Oma Slipp & Mekaniske Verksted AS

Our ref.: EMEM/emeb

Sertifikater til deres bygg Kostersund-
Nogva kontrakt 14684.

Vedlagt følger:

Scania

2 stk. EIAPP-sertifikat for Scania DI13 92M, nr.: EIAPP-F-173245-0026 & 0027.
1 stk. DNV- typesertifikat for Scania DI13 92M, nr.: TAM000004Z Rev 2.
1 stk. DNV- typesertifikat for Nogva Motor Computer, nr.: TAA00000MT Rev 1.

Søvik 11.01.2021

Med vennlig hilsen
NOGVA MOTORFABRIKK AS

Elsebet M.E. Bjørnøy
Elsebet Malena Eide Bjørnøy

DNV·GL

ENGINE INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

Certificate no.:
EIAPP-F-173245-0026

Issued under the provisions of the Protocol of 1997, as amended by resolution MEPC.176(58) in 2008, to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified of the Protocol of 1978 related thereto (hereinafter referred to as "the Convention")
under the authority of the Government of

SWEDEN

by **DNV GL**

Particulars of the engine:

Engine manufacturer:	**Scania CV AB**
Model number:	**DI13092M**
Serial number:	**7264611**
Test cycle(s):	**C1 / E3**
Rated power [kW] and speed [rpm]:	**405 @ 1800**
Engine approval number:	**EIAPP-F-173245-0026**

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 2008 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 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 **Hamburg** on **2021-01-05**

This document is signed electronically in accordance with IMO FAL. 5/Circ.39/Rev.2. Validation and authentication can be obtained from trust.dnvgl.com by using the Unique Tracking Number (UTN): EIAPP-F-173245-0026

Fabian Kock
Head of Section Environmental Certification

Certificate no.: EIAPP-F-173245-0026

SUPPLEMENT TO ENGINE INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

RECORD OF CONSTRUCTION, TECHNICAL FILE AND MEANS OF VERIFICATION

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 The Record shall be at least in English, French or Spanish. If an official language of the issuing country is also used, this shall prevail in case of a dispute or discrepancy.

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 verifications refer to mandatory requirements from the NOx Technical Code 2008.

1. Particulars of the engine

1.1	Name and address of manufacturer	**Scania CV AB Vagnmakarvägen 1 Södertälje, Sweden**	
1.2	Place of engine build	**Södertälje, Sweden**	
1.3	Date of engine build		**2020**
1.4	Place of pre-certification survey	**Södertälje, Sweden**	
1.5	Date of pre-certification survey		**2020**
1.6	Engine type and model number		**DI13092M**
1.7	Engine serial number		**7264611**
1.8	If applicable, the engine is a parent engine ☐ of the following engine family ☑	or a member engine ☑ or engine group ☐	
		DI13092M	
	As approved with approval no.	**EIAPP-F-173245**	
1.9	Individual engine or engine family/engine group details:		
1.9.1	Approval reference		**EIAPP-F-173245-0026**
1.9.2	Rated power (kW) and rated speed (rpm) values or range		**405 @ 1800**
1.9.3	Test cycle(s)		**C1 / E3**
1.9.4	Parent engine(s) test fuel oil specification		**ISO-F-DMA**
1.9.5	Applicable NOx emission limit (g/kWh), regulation 13.3, 13.4, 13.5.1		**10.0, 7.8, 2.0 / 10.0, 7.8, 2.0**
1.9.6	Parent engine(s) emission value (g/kWh)		**1.7, 1.7, 1.7 / 1.7, 1.7, 1.7**

2. Particulars of the technical file

The technical file, as required by chapter 2 of the NOx Technical Code 2008, is an essential part of the EIAPP Certificate and must always accompany an engine throughout its life and always be available on board a ship.

2.1	Technical file identification/approval number	**EIAPP-F-173245-0026**
2.2	Technical file approval date	**2021-01-05**

3. Specifications for the onboard NOx verification procedures

The specifications for the on board NOx verification procedures, as required by Ch. 6 of the NOx Technical Code 2008, are an essential part of the EIAPP Certificate and must always accompany an engine through its life and always be available on board a ship.

3.1	Engine parameter check method:	
3.1.1	Identification/approval number	**EIAPP-F-173245-0026**
3.1.2	Approval date	**2021-01-05**
3.2	Direct measurement and monitoring method:	
3.2.1	Identification/approval number	-
3.2.2	Approval date	-

Alternatively the simplified measurement method in accordance with 6.3 of the NOx Technical Code 2008 may be utilized.

Issued at **Hamburg** on **2021-01-05**

This document is signed electronically in accordance with IMO FAL. 5/Circ.39/Rev.2. Validation and authentication can be obtained from trust.dnvgl.com by using the Unique Tracking Number (UTN): EIAPP-F-173245-0026

Fabian Kock
Head of Section Environmental Certification

SCANIA

TECHNICAL DOCUMENTS

According to

Revised MARPOL Annex VI and NOx Technical Code 2008

Applies for:

Engine type	**DI13 092M**
Engine number	**7264611**
Power (kW)	**405 kw**
Rated speed (rpm)	**1800 rpm**
Engine built	**2020**
Engine family	**DI13 092M**
Approval number	**DNV GL EIAPP-F-173245**

APPROVED

EIAPP-F-173245-0026

SEE LETTER Date: 2021-01-05

Table of Contents

1. Record of engine performance and emission relevant components and settings 3
1.1 Allowable adjustment of components 3
1.2 Diesel fuel 3
1.3 Emission relevant components and settings 4
2. On board verification procedure 5
2.1 Marking emission related engine components 6
2.2 Marking emission related SCR components 7
3. SCR System 10
3.1 General description of the SCR system 10
3.1.1 Urea Dosing and quality detection 10
3.1.2 Excessive slip (NH_3) monitoring 10
3.1.3 Auxiliary emission control strategy 11
3.2 Correct placing of components in SCR-system 12
3.3 Approved length of piping 13
3.3.1 Approved exhaust pipe bends 13
3.4 Verification of SCR and ERV with help of diagnose and warning system 14
3.4.1 Verification of SCR with help of diagnose and warning system 14
3.4.2 Verification of ERV with help of diagnose and warning system 14
3.4.3 Warning lights for UDS- / AFT- and ERV-Diagnose 15
4. Specification of the SCR-system and parts 16
5. Test reports for parent engine 17
5.1 Engine Information 17
5.2 Specified ambient conditions 17
5.3 Application / Intended for 18
5.4 Emission test results 18
5.5 Injection Rate Urea 18
5.6 Engine family information 18
5.7 Miscellaneous features 19
5.8 Test cell information 20
5.9 Emission test reports 21

Approval No EIAPP-F-173245-0026
Page 2 of 22

1. Record of engine performance and emission relevant components and settings

1.1 Allowable adjustment of components

Allowable adjustment of components and settings are described in *chapter 2. On board verification procedure.*

1.2 Diesel fuel

The engine exhaust emissions and power output are dependent on correct fuel quality. The composition of the diesel fuel is vitally important to both engine operation and expected durability of the aftertreatment system and all of its components. The table below shows the requirements for the most important properties. The diesel fuel shall comply with standard: ISO-F-DMA.

Viscosity at 40°C	2.0 - 4.5 mm^2/s (cSt)
Density at 15°C	max 0.845 kg/dm^3
Sulphur (concentration by mass)	max. 0.005%
Ignitability (CET rating)	min. 51
Flashpoint, min	60°C

1.3 Emission relevant components and settings

Selection criteria for parent engine = Max NOx emission, g/kWh

Engine type	**DI13 092M**
Application	E3 / C1
No. of cylinders	6
Rated power, kW	257/294/331/368/**405**
D:o max per cylinder, kW	42.8/49/51.2/61.3/67.5
Rated speed, r/min	1800
Bore / Stroke, mm	130 / 160
Selected parent engine for IMO Tier III	405 kW@1800 rpm
Emission relevant components of the engine	
Cylinder head	2183414
Cylinder head gasket	1893055
Piston	1783533
Connecting rod	2190306
Camshaft	1523424
Turbocharger	1866346
Injector	1734493
Charge air cooler	2481601 Heat exchange (HE), 2156635 Keel cooling (KC)
Test Plan Number	2447715 (257 kW)
	2447716 (294 kW)
	2447717 (331 kW)
	2447768 (368 kW)
	2447769 (405 kW)
Valve clearance* Cold engine: Intake 0.45 mm, outlet 0.70 mm	
SCR-System emission relevant components	
Exhaust Routing Valve (By-pass valve)	2571861
Urea Dosing unit	2722701
Mixing Unit	2173380
SCR Catalytic Converter	2402666
NOx-sensor after SCR-unit	2294291
NOx-sensor at engine outlet	2294290
Urea tank assembly	2596298
Control unit EEC3 (SCR-*ECU*)	1918851
Urea pump	2655852, 2695808
Urea quality sensor	2286102
Temperature sensor	2604683

*Also see label on rocker cover

2. On board verification procedure

The method to verify the on board NOx emissions is the engine parameter check method.
Components and settings to check are listed below:

Engine related components and settings (for markings see 2.1)		
Turbocharger	These components/settings can be checked without dismantling. Location of part numbers see sketches page 6.	No adjustment are allowed
Test plan number, see below		See "Important information" below
Valve clearance		See chapter 1, page 3
Cylinder head	These components can only be checked after dismantling and should only be checked during maintenance or if there is doubt about the correctness of the components. Location of part numbers, see sketches page 6.	No adjustment are allowed
Cylinder head gasket		No adjustment are allowed
Piston		No adjustment are allowed
Connecting rod		No adjustment are allowed
Camshaft		No adjustment are allowed
Charge air cooler		No adjustment are allowed
Injector		No adjustment are allowed
SCR related components and settings (for markings see chapter 2.2)		
SCR system	Some components can be checked without dismantling the system. Location of part numbers, see page 7 - 9.	No adjustment are allowed
SCR software	SCR Software can be verified by a label on the engine control unit, ECU (test plan number), see sketch page 6.	See "Important information" below. No adjustment are allowed
Other SCR related verification (for more details see chapter 3.)		
3.1 General description of the SCR system, maintenance. 3.2 Correct placing of components in SCR-system 3.3 Approved length of piping 3.4 Verification of SCR and ERV with help of diagnose and warning system		No adjustment are allowed

Tier III operation mode (when the SCR-system is activated) in NECA area must be noted in the record book and every time the yellow amber lamp is on shall be recorded.
For details and information of the SCR-system see chapter 3.

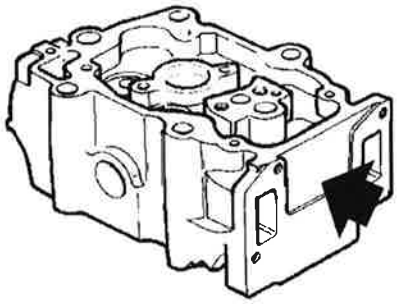
Important information

The injection advance timing of the Engine Control Unit (ECU) is the same for all engines within an engine type. Different ratings, within an engine type, are obtained by variation of the fuel delivery. A test plan number, labelled on the ECU, is introduced for individual combinations of power and speed. The SCR-ECU EEC3 is also covered by the test plan number. Any emission related changes in the ECU or EEC3 will result in a new test plan number.

Modifications and verifications of the software in the ECU and in the EEC3 can only be carried out by Scania authorized service organisation and all program modifications are electronically monitored. Unauthorized access to the ECU and EEC3, the related settings and software will result in immediate suspension of the certificates and breach of the warranties.

