning of mode		11:37AM	12:00PM	12:22PM	12:42PM

Ambient Data					
Atmospheric pressure	kPa	98.8	98.9	98.9	98.9
Intake air temperature	°C	23.1	23.1	23.1	23.0
Intake air humidity	g/kg	3.86	3.86	3.86	4.14
Atmospheric factor (fa)		0.993	0.992	0.992	0.992

Gaseous Emissions Data:					
NOx concentration dry	ppm	1159	816	620	415
CO concentration dry	ppm	0.0070	0.0080	0.0100	0.0120
CO2 concentration dry	%	7.500	6.860	6.220	4.900
O2 concentration dry	%	10.55	11.39	12.23	13.98
HC concentration wet	ppm	87.00	93.00	98.00	110.00
NOx humidity correction factor		0.889	0.889	0.889	0.893
Fuel specification factor (FFH)		1.865	1.865	1.865	1.865
Dry/wet correction factor		0.928	0.933	0.938	0.949
NOx mass flow	kg/hr	12.8760	7.6330	4.4880	2.1720
CO mass flow	kg/hr	0.5480	0.5000	0.4910	0.4320
CO2 mass flow	kg/hr	896.79	690.69	484.33	274.80
O2 mass flow	kg/hr	N/A	N/A	N/A	N/A
HC mass flow	kg/hr	0.3527	0.3158	0.2561	0.2047
SO2 mass flow	kg/hr	N/A	N/A	N/A	N/A
NOx specific	g/kWhr	9.034	7.141	6.297	6.096

* If applicable

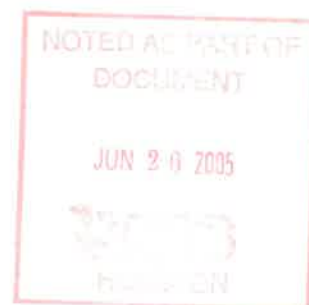


Engine Test Data*

Emissions Test Report No.: 3512B-5					Sheet 5/5
Mode		1	2	3	4
Power/Torque	%	100	75	50	25
Speed	%	100	100	100	100
Time at beginning of mode		11:37AM	12:00PM	12:22PM	12:42PM

Engine Data					
Speed	rpm	1800	1800	1800	1800
Auxiliary power	kW	0	0	0	0
Dynamometer setting	Nm	7554	5666	3777	1889
Power	kW	1425.1	1068.9	712.6	356.3
Mean effective pressure	bar	18.36	13.77	9.18	4.59
Fuel rack	mm	21.53	16.86	13.08	9.35
Uncorrected spec. fuel consumption	g/kWhr	204.0	210.4	222.7	255.8
Fuel flow	kg/hr	290.8	224.9	158.7	91.2
Air flow	kg/hr	8180.0	6870.0	5302.0	3797.0
Exhaust flow (gexhw)	kg/hr	8471.0	7095.0	5460.0	3888.0
Exhaust temperature	°C	464	441	415	349
Exhaust back pressure	mbar	67.70	46.60	26.20	9.60
Cylinder Coolant temperature out	°C	95	94	93	92
Cylinder Coolant temperature in	°C	89.0	89.0	89.0	89.0
Cylinder Coolant pressure	bar	2.73	2.72	2.72	2.71
Aftercooler Coolant temperature in	°C	60.6	60.8	61.0	60.8
Temperature intercooled air	°C	71.8	68.7	66.3	64.0
Lubricant temperature	°C	100	99	97	96
Lubricant pressure	bar	3.82	3.92	4.03	4.15
Inlet depression	mbar	36.6	26.1	15.1	7.8

* If applicable



ENGINE INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

(Note: This Certificate shall be supplemented by a Record of Construction, Technical File and Means of Verification)

Issued under the provisions of the Protocol of 1997 to the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 related thereto (hereinafter referred to as "the Convention") under the authority of the Government of:

The Kingdom of Denmark

(full designation of country)

by the **American Bureau of Shipping**

Engine Manufacturer	Model Number	Serial Number	Test Cycle(s)	Rated Power (kW) and Speed (RPM)	Engine Approval Number
Caterpillar	3512B (0K-2460)	8EM00429	D2	1125 kW @ 1800 RPM	ABSHS-NTC-1013-0001-00035

THIS IS TO CERTIFY:

1. That the above-mentioned marine diesel engine has been surveyed for pre-certification in accordance with the requirements of the Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines made mandatory by Annex VI of the Convention; and
2. That the pre-certification survey shows that the engine, its components, adjustable features, and Technical File, prior to the engine's installation and/or service on board a ship, fully comply with the applicable requirements of regulation 13 of Annex VI of the Convention.