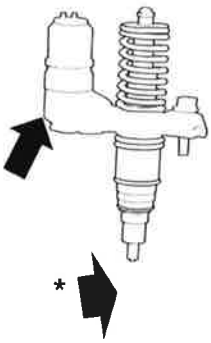
2.1 Marking emission related engine components

Cylinder head

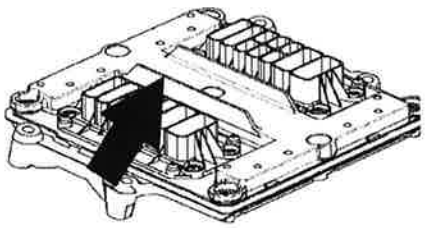


Cylinder head gasket

Injector

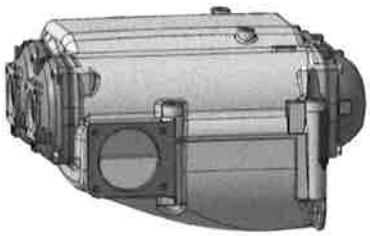


Engine control unit, ECU *Test plan number*

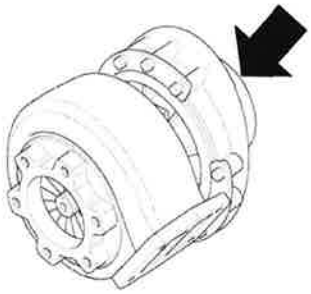


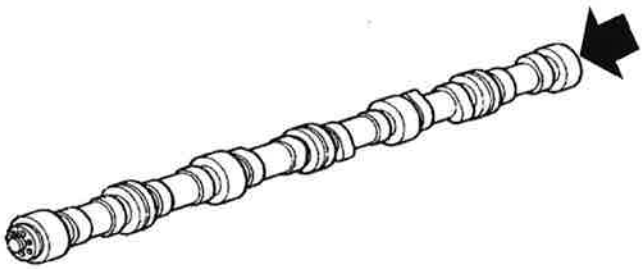
Charge Air Cooler

ID-number inside on cooler



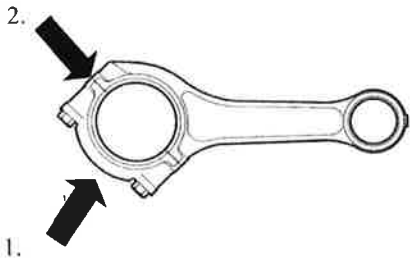
Turbo charger





Camshaft

1. Connecting rod No.
2. Cylinder No. punched when fitted



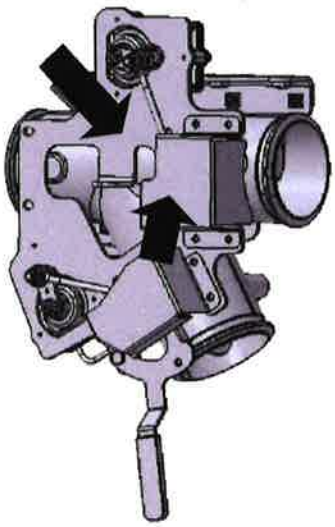
Piston

Part No			
* **Injector part No. (see p. 3)**	**Bosch type**	**Marking**
2098522	DLLA 145 P2230	2230

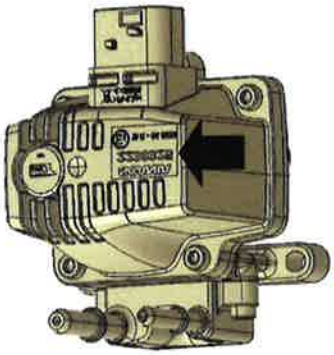
2668318

2.2 Marking emission related SCR components

By-Pass valve, part number at the arrow.

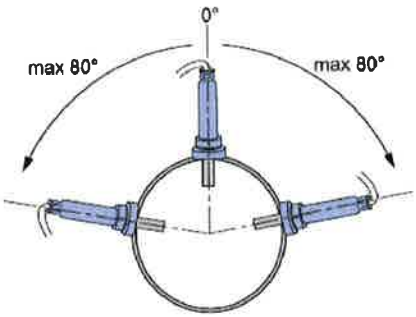


Urea dosing assembly



Mixing unit (Evaporator)

NOx-sensor upstream and downstream



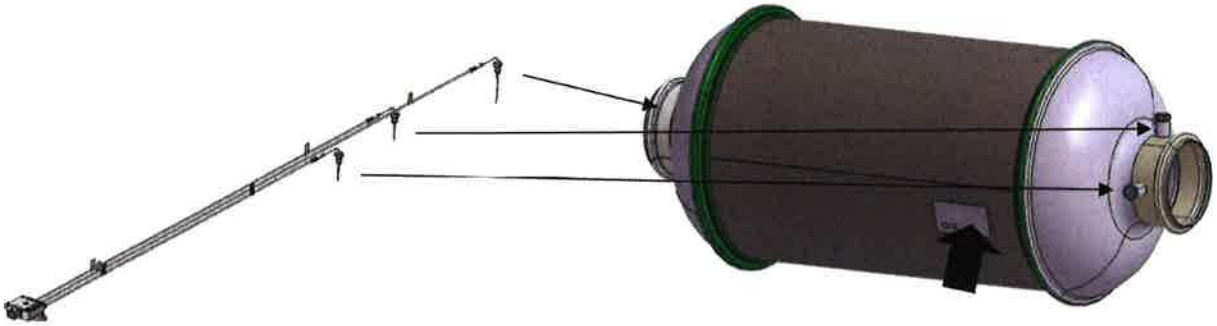
Mounting angles

The mixing unit, catalytic converter and the by-pass valve are covered with insulation protection to prevent the exposure of hot surfaces. Part numbers can be shown at maintenance.

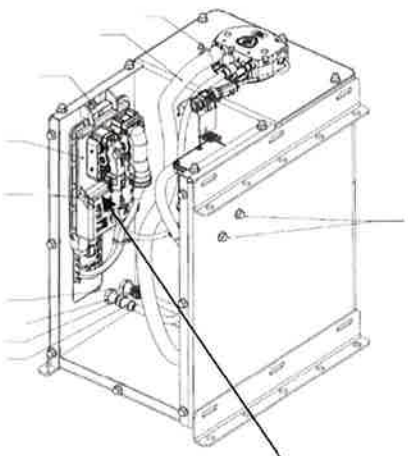
Approval No EIAPP-F-173245-0026
Page 7 of 22

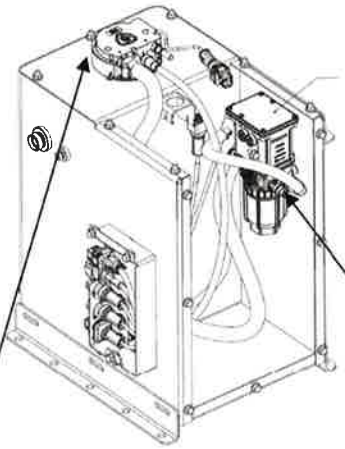
Temperature sensor assy

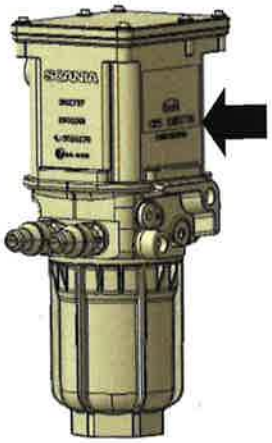
Catalytic converter incl. ammonia slip catalyst



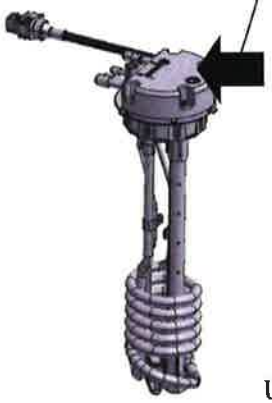
Urea tank







Urea pump, included in the urea tank



Urea quality sensor

Electronic control unit EEC3
ID/Part-number on the back of the EEC3.

SCR control unit EEC3, urea Quality Sensor and Urea pump are built-in into the back of the Urea tank. The ID-numbers are marked on respective part and can be controlled at maintenance.

3. SCR System

3.1 General description of the SCR system

This is a general description of the SCR-system intended to give an overview how the system works. Details to be checked during on board verification are to be found in chapter 3.2-3.4

The complete aftertreatment and the SCR is very robust and are designed to last longer than the base engine. To guarantee emission over time, Scania recommends that for every second engine overhaul the complete aftertreatment system including the SCR should be exchanged. For NOx-sensors, we recommend that they are exchanged at every engine overhaul. Engine overhaul corresponding to 20 000 hour of operation. Advanced diagnose is incorporated in the aftertreatment system and if a component fails before recommended exchange interval it is designed to set a warning light to alert the operator. Two warning lights are used for different type of faults, see chapter 3.4.3 for more information.

The maintenance of the SCR-system is limited to exchange filters in the dosing unit and in the tank. More extensive service is only necessary at engine overhaul where NOx sensor or complete after treatment is recommended to be exchanged. The feedback control of the SCR-system and its integrated diagnose will point out if there is a fault/component that might need change prior to this.

The normal operating temperature for the SCR is between 210 °C and 510 °C.

No additional additives are allowed in the fuel, to prevent contamination of the catalyst and sensors. Extra additives, higher sulphur content, contaminations or solvents will *decrease* the lifetime of the sensors and the catalysts.

If the catalyst is poisoned, for example due to the use of incorrect fuel with a high sulphur content, it is sometimes possible to operate the engine with correct fuel at high load for > 1h to reverse the contamination. Warning light will automatically be turned off if the catalyst contamination is reversed and normal conversion ratio is recovered. No more service would be necessary in these cases.

The SCR-system is a closed loop feedback control system and it continuously monitors the level and quality of Urea in its tank, tailpipe NOx-emissions and the temperature before the catalytic converter to ensure emissions are kept.

The operator shall record time and date when the SCR-system (IMO tier III mode) is activated in NECA area. If the yellow (amber) warning lamp is activated and the SCR system is turned off the operator shall keep record of time/date and, if possible, the reason (fault code) for activation of the lamp.
The SCR-systems starts dozing urea automatically when working temperature allows it. Normally this will take approximately 10 - 15 minutes at 50 % engine load.

3.1.1 Urea Dosing and quality detection

The Urea quality can be any blend between 32,5% to 40% and dosing is based on the values measured by the Urea-quality sensor. NOx-sensors ensure correct amount of DEF is dosed to meet required tailpipe emissions.

3.1.2 Excessive slip (NH_3) monitoring

The dosing method and SCR will keep the NH3 slip relative low, even if the ASC (Ammonia Slip Catalyst) is not working. If both the SCR and ASC, for some reason, would be heavily reduced in efficiency. For example after an fully HC saturated exothermic in SCR / ASC the NH_3 levels can go high. This would trigger AFT efficiency monitoring test, since NOx sensor post SCR will read high NOx levels (although its

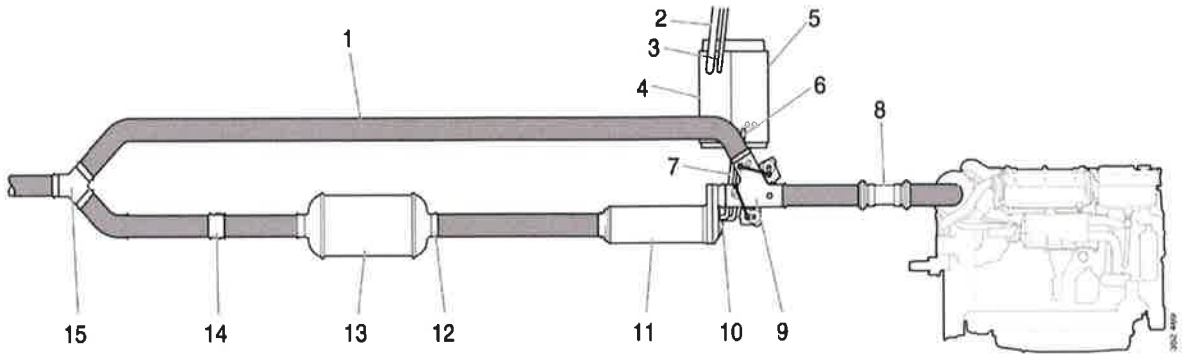
actually NH_3 levels). NH_3 slip levels with everything working as normal is <5 ppm. NH_3 with total "dead "ASC is <100 ppm. NH_3 levels when yellow (amber) warning light triggered from the SCRX test, is typically 500 ppm.

3.1.3 Auxiliary emission control strategy

If there is a risk for large hydrocarbon storage, extremely warm SCR-temperature or fault code indicating high SCR backpressure, the system will automatically bypass the SCR.

Approval No EIAPP-F-173245-0026
Page 11 of 22

3.2 Correct placing of components in SCR-system



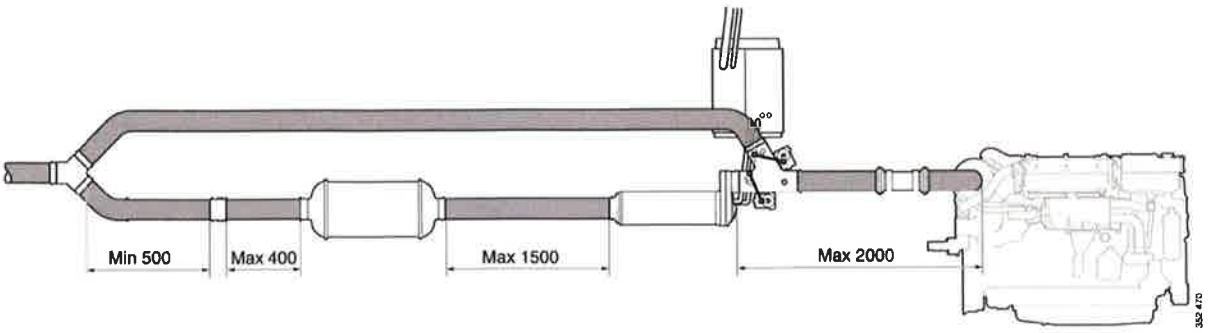
Pos.	Component	Component delivered with the engine from the factory	Component/part to be installed in the vessel together with the engine
1	By-pass tube		X
2	Return pipe for urea to holding tank		X
3	Pipe from holding tank		X
4	Reductionfluid tank	X	X
5	SCR-electronic control unit and urea pump	X	X
6	Return pipe for urea to urea pump		X
7	Return pipe for urea to urea dosing device		X
8	Exhaust flange		X
9	By-pass valve	X	X
10	Urea dosing device	X	
11	Evaporator / Mixer	X	X
12	Exhaust temperature sensor, 2 pc.	X	X
13	SCR.catalyst	X	X
14	Exhaust pipe with 1 pc NOx sensor and 1 pc exhaust temperature sensor	X	X
15	Y-conector		X

Component delivered with the engine from the factory means the components included in the SCR-system are delivered by Scania.

Component/part to be installed in the vessel together with the engine means that those parts are not always delivered by Scania. The ship builder orders those parts/pipes by their own suppliers and shall use the installation handbook (delivered with the engine) to install the completet system. The yellow (amber) warning lamp and red stop light are to be installed by the ship builder and shall be clearly marked as indicator lights for SCR-system. The design of the different exhaust pipe parts is very much depending on the engine compartment design and are therefore not delivered by Scania.

There are no restrictions on the installation of the catalytic converter concerning vertical or horizontal installation. The flow direction is marked on the converter.

3.3 Approved length of piping



From	To	Length of pipe (mm)
Turbocharger	Evaporators inlet	Max 2000
Evaporators outlet	SCR-catalyst inlet	Max 1500
SCR-catalyst outlet	Pipe with NOx-sensor	Max 400
Pipe with NOx-sensor	Y-connector or exhaust outlet	Min 500
Exhaust pipe diameter		127 mm (5 inches)
Max **allowed** backpressure without aftertreatment device is 150 mbar in by-pass mode		

Engine	Application	Usage mode	Power [kW]	Engine speed [rpm]	Max allowed exhaust static back pressure [mbar] with aftertreatment device
DI13 092M	C1 / E3	IMO Tier 3	257	1800	180
DI13 092M	C1 / E3	IMO Tier 3	294	1800	210
DI13 092M	C1 / E3	IMO Tier 3	331	1800	240
DI13 092M	C1 / E3	IMO Tier 3	368	1800	270
DI13 092M	C1 / E3	IMO Tier 3	405	1800	300

3.3.1 Approved exhaust pipe bends

The sum of the exhaust pipe bends between the turbocharger outlet and the SCR catalyst inlet must not exceed 540 °. Example:

Maximum angle before SCR-catalyst	No. of 90° exhaust bends	No. of 45° exhaust bends
540°	4 pcs.	4 pcs.
540°	6 pcs.	0 pcs.

Exhaust bends radius should be at least 1.5 x the pipe diameter, based on 127 mm pipe diameter (5 inches).

Note!
No exhaust pipe bends shall be installed between the SCR catalyst outlet and NOx sensor.

3.4 Verification of SCR and ERV with help of diagnose and warning system

The engine and aftertreatment rely on advanced diagnose to point out if there is something wrong. To control that the engine and aftertreatment is working as intended it is therefore important to verify the diagnose and corresponding alarm signal. If not, a yellow (amber) warning light will be illuminated to inform the operator/surveyor that something is wrong. Verify correct function of the SCR and ERV (Emission Routing valve) is done according to chapter 3.4.1 and 3.4.2 below:

3.4.1 Verification of SCR with help of diagnose and warning system

A) First check the log book for previous failures and if there have been any check that they have been corrected.

B) Check that the yellow (amber) light is not permanently illuminated by the following procedure:
If engine is running: check if the yellow warning light is illuminated or not.
If engine is not running: turn the ignition key on, without starting the engine.
If the warning light is permanently illuminated, there is something wrong with the engine, or its aftertreatment system, that needs to be rectified. Note! The yellow (amber) light shall light up at key-on for a few seconds and then go off (read chapter 3.4.3 for more information of warning lights).

C) If any doubt that the warning light is not installed in a correct manner and/or is not working as intended, then perform the following procedure:

- ✓ Turn the ignition key on without starting the engine.
- ✓ Disconnect one of the NOx-sensor in the after-treatment system from the electrical harness.
- ✓ Start the engine.
- ✓ Idle the engine for >= 1 minute.
- ✓ Check that yellow (amber) warning light is activated. This is an indication that the SCR-system and its diagnose and alarm signals are working as intended. This also means that the engine will operate with acceptable NOx emissions during normal operation.
- ✓ Stop the engine and connect the NOx-sensor back into the electrical harness.
- ✓ Start the engine and idle for > 1 minute.
- ✓ Check that the yellow (amber) warning light is no longer illuminated.
- ✓ Test is completed. Engine and after treatment are working as intended and is ready to use in normal operation again.

3.4.2 Verification of ERV with help of diagnose and warning system

A) First check the log book for previous failures and if there have been any check that they have been corrected.

B) Check that the yellow (amber) light is not permanently illuminated by the following procedure:
If engine is running: check if the yellow warning light is illuminated or not.
If engine is not running: turn the ignition key on, without starting the engine.
If the warning light is permanently illuminated, there is something wrong with the engine, or its aftertreatment system, that needs to be rectified. Note! The yellow (amber) light shall light up at key-on for a few seconds and then go off (read chapter 3.4.3 for more information of warning lights).

C) If any doubt that the warning light is not installed in a correct manner and/or is not working as intended, then perform the following procedure:

- ✓ Turn the ignition key on without starting the engine.

- ✓ Start the engine.
- ✓ Secure that IMO Tier III mode is activated.
- ✓ Idle /slightly load the engine until ERV valve routes the exhaust through the SCR converter and closes the by-pass valve (depending on engine temp, the ERV acts directly or after a couple of minutes).
- ✓ Disconnect the exhaust pressure sensor at engine out from the electrical socket. Check that both of the ERV valves goes to by-pass (port valve fully closed and by-pass valve fully open).
- ✓ Check that yellow (amber) warning light is activated. This is an indication that the ERV and its diagnose and alarm signals are working as intended during normal engine operation.
- ✓ Stop engine and connect the pressure-sensor back to the electrical socket.
- ✓ Start the engine, check that desired ECA mode is IMO Tier III.
- ✓ Idle for minimum 3 minutes.
- ✓ Check that the yellow (amber) warning light is no longer illuminated.
- ✓ Check that ERV valves goes to port fully closed and by-phase fully opened.
- ✓ Test is completed. Engine and aftertreatment are working as intended and is ready to use in normal operation again.

3.4.3 Warning lights for UDS- / AFT- and ERV-Diagnose

Two warning lights are used as alarm for faults in the *AFT* (after treatment including the SCR), *UDS* (Urea Dosing System) and the *ERV* (Emission Routing Valve, by-pass). The DTC (Diagnostic Trouble Code) is either triggered in the UDS controller (EEC3) and sent by CAN to the EMS (S8) so that the EMC can trigger the alarm lamps, or directly in the EMS (S8). No lamps are triggered directly from UDS controller (EEC3).

The different fault codes and the CAN-messages can be accessed via the connector on the engine ECU-socket with a scan-tool and visualised on the display/physical lamps used for the engine, where the shipbuilder is responsible to install warning lights.

Yellow (amber) warning lamp is used for several emission related faults. For example emission related faults in the SCR-system. If illuminated there is something wrong with the engine or aftertreatment that must be rectified.

Red stop lamp is used for very urgent faults. Today only two DTC connected to UDS/ AFT /ERV trigger the red lamp. This is *Plausible Exotherm in the After treatment* and *Invalid Data Received From Reductant Control Module* (diagnose indicating exotherm doesn't work). There is also a workshop test that triggers red stop lamp, this is the simulated exotherm active diagnostic.

4. Specification of the SCR-system and parts.

Catalytic converter:

Manufacturer(s):	Haldor Topsoe
Type(s):	DNXR 805
Number of catalytic converters and elements:	1 (zone coated Ammonia Slip Cat. in tail)
Number of blocks within the catalytic converter:	1
Number of layers within the catalytic converter:	1
Volume of the catalytic converter(s):	32 + 5.2 Litres
Type of catalytic action:	NOx Reduction, NH3 reduction
Substrate (structure and material):	Honeycomb – TiO_2
Cell density:	260 $\pm$ 10 CPSI
Type of casing for the catalytic converter(s):	Sheet metal
Consumable reagent (where appropriate):	Urea
Normal operational temperature range of reagent:	- 5 - + 50 °C
International standard (where appropriate):	ISO 22241

5. Test reports for parent engine

5.1 Engine Information

Manufacturer	SCANIA CV AB				
Family Identification	DI13 092M				
Engine intended for cycle	**E3**	**C1**			
Engine type, parent engine (tested engine)	DI13 092M				
Serial number, test engine	6233014				
Rated speed	1800				r/min
Rated power	405				kW
Intermediate speed	N/A	1300			r/min
Maximum torque at intermediate speed	N/A	2581			Nm
Static injection pump timing	N/A	N/A			° BTDC
Electronic injection control	Yes	Yes			
Variable injection timing	Yes	Yes			
Variable turbo charger geometry	No	No			
Cylinder number and configuration	6, in-line	6, in-line			
Nominal compression ratio	17.3	17.3			
Mean effective pressure at rated power		21.2			bar
Max cylinder pressure at rated power		178.7			bar

5.2 Specified ambient conditions

Nominal coolant into engine *	40	40			° C
Nominal charge air temperature, if applicable **(Applies for keel cooling engines)**	44	44			° C
Cooling system spec: Intermediate cooler	Yes	Yes			
Cooling system spec: Charge air stages	1	1			
L/H temp cooling system set points	N.A.	N.A.			
Maximum inlet depression	-30	-30			mbar
Exhaust back pressure (A-T connected / Not connected) at the actual test.	150 / 400	150 / 400			mbar
Fuel specification	Acc. To ISO-F-DM4				
Fuel temperature	38	38			° C
Lubricating oil specification	Acc. to ACEA E3, E4 or better, also see Operator's manual				

* Applies for keel cooling engines

5.3 Application / Intended for

Customer	X	X			
Final application/installation: Ship	X	X			
Final application/installation: Engine	Main E3	Main C1			

5.4 Emission test results

Cycle	**E3**	**C1**			
NOx Tier III	1.70	1.72			g/kWh
Test identification					
Date					
Test site: Scania Engine Lab, cell No.					
Test number					
Surveyor	DNV GL, Dipl.-Ing. Claus Kurok				
Date and place of report	2015-10-12 Södertälje				
Signature					

5.5 Injection Rate Urea

Injection rate of reductant at each load point (kg/h) in the E3 cycle				
Speed rpm	1800	1638	1440	1134
Power kW	405	304	202	101
Torque NM	2147	1771	1341	854
Urea g/min	123	116	77	26
Urea Dosing Kg/h	7.40	6.94	4.63	1.58

Injection rate of reductant at each load point (kg/h) in the C1 cycle								
Speed rpm	1800	1800	1800	1800	1300	1300	1300	650
Power kW	405	304	203	41	351	264	176	1
Torque NM	2149	1611	1075	216	2581	1936	129	20
Urea g/min	117	113	76	0	98	96	66	0
Urea Dosing Kg/h	7.00	6.78	4.57	0.00	5.88	5.77	3.95	0.00

Pressure drop and exhaust temp before and after the SCR was not measured at this test.