This certificate is valid for the life of the engine, subject to surveys in accordance with regulation 5 of Annex VI of the Convention, installed in ships under the authority of this Government.

Issued at Chicago, Illinois USA the 11th day of July 2005



ABS



P. Beattie
P. Beattie, Surveyor, American Bureau of Shipping

**SUPPLEMENT TO ENGINE INTERNATIONAL AIR POLLUTION PREVENTION
CERTIFICATE
(EIAPP CERTIFICATE)**

RECORD OF CONSTRUCTION, TECHNICAL FILE AND MEANS OF VERIFICATION

In respect of the provisions of Annex VI of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto (hereinafter referred to as "the Convention") and of the Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines (hereinafter referred to as the "NO_x Technical Code").

Notes:

1. This Record and its attachments shall be permanently attached to the EIAPP Certificate. The EIAPP Certificate shall accompany the engine throughout its life and shall be available on board the ship at all times.
2. If the language of the original Record is neither English nor French, the text shall include a translation into one of these languages.
3. Unless otherwise stated, regulations mentioned in this Record refer to regulations of Annex VI of the Convention and the requirements for an engine's Technical File and Means of Verification refer to mandatory requirements of the NO_x Technical Code.

1 Particulars of the engine

- 1.1 Name and address of manufacturer Caterpillar, Inc.
..... 100 N.E. Adams Street
..... Peoria, IL 47905, U.S.A.
- 1.2 Place of engine build Caterpillar, Inc.
..... 3701 State Road 26 East
..... Lafayette, IN 47905, U.S.A.
- 1.3 Date of engine build 9 May 2002
- 1.4 Place of pre-certification survey Caterpillar, Inc.
..... 3701 State Road 26 East
..... Lafayette, IN 47905, U.S.A.
- 1.5 Date of pre-certification survey 10 May 2002
- 1.6 Engine type and model number Caterpillar Model: 3512B (0K-2460)
- 1.7 Engine serial number 8EM00429
- 1.8 If applicable, the engine is a parent engine ☐ or a member engine ☒ of the following engine family ☒ or engine group ☐ Engine Family: 3500A1500&1800
- 1.9 Test cycle(s) (see chapter 3 of the NO_x Technical Code) D2
..... (Constant Speed Auxiliary Engine Application)
- 1.10 Rated Power (kW) and Speed (RPM) 1424 kW (1910 HP) @ 1800 RPM (Parent Engine)
- 1.11 Engine approval number ABSHS-NTC-1013-0001-00001 (Parent Engine)
- 1.12 Specification(s) of test fuel ISO 8217, DMX

- 1.13 NO_x reducing device designated approval number (if installed) N/A
- 1.14 Applicable NO_x Emission Limit (g/kWh) (regulation 13 of Annex VI) 10.05 g/kWh
- 1.15 Engine's actual NO_x Emission Value (g/kWh) 7.73 g/kWh

2 Particulars of the Technical File*

- 2.1 Technical File identification/approval number ABSHS-NTC-1013-0001-00035
- 2.2 Technical File approval date 20 June 2005

* The Technical File, as required by chapter 2 of NO_x Technical Code, is an essential part of EIAPP Certificate and must always accompany an engine throughout its life and always be available on board a ship.

3 Specifications for the On-board NO_x Verification Procedures for the Engine Parameter Survey**

- 3.1 On-board NO_x verification procedures identification/approval number
..... ABSHS-NTC-1013-0001-00035
- 3.2 On-board NO_x verification procedures approval date 20 June 2005

** The specifications for the on-board NO_x verification procedures, as required by chapter 6 of the NO_x Technical Code, is an essential part of the EIAPP Certificate and must always accompany an engine through its life and always be available on board a ship.

THIS IS TO CERTIFY that this Record is correct in all respects.

Issued at Chicago, Illinois USA the 11th day of July 2005



ABS



P. Beattie, Surveyor, American Bureau of Shipping