5.6 Engine family information

Combustion cycle	4 stroke
Cooling medium	50/50 Water/Glycol coolant
Cylinder configuration	6 in-line
Method of aspiration	Pressure charger, turbo charger
Fuel type to be used on board	Distillate
Combustion chamber	Open chamber
Valve port configuration	Cylinder head cross flow
Valve port number and size	2 inlet Ø 34,8 mm, 2 outlet Ø 35 mm
Fuel system type	Electronic unit injectors, PDE

5.7 Miscellaneous features

Exhaust gas recirculation	No
Water injection/emulsion	No
Air injection	No
Charge cooling system	Yes, air-to-water charge air cooling
Exhaust aftertreatment	Yes for Tier III compliance
Exhaust aftertreatment type	Selective Catalytic Reduction, SCR
Dual fuel	No

5.8 Test cell information

Test Cell: L9		Tested running cycle: E3, C1		Date:	
Exhaust pipe					
Diameter	mm	125			
Length	m	4			
Insulation		N/A			
Probe location	mm	Length of straight pipe from probe: upstream ~1000 downstream ~300.			
Remark					
Measurement equipment				**Calibration**	
Analyser	**Manufacturer**	**Model**	**Measurement range**	**Span gas conc.**	**Deviation**
NO_x analyser	Horiba	CLA-755A	500/5000 ppm	490.3 / 4863 ppm	± 1%
CO analyser	Horiba	AIA-721	5000 ppm	4949 ppm	± 1%
CO_2 analyser*	Horiba	AIA-722	15%	14.78 %	± 1%
O_2 analyser*	Horiba	MPA-720	25%	24.52 %	± 1%
HC analyzer	Horiba	FIA-725A	500/5000 ppm	162/1604 ppm	± 1%
Speed	Leine & Linde	865	0 - 4000 r/m		
Torque	HBM	T12	0 - 10 kNm	-2000 - 4000 Nm	± 10Nm
Air flow	ABB	Sensyflow P	0(200) - 4000 kg/min	197-3885 kg/h	± 1%
Temperatures					
Coolant	Pentronic	PT100	0 - 250 °C	0/150 °C	± 0,25%
Lubricant	Pentronic	PT100	0 - 250 °C	0/150 °C	± 0,25%
Exhaust gas	Pentronic	Termoelement Typ K	0 - 1200 °C	600 °C	± 0,4%
Inlet air	Pentronic	PT100	0 - 250 °C	0/150 °C	± 0,25%
Intercooled air	Pentronic	PT100	0 - 250 °C	0/150 °C	± 0,25%
Fuel	Pentronic	PT100	0 - 250 °C	0/150 °C	± 0,25%
Pressures					
Exhaust gas	Keller	PX-23X	0-500 mbar	0-500 mbar	± 0,2% fs
Inlet manifold	Keller	PD-39X	± 300 mbar	± 300 mbar	± 0,2% fs
Atmospheric	Vaisala	PTB 330	500 - 1100 mbar	500-1100 mbar	± 0,3 mbar
Vapour pressure					
Intake air	N/A				
Humidity					
Intake air	Mitchell	OPTIDEW	-40 - +90 Cdp	-25 - +15 Cdp	0,4 Cdp

Test fuel characteristics					
Fuel type	Diesel fuel acc. ISO-F-DMA				
Properties					
Density	ISO 3675	835.3	kg/m³		
Viscosity	ISO 3104:94/COR 1:97	2.696	mm²/s		
Fuel elemental analysis and test methods					
Carbon	ASTM D 5291-10	86.6	% mass		
Hydrogen	ASTM D 5291-10	13.5	% mass		
Nitrogen	ASTM D4629-08	<0.0003	% mass		
Oxygen	SS-EN 12205:1996	< 0.1	% mass		
Sulphur	SS-EN 20846:2004	0.0007	% mass		
Energy	SS 15 51 38:1992	42.93	MJ/kg		

5.9 Emission test reports

E3 MARINE EMISSIONS

Engine name : DI13092M	Date : 2015/10/13	Protocol : 69097744			
Mode		1	2	3	4
Power %	[]	100	75	50	25
Speed %	[rpm]	100	91	80	63
Start time	[min]	10	20	30	40
Engine performance data					
Engine power	[kW]	405	304	202	101
Engine speed	[rpm]	1800	1638	1440	1134
Fuel consumption	[g/kWh]	198,4	190,6	191,5	199,6
Fuel mass flow	[kg/h]	80,311	57,924	38,755	20,231
Coolant temperature before engine	[°C]	40,5	40,7	40,9	40,8
Coolant temperature after engine	[°C]	45,0	43,2	41,7	40,9
Charge air outlet temperature	[°C]	50,4	45,7	42,4	40,5
Charge air reference temperature	[°C]	50,4	45,7	42,4	40,5
Charge air pressure	[bar]	1,71	1,25	0,74	0,29
Ambient and gasesous emission data					
Barometric pressure of testbed	[mbar]	1023,4	1023,4	1023,3	1023,2
Temperature of engine air inlet	[°C]	25,5	25,5	25,5	25,6
Abs. humdity at engine	[g/kg]	10,55	10,44	10,37	10,61
Relative humidity	[%]	52,76	52,42	51,91	52,61
Dewpoint temperature	[°C]	15,1	15,0	14,8	15,1
Massflow air	[kg/h]	1878,8	1441,1	977,0	585,6
Atmospheric factor (fa)	[-]	0,98	0,98	0,98	0,98
NOx Wet	[ppm]	204,0	226,0	204,4	203,0
HC Wet	[ppm]	7,6	6,3	4,2	3,9
CO Concentration dry	[ppm]	35,2	40,3	38,5	9,6
CO2 Concentration dry	[%]	9,50	8,89	8,70	7,59
O2 Concentration dry	[%]	7,68	8,46	8,72	10,26
Exhaust temperature at sampl.point	[°C]	419	372	337	265
Exhast back pressure at sampl.point	[mbar]	303,88	186,58	96,76	39,30
Air fuel ratio	[-]	0,04	0,04	0,04	0,03
Correction factors					
Correction factor NOx	[-]	1,00	1,00	1,00	1,00
Dry to wet correction	[-]	0,92	0,92	0,93	0,93
Calculated gas mass flow					
NOx	[g/s]	0,18	0,15	0,09	0,05
HC	[g/s]	0,00	0,00	0,00	0,00
CO	[g/s]	0,02	0,01	0,01	0,00
CO2	[g/s]	72,16	51,94	34,48	18,12
O2	[g/s]	42,38	35,93	25,12	17,81
Exhaust mass flow (Wet)	[kg/h]	1959,1	1499,1	1015,7	605,9
Calculated specific emissions					
NOx	[g/kWh]	1,566	1,767	1,624	1,927
HC	[g/kWh]	0,018	0,015	0,010	0,011
CO	[g/kWh]	0,151	0,178	0,173	0,052
CO2	[g/kWh]	641,646	615,439	613,256	643,805
O2	[g/kWh]	376,837	425,686	446,819	632,656

Specific emissions : E3						Sum
E3 Weighting factors	[-]	0,20	0,50	0,15	0,15	1
Weighted power	[kW]	80,972	151,925	30,363	15,202	**278,462**
NOx	[g/kWh]	0,455	0,964	0,177	0,105	**1,70**
HC	[g/kWh]	0,005	0,008	0,001	0,001	**0,01**
CO	[g/kWh]	0,044	0,097	0,019	0,003	**0,16**
CO2	[g/kWh]	186,579	335,775	66,869	35,147	**624,37**

Approval No EIAPP-F-173245-0026
Page 21 of 22

C1 MARINE EMISSIONS

Engine name:		D13 92M	Date:	2015-10-13			Protocol:	69097745	
Mode		1	2	3	4	5	6	7	8
Torque %	-	100	75	50	10	100	75	50	0
Speed	rpm	Rated				Intermediate			Idle
Start time	min	10	20	30	40	50	60	70	80
Engine performance data									
Engine Power Uncorrected (EM00)	kW	405	304	203	41	351	264	176	1
Speed (NM00)	rpm	1800	1800	1800	1800	1300	1300	1300	650
Fuel Consumption Uncorrected (QB01)	g/kWh	198,4	194,2	199,3	317,2	192,6	190,4	192,5	2102,2
Fuel mass flow (QB00)	g/min	1339,8	983,2	673,1	214,6	1127,6	836,1	563,5	25,1
Charge air temperature (TL30)	°C	50,3	46,3	42,9	40,5	46,8	43,9	41,8	38,6
Charge air reference temperature	°C	50,30	46,30	42,90	40,50	46,80	43,90	41,80	38,60
Charge air pressure (PL30)	bar	1,71	1,22	0,74	0,16	1,72	1,11	0,61	0,00
Ambient and gaseous emission									
Barometric pressure of intake air (PL00)	mbar	1023,2	1023,2	1023,2	1022,8	1023,0	1023,0	1023,0	1023,0
Temperature of intake air (TL15)	°C	25,50	25,50	25,40	25,30	25,50	25,60	25,60	25,90
Humidity of intake air (RL13)	g/kg	10,51	10,43	10,64	10,53	10,51	10,59	10,34	10,55
Intake air mass flow (QL01)	kg/min	31,30	26,00	20,70	13,80	22,60	17,70	13,60	4,40
Dewpoint temperature (TL03)	°C	15,00	14,88	15,19	15,02	15,00	15,11	14,75	15,05
Atmospheric factor (fa)	-	0,98	0,98	0,98	0,98	0,98	0,98	0,98	0,98
NOx Wet (RG26)	ppm	209,0	183,0	140,0	296,0	261,0	198,0	157,0	216,0
CO Dry (RG27)	ppm	34,0	29,0	17,0	92,0	72,0	86,0	37,0	41,0
HC Wet (RG25)	ppm	6,2	7,6	9,5	68,2	3,5	2,8	2,9	62,1
Exhaust temperature (TG21) at sampling point	°C	419	360	306	184	438	398	334	100
Exhaust back pressure (PG23) at sampling point	mbar	304,6	207,0	129,3	15,9	197,5	126,7	75,0	-0,4
Air fuel ratio (RL06)	-	0,04	0,04	0,03	0,02	0,05	0,05	0,04	0,01
Correction factors									
NOx humidity correction factor CCNR (K_{HMES})	-	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Fuel specific factor (F_{FH})	-	1,89	1,90	1,91	1,94	1,88	1,88	1,89	1,96
Dry to wet correction for CO (RG19)	-	0,90	0,91	0,92	0,95	0,89	0,89	0,90	0,97
Humidity correction factor for particulates	-	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
fa correction factor for particulates (K_{fa})	-	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02
Calculated gas mass flow									
NOx (IMO)	kg/h	0,65	0,47	0,28	0,39	0,59	0,35	0,21	0,09
CO	kg/h	0,06	0,04	0,02	0,07	0,09	0,08	0,03	0,01
HC	kg/h	0,01	0,01	0,01	0,03	0,00	0,00	0,00	0,01
Exhaust mass flow Wet (QG24)	kg/h	1959,8	1618,6	1280,4	841,5	1424,3	1110,2	849,0	266,0
Calculated specific emission									
NOx (IMO)	g/kWh	1,603	1,543	1,402	9,629	1,679	1,322	1,199	91,233
CO	g/kWh	0,143	0,136	0,095	1,733	0,251	0,311	0,155	10,219
HC	g/kWh	0,014	0,019	0,029	0,670	0,007	0,006	0,007	7,912
Calculated specific emission									Sum
C1 Weighting factors	-	0,15	0,15	0,15	0,10	0,10	0,10	0,10	0,15	1,000
Weighted power	kW	60,750	45,600	30,450	4,100	35,100	26,400	17,600	0,150	220,150
NOx (IMO)	g/kWh	0,442	0,320	0,194	0,179	0,268	0,158	0,096	0,062	**1,72**
CO	g/kWh	0,039	0,028	0,013	0,032	0,040	0,037	0,012	0,007	**0,21**
HC	g/kWh	0,004	0,004	0,004	0,012	0,001	0,001	0,001	0,005	**0,03**

Mean effective pressure at rated speed (PM00)	bar	21,2	**SPECIFIC PARAMETERS**						
Max cylinder pressure at rated speed (PM01)	bar	178,7							
Coolant temperature before engine (TW54)	°C	39,8	41	40,7	40,8	40,5	40,6	40,8	39,2
Coolant temperature after engine (TW50)	°C	44,4	43,5	41,8	40,9	43,4	42,5	41,5	38,9
Lubricant temperature after oil cooler (TO05)	°C	94	91	86	78	92	89	85	71
Lubricant pressure after filter (PO07)	bar	4,29	4,41	4,56	4,9	3,8	3,92	4,11	2,58
Coolant pressure (PX11)	bar	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Maximum inlet depression (PL17)	mbar	29	20	13	6	16	10	6	1
CO_2 Concentration dry (RG28)	%	9,51	8,3	7,08	3,24	11,11	10,52	9,07	1,2
O_2 Concentration Wet (RG29)	%	76722,0	92810,0	109705,0	162516,0	54715,0	62758,0	82511,0	192022,0
Maximum torque at rated speed	Nm	2149							
Maximum torque	Nm	2581	***The blue rows are directly copied from the test protocol***						
Speed at maximum torque	rpm	1300							
Idle speed	rpm	650							
Fuel injection / stroke at Rated Power	-	248,0							
Fuel injection / stroke at Maximum torque	-	289,0							

DNV·GL

ENGINE INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

Certificate no.:
EIAPP-F-173245-0027

Issued under the provisions of the Protocol of 1997, as amended by resolution MEPC.176(58) in 2008, to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified of the Protocol of 1978 related thereto (hereinafter referred to as "the Convention")
under the authority of the Government of

SWEDEN

by **DNV GL**

Particulars of the engine:

Engine manufacturer:	**Scania CV AB**
Model number:	**DI13092M**
Serial number:	**7264346**
Test cycle(s):	**C1 / E3**
Rated power [kW] and speed [rpm]:	**405 @ 1800**
Engine approval number:	**EIAPP-F-173245-0027**

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 2008 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 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 **Hamburg** on **2021-01-05**

This document is signed electronically in accordance with IMO FAL. 5/Circ.39/Rev.2. Validation and authentication can be obtained from trust.dnvgl.com by using the Unique Tracking Number (UTN): EIAPP-F-173245-0027

Fabian Kock
Head of Section Environmental Certification

Certificate no.: EIAPP-F-173245-0027

SUPPLEMENT TO ENGINE INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

RECORD OF CONSTRUCTION, TECHNICAL FILE AND MEANS OF VERIFICATION

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 The Record shall be at least in English, French or Spanish. If an official language of the issuing country is also used, this shall prevail in case of a dispute or discrepancy.

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 verifications refer to mandatory requirements from the NOx Technical Code 2008.

1. Particulars of the engine

1.1	Name and address of manufacturer	**Scania CV AB Vagnmakarvägen 1 Södertälje, Sweden**	
1.2	Place of engine build	**Södertälje, Sweden**	
1.3	Date of engine build		**2020**
1.4	Place of pre-certification survey	**Södertälje, Sweden**	
1.5	Date of pre-certification survey		**2020**
1.6	Engine type and model number		**DI13092M**
1.7	Engine serial number		**7264346**
1.8	If applicable, the engine is a parent engine ☐ / of the following engine family ☑	or a member engine ☑ / or engine group ☐	
		DI13092M	
	As approved with approval no.	**EIAPP-F-173245**	

1.9 Individual engine or engine family/engine group details:

1.9.1	Approval reference	**EIAPP-F-173245-0027**
1.9.2	Rated power (kW) and rated speed (rpm) values or range	**405 @ 1800**
1.9.3	Test cycle(s)	**C1 / E3**
1.9.4	Parent engine(s) test fuel oil specification	**ISO-F-DMA**
1.9.5	Applicable NOx emission limit (g/kWh), regulation 13.3, 13.4, 13.5.1	**10.0, 7.8, 2.0 / 10.0, 7.8, 2.0**
1.9.6	Parent engine(s) emission value (g/kWh)	**1.7, 1.7, 1.7 / 1.7, 1.7, 1.7**

2. Particulars of the technical file

The technical file, as required by chapter 2 of the NOx Technical Code 2008, is an essential part of the EIAPP Certificate and must always accompany an engine throughout its life and always be available on board a ship.

2.1	Technical file identification/approval number	**EIAPP-F-173245-0027**
2.2	Technical file approval date	**2021-01-05**

3. Specifications for the onboard NOx verification procedures

The specifications for the on board NOx verification procedures, as required by Ch. 6 of the NOx Technical Code 2008, are an essential part of the EIAPP Certificate and must always accompany an engine through its life and always be available on board a ship.

3.1	Engine parameter check method:	
3.1.1	Identification/approval number	**EIAPP-F-173245-0027**
3.1.2	Approval date	**2021-01-05**
3.2	Direct measurement and monitoring method:	
3.2.1	Identification/approval number	-
3.2.2	Approval date	-

Alternatively the simplified measurement method in accordance with 6.3 of the NOx Technical Code 2008 may be utilized.

Issued at **Hamburg** on **2021-01-05**

This document is signed electronically in accordance with IMO FAL. 5/Circ.39/Rev.2. Validation and authentication can be obtained from trust.dnvgl.com by using the Unique Tracking Number (UTN): EIAPP-F-173245-0027

Fabian Kock
Head of Section Environmental Certification

TECHNICAL DOCUMENTS

According to

Revised MARPOL Annex VI and NOx Technical Code 2008

Applies for:

Engine type	**DI13 092M**
Engine number	**7264346**
Power (kW)	**405 kw**
Rated speed (rpm)	**1800 rpm**
Engine built	**2020**
Engine family	**DI13 092M**
Approval number	**DNV GL EIAPP-F-173245**

APPROVED

EIAPP-F-173245-0027

SEE LETTER

Date: 2021-01-05

Table of Contents

1. Record of engine performance and emission relevant components and settings 3
1.1 Allowable adjustment of components.....3
1.2 Diesel fuel 3
1.3 Emission relevant components and settings 4
2. On board verification procedure.....5
2.1 Marking emission related engine components 6
2.2 Marking emission related SCR components 7
3. SCR System 10
3.1 General description of the SCR system 10
3.1.1 Urea Dosing and quality detection 10
3.1.2 Excessive slip (NH_3) monitoring 10
3.1.3 Auxiliary emission control strategy.....11
3.2 Correct placing of components in SCR-system.....12
3.3 Approved length of piping 13
3.3.1 Approved exhaust pipe bends 13
3.4 Verification of SCR and ERV with help of diagnose and warning system 14
3.4.1 Verification of SCR with help of diagnose and warning system 14
3.4.2 Verification of ERV with help of diagnose and warning system.....14
3.4.3 Warning lights for UDS- / AFT- and ERV-Diagnose 15
4. Specification of the SCR-system and parts.....16
5. Test reports for parent engine.....17
5.1 Engine Information.....17
5.2 Specified ambient conditions 17
5.3 Application / Intended for 18
5.4 Emission test results 18
5.5 Injection Rate Urea 18
5.6 Engine family information.....18
5.7 Miscellaneous features 19
5.8 Test cell information 20
5.9 Emission test reports 21

Approval No EIAPP-F-173245-0027
Page 2 of 22

1. Record of engine performance and emission relevant components and settings

1.1 Allowable adjustment of components

Allowable adjustment of components and settings are described in *chapter 2. On board verification procedure.*

1.2 Diesel fuel

The engine exhaust emissions and power output are dependent on correct fuel quality. The composition of the diesel fuel is vitally important to both engine operation and expected durability of the aftertreatment system and all of its components. The table below shows the requirements for the most important properties. The diesel fuel shall comply with standard: ISO-F-DMA.

Viscosity at 40°C	2.0 - 4.5 mm^2/s (cSt)
Density at 15°C	max 0.845 kg/dm^3
Sulphur (concentration by mass)	max. 0.005%
Ignitability (CET rating)	min. 51
Flashpoint, min	60°C

1.3 Emission relevant components and settings

Selection criteria for parent engine = Max NOx emission, g/kWh

Engine type	**DI13 092M**
Application	E3 / C1
No. of cylinders	6
Rated power, kW	257/294/331/368/**405**
D:o max per cylinder, kW	42.8/49/51.2/61.3/67.5
Rated speed, r/min	1800
Bore / Stroke, mm	130 / 160
Selected parent engine for IMO Tier III	405 kW@1800 rpm
Emission relevant components of the engine	
Cylinder head	2183414
Cylinder head gasket	1893055
Piston	1783533
Connecting rod	2190306
Camshaft	1523424
Turbocharger	1866346
Injector	1734493
Charge air cooler	2481601 Heat exchange (HE), 2156635 Keel cooling (KC)
Test Plan Number	2447715 (257 kW)
	2447716 (294 kW)
	2447717 (331 kW)
	2447768 (368 kW)
	2447769 (405 kW)
Valve clearance* Cold engine: Intake 0.45 mm, outlet 0.70 mm	
SCR-System emission relevant components	
Exhaust Routing Valve (By-pass valve)	2571861
Urea Dosing unit	2722701
Mixing Unit	2173380
SCR Catalytic Converter	2402666
NOx-sensor after SCR-unit	2294291
NOx-sensor at engine outlet	2294290
Urea tank assembly	2596298
Control unit EEC3 (SCR-*ECU*)	1918851
Urea pump	2655852, 2695808
Urea quality sensor	2286102
Temperature sensor	2604683

*Also see label on rocker cover

2. On board verification procedure

The method to verify the on board NOx emissions is the engine parameter check method.
Components and settings to check are listed below:

Engine related components and settings (for markings see 2.1)		
Turbocharger	These components/settings can be checked without dismantling. Location of part numbers see sketches page 6.	No adjustment are allowed
Test plan number, see below		See "Important information" below
Valve clearance		See chapter 1, page 3
Cylinder head	These components can only be checked after dismantling and should only be checked during maintenance or if there is doubt about the correctness of the components. Location of part numbers, see sketches page 6.	No adjustment are allowed
Cylinder head gasket		No adjustment are allowed
Piston		No adjustment are allowed
Connecting rod		No adjustment are allowed
Camshaft		No adjustment are allowed
Charge air cooler		No adjustment are allowed
Injector		No adjustment are allowed
SCR related components and settings (for markings see chapter 2.2)		
SCR system	Some components can be checked without dismantling the system. Location of part numbers, see page 7 - 9.	No adjustment are allowed
SCR software	SCR Software can be verified by a label on the engine control unit, ECU (test plan number), see sketch page 6.	See "Important information" below. No adjustment are allowed
Other SCR related verification (for more details see chapter 3.)		
3.1 General description of the SCR system, maintenance. 3.2 Correct placing of components in SCR-system 3.3 Approved length of piping 3.4 Verification of SCR and ERV with help of diagnose and warning system		No adjustment are allowed

Tier III operation mode (when the SCR-system is activated) in NECA area must be noted in the record book and every time the yellow amber lamp is on shall be recorded.
For details and information of the SCR-system see chapter 3.

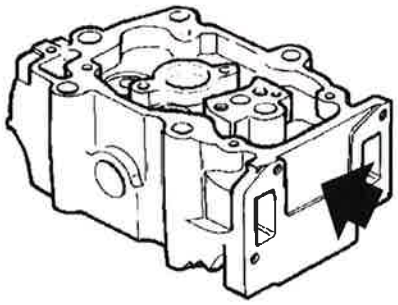
Important information

The injection advance timing of the Engine Control Unit (ECU) is the same for all engines within an engine type. Different ratings, within an engine type, are obtained by variation of the fuel delivery. A test plan number, labelled on the ECU, is introduced for individual combinations of power and speed. The SCR-ECU EEC3 is also covered by the test plan number. Any emission related changes in the ECU or EEC3 will result in a new test plan number.

Modifications and verifications of the software in the ECU and in the EEC3 can only be carried out by Scania authorized service organisation and all program modifications are electronically monitored. Unauthorized access to the ECU and EEC3, the related settings and software will result in immediate suspension of the certificates and breach of the warranties.

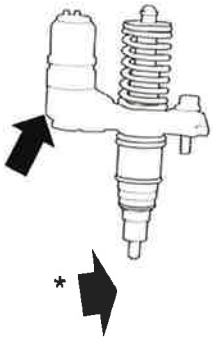
2.1 Marking emission related engine components

Cylinder head

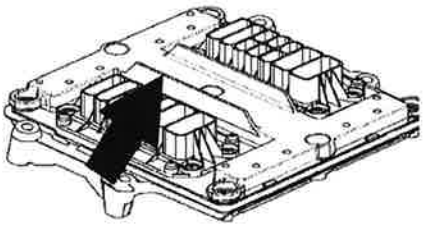


Cylinder head gasket

Injector

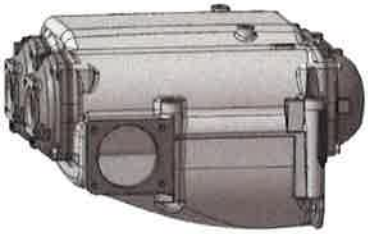


Engine control unit, ECU *Test plan number*

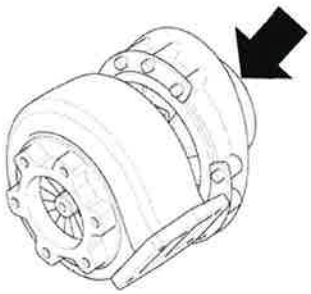


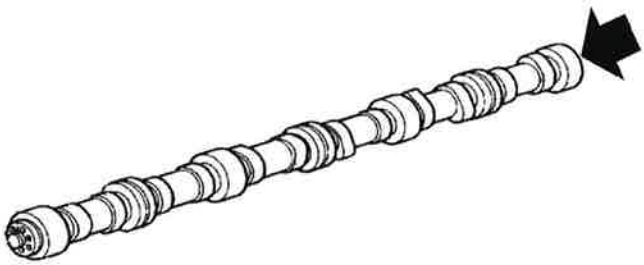
Charge Air Cooler

ID-number inside on cooler



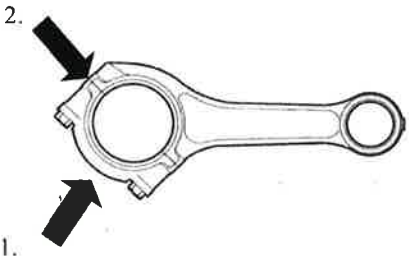
Turbo charger





Camshaft

1. Connecting rod No.
2. Cylinder No. punched when fitted



Piston

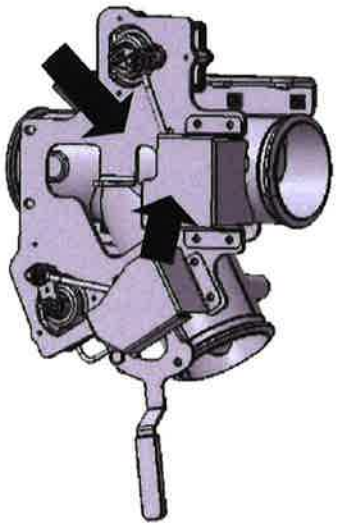
Part No			
* **Injector part No. (see p. 3)**	**Bosch type**	**Marking**
2098522	DLLA 145 P2230	2230

2668318

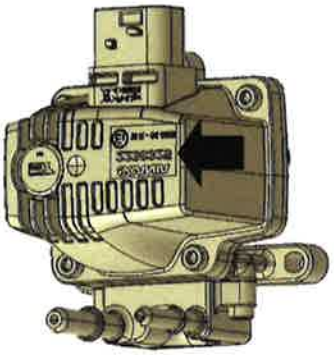
Approval No EIAPP-F-173245-0027
Page 6 of 22

2.2 Marking emission related SCR components

By-Pass valve, part number at the arrow.

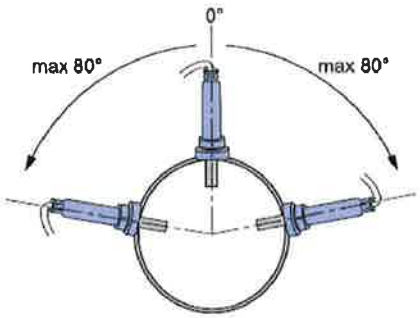


Urea dosing assembly



Mixing unit (Evaporator)

NOx-sensor upstream and downstream

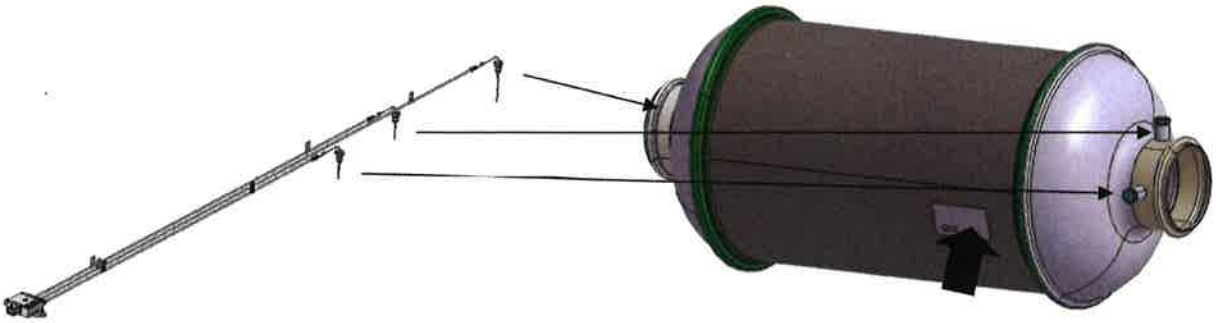


Mounting angles

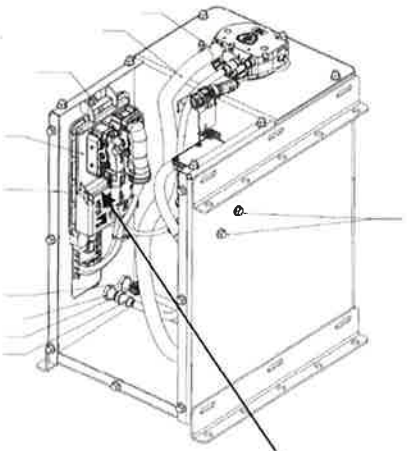
The mixing unit, catalytic converter and the by-pass valve are covered with insulation protection to prevent the exposure of hot surfaces. Part numbers can be shown at maintenance.

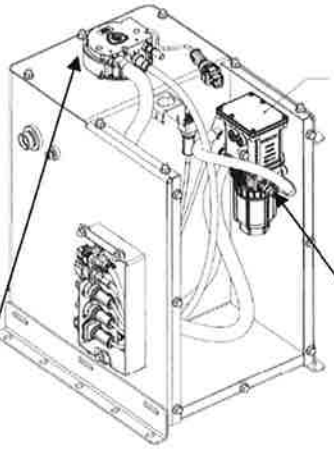
Temperature sensor assy

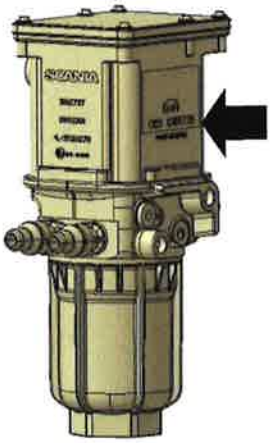
Catalytic converter incl. ammonia slip catalyst



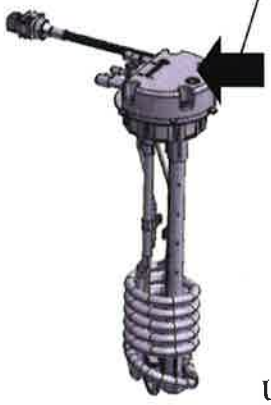
Urea tank







Urea pump, included in the urea tank



Urea quality sensor

Electronic control unit EEC3
ID/Part-number on the back of the EEC3.

SCR control unit EEC3, urea Quality Sensor and Urea pump are built-in into the back of the Urea tank. The ID-numbers are marked on respective part and can be controlled at maintenance.

3. SCR System

3.1 General description of the SCR system

This is a general description of the SCR-system intended to give an overview how the system works. Details to be checked during on board verification are to be found in chapter 3.2-3.4

The complete aftertreatment and the SCR is very robust and are designed to last longer than the base engine. To guarantee emission over time, Scania recommends that for every second engine overhaul the complete aftertreatment system including the SCR should be exchanged. For NOx-sensors, we recommend that they are exchanged at every engine overhaul. Engine overhaul corresponding to 20 000 hour of operation. Advanced diagnose is incorporated in the aftertreatment system and if a component fails before recommended exchange interval it is designed to set a warning light to alert the operator. Two warning lights are used for different type of faults, see chapter 3.4.3 for more information.

The maintenance of the SCR-system is limited to exchange filters in the dosing unit and in the tank. More extensive service is only necessary at engine overhaul where NOx sensor or complete after treatment is recommended to be exchanged. The feedback control of the SCR-system and its integrated diagnose will point out if there is a fault/component that might need change prior to this.

The normal operating temperature for the SCR is between 210 °C and 510 °C.

No additional additives are allowed in the fuel, to prevent contamination of the catalyst and sensors. Extra additives, higher sulphur content, contaminations or solvents will *decrease* the lifetime of the sensors and the catalysts.

If the catalyst is poisoned, for example due to the use of incorrect fuel with a high sulphur content, it is sometimes possible to operate the engine with correct fuel at high load for > 1h to reverse the contamination. Warning light will automatically be turned off if the catalyst contamination is reversed and normal conversion ratio is recovered. No more service would be necessary in these cases.

The SCR-system is a closed loop feedback control system and it continuously monitors the level and quality of Urea in its tank, tailpipe NOx-emissions and the temperature before the catalytic converter to ensure emissions are kept.

The operator shall record time and date when the SCR-system (IMO tier III mode) is activated in NECA area. If the yellow (amber) warning lamp is activated and the SCR system is turned off the operator shall keep record of time/date and, if possible, the reason (fault code) for activation of the lamp.
The SCR-systems starts dozing urea automatically when working temperature allows it. Normally this will take approximately 10 - 15 minutes at 50 % engine load.

3.1.1 Urea Dosing and quality detection

The Urea quality can be any blend between 32,5% to 40% and dosing is based on the values measured by the Urea-quality sensor. NOx-sensors ensure correct amount of DEF is dosed to meet required tailpipe emissions.

3.1.2 Excessive slip (NH_3) monitoring

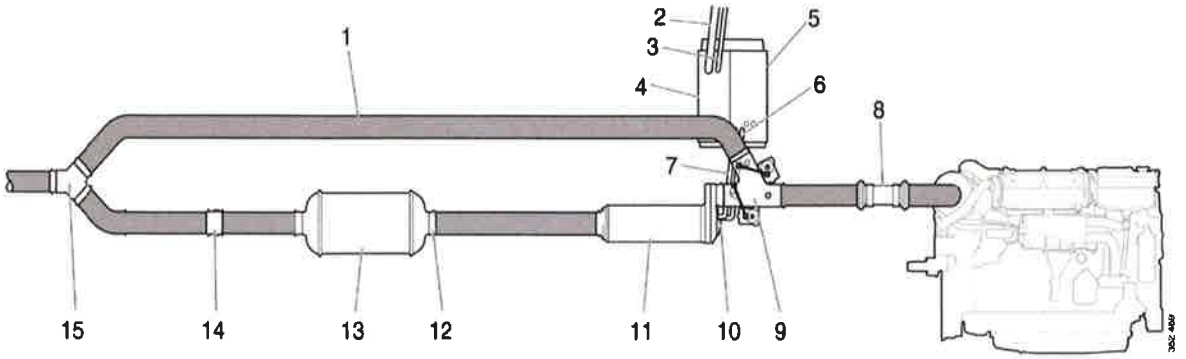
The dosing method and SCR will keep the NH3 slip relative low, even if the ASC (Ammonia Slip Catalyst) is not working. If both the SCR and ASC, for some reason, would be heavily reduced in efficiency. For example after an fully HC saturated exothermic in SCR / ASC the NH_3 levels can go high. This would trigger AFT efficiency monitoring test, since NOx sensor post SCR will read high NOx levels (although its

actually NH_3 levels). NH_3 slip levels with everything working as normal is <5 ppm. NH_3 with total "dead "ASC is <100 ppm. NH_3 levels when yellow (amber) warning light triggered from the SCRX test, is typically 500 ppm.

3.1.3 Auxiliary emission control strategy

If there is a risk for large hydrocarbon storage, extremely warm SCR-temperature or fault code indicating high SCR backpressure, the system will automatically bypass the SCR.

3.2 Correct placing of components in SCR-system



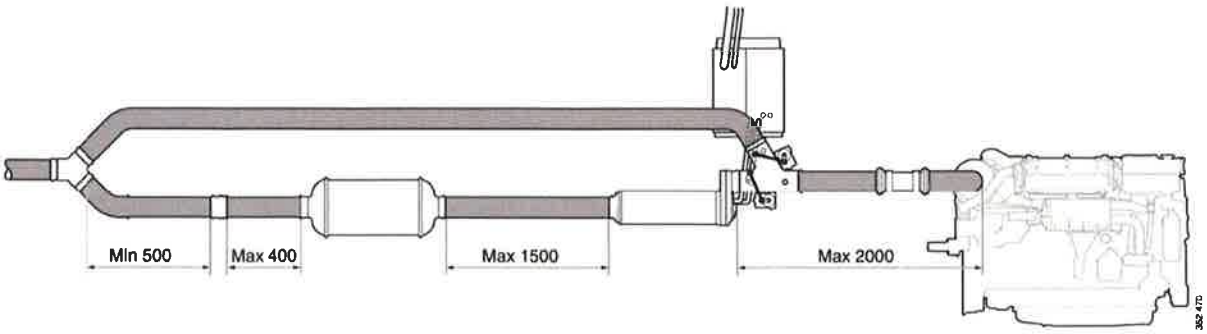
Pos.	Component	Component delivered with the engine from the factory	Component/part to be installed in the vessel together with the engine
1	By-pass tube		X
2	Return pipe for urea to holding tank		X
3	Pipe from holding tank		X
4	Reductionfluid tank	X	X
5	SCR-electronic control unit and urea pump	X	X
6	Return pipe for urea to urea pump		X
7	Return pipe for urea to urea dosing device		X
8	Exhaust flange		X
9	By-pass valve	X	X
10	Urea dosing device	X	
11	Evaporator / Mixer	X	X
12	Exhaust temperature sensor, 2 pc.	X	X
13	SCR.catalyst	X	X
14	Exhaust pipe with 1 pc NOx sensor and 1 pc exhaust temperature sensor	X	X
15	Y-conector		X

Component delivered with the engine from the factory means the components included in the SCR-system are delivered by Scania.

Component/part to be installed in the vessel together with the engine means that those parts are not always delivered by Scania. The ship builder orders those parts/pipes by their own suppliers and shall use the installation handbook (delivered with the engine) to install the completet system. The yellow (amber) warning lamp and red stop light are to be installed by the ship builder and shall be clearly marked as indicator lights for SCR-system. The design of the different exhaust pipe parts is very much depending on the engine compartment design and are therefore not delivered by Scania.

There are no restrictions on the installation of the catalytic converter concerning vertical or horizontal installation. The flow direction is marked on the converter.

3.3 Approved length of piping



From	To	Length of pipe (mm)
Turbocharger	Evaporators inlet	Max 2000
Evaporators outlet	SCR-catalyst inlet	Max 1500
SCR-catalyst outlet	Pipe with NOx-sensor	Max 400
Pipe with NOx-sensor	Y-connector or exhaust outlet	Min 500
Exhaust pipe diameter		127 mm (5 inches)
Max **allowed** backpressure without aftertreatment device is 150 mbar in by-pass mode		

Engine	Application	Usage mode	Power [kW]	Engine speed [rpm]	Max allowed exhaust static back pressure [mbar] with aftertreatment device
DI13 092M	C1 / E3	IMO Tier 3	257	1800	180
DI13 092M	C1 / E3	IMO Tier 3	294	1800	210
DI13 092M	C1 / E3	IMO Tier 3	331	1800	240
DI13 092M	C1 / E3	IMO Tier 3	368	1800	270
DI13 092M	C1 / E3	IMO Tier 3	405	1800	300

3.3.1 Approved exhaust pipe bends

The sum of the exhaust pipe bends between the turbocharger outlet and the SCR catalyst inlet must not exceed 540 °. Example:

Maximum angle before SCR-catalyst	No. of 90° exhaust bends	No. of 45° exhaust bends
540°	4 pcs.	4 pcs.
540°	6 pcs.	0 pcs.

Exhaust bends radius should be at least 1.5 x the pipe diameter, based on 127 mm pipe diameter (5 inches).

Note!
No exhaust pipe bends shall be installed between the SCR catalyst outlet and NOx sensor.

3.4 Verification of SCR and ERV with help of diagnose and warning system

The engine and aftertreatment rely on advanced diagnose to point out if there is something wrong. To control that the engine and aftertreatment is working as intended it is therefore important to verify the diagnose and corresponding alarm signal. If not, a yellow (amber) warning light will be illuminated to inform the operator/surveyor that something is wrong. Verify correct function of the SCR and ERV (Emission Routing valve) is done according to chapter 3.4.1 and 3.4.2 below:

3.4.1 Verification of SCR with help of diagnose and warning system

A) First check the log book for previous failures and if there have been any check that they have been corrected.

B) Check that the yellow (amber) light is not permanently illuminated by the following procedure:
If engine is running: check if the yellow warning light is illuminated or not.
If engine is not running: turn the ignition key on, without starting the engine.
If the warning light is permanently illuminated, there is something wrong with the engine, or its aftertreatment system, that needs to be rectified. Note! The yellow (amber) light shall light up at key-on for a few seconds and then go off (read chapter 3.4.3 for more information of warning lights).

C) If any doubt that the warning light is not installed in a correct manner and/or is not working as intended, then perform the following procedure:

- ✓ Turn the ignition key on without starting the engine.
- ✓ Disconnect one of the NOx-sensor in the after-treatment system from the electrical harness.
- ✓ Start the engine.
- ✓ Idle the engine for >= 1 minute.
- ✓ Check that yellow (amber) warning light is activated. This is an indication that the SCR-system and its diagnose and alarm signals are working as intended. This also means that the engine will operate with acceptable NOx emissions during normal operation.
- ✓ Stop the engine and connect the NOx-sensor back into the electrical harness.
- ✓ Start the engine and idle for > 1 minute.
- ✓ Check that the yellow (amber) warning light is no longer illuminated.
- ✓ Test is completed. Engine and after treatment are working as intended and is ready to use in normal operation again.

3.4.2 Verification of ERV with help of diagnose and warning system

A) First check the log book for previous failures and if there have been any check that they have been corrected.

B) Check that the yellow (amber) light is not permanently illuminated by the following procedure:
If engine is running: check if the yellow warning light is illuminated or not.
If engine is not running: turn the ignition key on, without starting the engine.
If the warning light is permanently illuminated, there is something wrong with the engine, or its aftertreatment system, that needs to be rectified. Note! The yellow (amber) light shall light up at key-on for a few seconds and then go off (read chapter 3.4.3 for more information of warning lights).

C) If any doubt that the warning light is not installed in a correct manner and/or is not working as intended, then perform the following procedure:

- ✓ Turn the ignition key on without starting the engine.

- ✓ Start the engine.
- ✓ Secure that IMO Tier III mode is activated.
- ✓ Idle /slightly load the engine until ERV valve routes the exhaust through the SCR converter and closes the by-pass valve (depending on engine temp, the ERV acts directly or after a couple of minutes).
- ✓ Disconnect the exhaust pressure sensor at engine out from the electrical socket. Check that both of the ERV valves goes to by-pass (port valve fully closed and by-pass valve fully open).
- ✓ Check that yellow (amber) warning light is activated. This is an indication that the ERV and its diagnose and alarm signals are working as intended during normal engine operation.
- ✓ Stop engine and connect the pressure-sensor back to the electrical socket.
- ✓ Start the engine, check that desired ECA mode is IMO Tier III.
- ✓ Idle for minimum 3 minutes.
- ✓ Check that the yellow (amber) warning light is no longer illuminated.
- ✓ Check that ERV valves goes to port fully closed and by-phase fully opened.
- ✓ Test is completed. Engine and aftertreatment are working as intended and is ready to use in normal operation again.

3.4.3 Warning lights for UDS- / AFT- and ERV-Diagnose

Two warning lights are used as alarm for faults in the *AFT* (after treatment including the SCR), *UDS* (Urea Dosing System) and the *ERV* (Emission Routing Valve, by-pass). The DTC (Diagnostic Trouble Code) is either triggered in the UDS controller (EEC3) and sent by CAN to the EMS (S8) so that the EMC can trigger the alarm lamps, or directly in the EMS (S8). No lamps are triggered directly from UDS controller (EEC3).

The different fault codes and the CAN-messages can be accessed via the connector on the engine ECU-socket with a scan-tool and visualised on the display/physical lamps used for the engine, where the shipbuilder is responsible to install warning lights.

Yellow (amber) warning lamp is used for several emission related faults. For example emission related faults in the SCR-system. If illuminated there is something wrong with the engine or aftertreatment that must be rectified.

Red stop lamp is used for very urgent faults. Today only two DTC connected to UDS/ AFT /ERV trigger the red lamp. This is *Plausible Exotherm in the After treatment* and *Invalid Data Received From Reductant Control Module* (diagnose indicating exotherm doesn't work). There is also a workshop test that triggers red stop lamp, this is the simulated exotherm active diagnostic.

4. Specification of the SCR-system and parts.

Catalytic converter:

Manufacturer(s):	Haldor Topsoe
Type(s):	DNXR 805
Number of catalytic converters and elements:	1 (zone coated Ammonia Slip Cat. in tail)
Number of blocks within the catalytic converter:	1
Number of layers within the catalytic converter:	1
Volume of the catalytic converter(s):	32 + 5.2 Litres
Type of catalytic action:	NOx Reduction, NH3 reduction
Substrate (structure and material):	Honeycomb – TiO_2
Cell density:	260 $\pm$ 10 CPSI
Type of casing for the catalytic converter(s):	Sheet metal
Consumable reagent (where appropriate):	Urea
Normal operational temperature range of reagent:	- 5 - + 50 °C
International standard (where appropriate):	ISO 22241

5. Test reports for parent engine

5.1 Engine Information

Manufacturer	SCANIA CV AB				
Family Identification	DI13 092M				
Engine intended for cycle	**E3**	**C1**			
Engine type, parent engine (tested engine)	DI13 092M				
Serial number, test engine	6233014				
Rated speed	1800				r/min
Rated power	405				kW
Intermediate speed	N/A	1300			r/min
Maximum torque at intermediate speed	N/A	2581			Nm
Static injection pump timing	N/A	N/A			° BTDC
Electronic injection control	Yes	Yes			
Variable injection timing	Yes	Yes			
Variable turbo charger geometry	No	No			
Cylinder number and configuration	6, in-line	6, in-line			
Nominal compression ratio	17.3	17.3			
Mean effective pressure at rated power		21.2			bar
Max cylinder pressure at rated power		178.7			bar

5.2 Specified ambient conditions

Nominal coolant into engine *	40	40			° C
Nominal charge air temperature, if applicable **(Applies for keel cooling engines)**	44	44			° C
Cooling system spec: Intermediate cooler	Yes	Yes			
Cooling system spec: Charge air stages	1	1			
L/H temp cooling system set points	N.A.	N.A.			
Maximum inlet depression	-30	-30			mbar
Exhaust back pressure (A-T connected / Not connected) at the actual test.	150 / 400	150 / 400			mbar
Fuel specification	Acc. To ISO-F-DM4				
Fuel temperature	38	38			° C
Lubricating oil specification	Acc. to ACEA E3, E4 or better, also see Operator's manual				

* Applies for keel cooling engines

5.3 Application / Intended for

Customer	X	X			
Final application/installation: Ship	X	X			
Final application/installation: Engine	Main E3	Main C1			

5.4 Emission test results

Cycle	**E3**	**C1**			
NOx Tier III	1.70	1.72			g/kWh
Test identification					
Date					
Test site: Scania Engine Lab, cell No.					
Test number					
Surveyor	DNV GL, Dipl.-Ing. Claus Kurok				
Date and place of report	2015-10-12 Södertälje				
Signature					

5.5 Injection Rate Urea

Injection rate of reductant at each load point (kg/h) in the E3 cycle				
Speed rpm	1800	1638	1440	1134
Power kW	405	304	202	101
Torque NM	2147	1771	1341	854
Urea g/min	123	116	77	26
Urea Dosing Kg/h	7.40	6.94	4.63	1.58

Injection rate of reductant at each load point (kg/h) in the C1 cycle								
Speed rpm	1800	1800	1800	1800	1300	1300	1300	650
Power kW	405	304	203	41	351	264	176	1
Torque NM	2149	1611	1075	216	2581	1936	129	20
Urea g/min	117	113	76	0	98	96	66	0
Urea Dosing Kg/h	7.00	6.78	4.57	0.00	5.88	5.77	3.95	0.00

Pressure drop and exhaust temp before and after the SCR was not measured at this test.

5.6 Engine family information

Combustion cycle	4 stroke
Cooling medium	50/50 Water/Glycol coolant
Cylinder configuration	6 in-line
Method of aspiration	Pressure charger, turbo charger
Fuel type to be used on board	Distillate
Combustion chamber	Open chamber
Valve port configuration	Cylinder head cross flow
Valve port number and size	2 inlet Ø 34,8 mm, 2 outlet Ø 35 mm
Fuel system type	Electronic unit injectors, PDE

5.7 Miscellaneous features

Exhaust gas recirculation	No
Water injection/emulsion	No
Air injection	No
Charge cooling system	Yes, air-to-water charge air cooling
Exhaust aftertreatment	Yes for Tier III compliance
Exhaust aftertreatment type	Selective Catalytic Reduction, SCR
Dual fuel	No

5.8 Test cell information

Test Cell: L9		Tested running cycle: E3, C1		Date:	
Exhaust pipe					
Diameter	mm	125			
Length	m	4			
Insulation		N/A			
Probe location	mm	Length of straight pipe from probe: upstream ~1000 downstream ~300.			
Remark					
Measurement equipment				Calibration	
Analyser	**Manufacturer**	**Model**	**Measurement range**	**Span gas conc.**	**Deviation**
NO_x analyser	Horiba	CLA-755A	500/5000 ppm	490.3 / 4863 ppm	± 1%
CO analyser	Horiba	AIA-721	5000 ppm	4949 ppm	± 1%
CO_2 analyser*	Horiba	AIA-722	15%	14.78 %	± 1%
O_2 analyser*	Horiba	MPA-720	25%	24.52 %	± 1%
HC analyzer	Horiba	FIA-725A	500/5000 ppm	162/1604 ppm	± 1%
Speed	Leine & Linde	865	0 - 4000 r/m		
Torque	HBM	T12	0 - 10 kNm	-2000 - 4000 Nm	± 10Nm
Air flow	ABB	Sensyflow P	0(200) - 4000 kg/min	197-3885 kg/h	± 1%
Temperatures					
Coolant	Pentronic	PT100	0 - 250 °C	0/150 °C	± 0,25%
Lubricant	Pentronic	PT100	0 - 250 °C	0/150 °C	± 0,25%
Exhaust gas	Pentronic	Termoelement Typ K	0 - 1200 °C	600 °C	± 0,4%
Inlet air	Pentronic	PT100	0 - 250 °C	0/150 °C	± 0,25%
Intercooled air	Pentronic	PT100	0 - 250 °C	0/150 °C	± 0,25%
Fuel	Pentronic	PT100	0 - 250 °C	0/150 °C	± 0,25%
Pressures					
Exhaust gas	Keller	PX-23X	0-500 mbar	0-500 mbar	± 0,2% fs
Inlet manifold	Keller	PD-39X	± 300 mbar	± 300 mbar	± 0,2% fs
Atmospheric	Vaisala	PTB 330	500 - 1100 mbar	500-1100 mbar	± 0,3 mbar
Vapour pressure					
Intake air	N/A				
Humidity					
Intake air	Mitchell	OPTIDEW	-40 - +90 Cdp	-25 - +15 Cdp	0,4 Cdp

Test fuel characteristics					
Fuel type	Diesel fuel acc. ISO-F-DMA				
Properties					
Density	ISO 3675	835.3	kg/m³		
Viscosity	ISO 3104:94/COR 1:97	2.696	mm²/s		
Fuel elemental analysis and test methods					
Carbon	ASTM D 5291-10	86.6	% mass		
Hydrogen	ASTM D 5291-10	13.5	% mass		
Nitrogen	ASTM D4629-08	<0.0003	% mass		
Oxygen	SS-EN 12205:1996	< 0.1	% mass		
Sulphur	SS-EN 20846:2004	0.0007	% mass		
Energy	SS 15 51 38:1992	42.93	MJ/kg		

5.9 Emission test reports

E3 MARINE EMISSIONS

Engine name : DI13092M	Date : 2015/10/13	Protocol : 69097744			
Mode		1	2	3	4
Power %	[]	100	75	50	25
Speed %	[rpm]	100	91	80	63
Start time	[min]	10	20	30	40
Engine performance data					
Engine power	[kW]	405	304	202	101
Engine speed	[rpm]	1800	1638	1440	1134
Fuel consumption	[g/kWh]	198,4	190,6	191,5	199,6
Fuel mass flow	[kg/h]	80,311	57,924	38,755	20,231
Coolant temperature before engine	[°C]	40,5	40,7	40,9	40,8
Coolant temperature after engine	[°C]	45,0	43,2	41,7	40,9
Charge air outlet temperature	[°C]	50,4	45,7	42,4	40,5
Charge air reference temperature	[°C]	50,4	45,7	42,4	40,5
Charge air pressure	[bar]	1,71	1,25	0,74	0,29
Ambient and gasesous emission data					
Barometric pressure of testbed	[mbar]	1023,4	1023,4	1023,3	1023,2
Temperature of engine air inlet	[°C]	25,5	25,5	25,5	25,6
Abs. humdity at engine	[g/kg]	10,55	10,44	10,37	10,61
Relative humidity	[%]	52,76	52,42	51,91	52,61
Dewpoint temperature	[°C]	15,1	15,0	14,8	15,1
Massflow air	[kg/h]	1878,8	1441,1	977,0	585,6
Atmospheric factor (fa)	[-]	0,98	0,98	0,98	0,98
NOx Wet	[ppm]	204,0	226,0	204,4	203,0
HC Wet	[ppm]	7,6	6,3	4,2	3,9
CO Concentration dry	[ppm]	35,2	40,3	38,5	9,6
CO2 Concentration dry	[%]	9,50	8,89	8,70	7,59
O2 Concentration dry	[%]	7,68	8,46	8,72	10,26
Exhaust temperature at sampl.point	[°C]	419	372	337	265
Exhast back pressure at sampl.point	[mbar]	303,88	186,58	96,76	39,30
Air fuel ratio	[-]	0,04	0,04	0,04	0,03
Correction factors					
Correction factor NOx	[-]	1,00	1,00	1,00	1,00
Dry to wet correction	[-]	0,92	0,92	0,93	0,93
Calculated gas mass flow					
NOx	[g/s]	0,18	0,15	0,09	0,05
HC	[g/s]	0,00	0,00	0,00	0,00
CO	[g/s]	0,02	0,01	0,01	0,00
CO2	[g/s]	72,16	51,94	34,48	18,12
O2	[g/s]	42,38	35,93	25,12	17,81
Exhaust mass flow (Wet)	[kg/h]	1959,1	1499,1	1015,7	605,9
Calculated specific emissions					
NOx	[g/kWh]	1,566	1,767	1,624	1,927
HC	[g/kWh]	0,018	0,015	0,010	0,011
CO	[g/kWh]	0,151	0,178	0,173	0,052
CO2	[g/kWh]	641,646	615,439	613,256	643,805
O2	[g/kWh]	376,837	425,686	446,819	632,656

Specific emissions : E3						Sum
E3 Weighting factors	[-]	0,20	0,50	0,15	0,15	1
Weighted power	[kW]	80,972	151,925	30,363	15,202	**278,462**
NOx	[g/kWh]	0,455	0,964	0,177	0,105	**1,70**
HC	[g/kWh]	0,005	0,008	0,001	0,001	**0,01**
CO	[g/kWh]	0,044	0,097	0,019	0,003	**0,16**
CO2	[g/kWh]	186,579	335,775	66,869	35,147	**624,37**

C1 MARINE EMISSIONS

Engine name:		D13 92M	Date:	2015-10-13			Protocol:	69097745	
Mode		1	2	3	4	5	6	7	8
Torque %	-	100	75	50	10	100	75	50	0
Speed	rpm	Rated				Intermediate			Idle
Start time	min	10	20	30	40	50	60	70	80
Engine performance data									
Engine Power Uncorrected (EM00)	kW	405	304	203	41	351	264	176	1
Speed (NM00)	rpm	1800	1800	1800	1800	1300	1300	1300	650
Fuel Consumption Uncorrected (QB01)	g/kWh	198,4	194,2	199,3	317,2	192,6	190,4	192,5	2102,2
Fuel mass flow (QB00)	g/min	1339,8	983,2	673,1	214,6	1127,6	836,1	563,5	25,1
Charge air temperature (TL30)	°C	50,3	46,3	42,9	40,5	46,8	43,9	41,8	38,6
Charge air reference temperature	°C	50,30	46,30	42,90	40,50	46,80	43,90	41,80	38,60
Charge air pressure (PL30)	bar	1,71	1,22	0,74	0,16	1,72	1,11	0,61	0,00
Ambient and gaseous emission									
Barometric pressure of intake air (PL00)	mbar	1023,2	1023,2	1023,2	1022,8	1023,0	1023,0	1023,0	1023,0
Temperature of intake air (TL15)	°C	25,50	25,50	25,40	25,30	25,50	25,60	25,60	25,90
Humidity of intake air (RL13)	g/kg	10,51	10,43	10,64	10,53	10,51	10,59	10,34	10,55
Intake air mass flow (QL01)	kg/min	31,30	26,00	20,70	13,80	22,60	17,70	13,60	4,40
Dewpoint temperature (TL03)	°C	15,00	14,88	15,19	15,02	15,00	15,11	14,75	15,05
Atmospheric factor (fa)	-	0,98	0,98	0,98	0,98	0,98	0,98	0,98	0,98
NOx Wet (RG26)	ppm	209,0	183,0	140,0	296,0	261,0	198,0	157,0	216,0
CO Dry (RG27)	ppm	34,0	29,0	17,0	92,0	72,0	86,0	37,0	41,0
HC Wet (RG25)	ppm	6,2	7,6	9,5	68,2	3,5	2,8	2,9	62,1
Exhaust temperature (TG21) at sampling point	°C	419	360	306	184	438	398	334	100
Exhaust back pressure (PG23) at sampling point	mbar	304,6	207,0	129,3	15,9	197,5	126,7	75,0	-0,4
Air fuel ratio (RL06)	-	0,04	0,04	0,03	0,02	0,05	0,05	0,04	0,01
Correction factors									
NOx humidity correction factor CCNR ($K_{H(ISO)}$)	-	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Fuel specific factor (F_{FH})	-	1,89	1,90	1,91	1,94	1,88	1,88	1,89	1,96
Dry to wet correction for CO (RG19)	-	0,90	0,91	0,92	0,95	0,89	0,89	0,90	0,97
Humidity correction factor for particulates	-	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
fa correction factor for particulates (K_{fa})	-	1,02	1,02	1,02	1,02	1,02	1,02	1,02	1,02
Calculated gas mass flow									
NOx (IMO)	kg/h	0,65	0,47	0,28	0,39	0,59	0,35	0,21	0,09
CO	kg/h	0,06	0,04	0,02	0,07	0,09	0,08	0,03	0,01
HC	kg/h	0,01	0,01	0,01	0,03	0,00	0,00	0,00	0,01
Exhaust mass flow Wet (QG24)	kg/h	1959,8	1618,6	1280,4	841,5	1424,3	1110,2	849,0	266,0
Calculated specific emission									
NOx (IMO)	g/kWh	1,603	1,543	1,402	9,629	1,679	1,322	1,199	91,233
CO	g/kWh	0,143	0,136	0,095	1,733	0,251	0,311	0,155	10,219
HC	g/kWh	0,014	0,019	0,029	0,670	0,007	0,006	0,007	7,912

Calculated specific emission									Sum
C1 Weighting factors	-	0,15	0,15	0,15	0,10	0,10	0,10	0,10	0,15	1,000
Weighted power	kW	60,750	45,600	30,450	4,100	35,100	26,400	17,600	0,150	220,150
NOx (IMO)	g/kWh	0,442	0,320	0,194	0,179	0,268	0,158	0,096	0,062	**1,72**
CO	g/kWh	0,039	0,028	0,013	0,032	0,040	0,037	0,012	0,007	**0,21**
HC	g/kWh	0,004	0,004	0,004	0,012	0,001	0,001	0,001	0,005	**0,03**

Mean effective pressure at rated speed (PM00)	bar	21,2	**SPECIFIC PARAMETERS**						
Max cylinder pressure at rated speed (PM01)	bar	178,7							
Coolant temperature before engine (TW54)	°C	39,8	41	40,7	40,8	40,5	40,6	40,8	39,2
Coolant temperature after engine (TW50)	°C	44,4	43,5	41,8	40,9	43,4	42,5	41,5	38,9
Lubricant temperature after oil cooler (TO05)	°C	94	91	86	78	92	89	85	71
Lubricant pressure after filter (PO07)	bar	4,29	4,41	4,56	4,9	3,8	3,92	4,11	2,58
Coolant pressure (PX11)	bar	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Maximum inlet depression (PL17)	mbar	29	20	13	6	16	10	6	1
CO_2 Concentration dry (RG28)	%	9,51	8,3	7,08	3,24	11,11	10,52	9,07	1,2
O_2 Concentration Wet (RG29)	%	76722,0	92810,0	109705,0	162516,0	54715,0	62758,0	82511,0	192022,0
Maximum torque at rated speed	Nm	2149							
Maximum torque	Nm	2581							
Speed at maximum torque	rpm	1300							
Idle speed	rpm	650							
Fuel injection / stroke at Rated Power	-	248,0							
Fuel injection / stroke at Maximum torque	-	289,0							

The blue rows are directly copied from the test protocol

TYPE APPROVAL CERTIFICATE

Certificate No:
TAM000004Z
Revision:
2

This is to certify:

That the Diesel Engine

with type designation(s)
DI13M

Issued to
Scania CV AB
Södertälje Stockholms Län, Sweden

is found to comply with
DNV GL Rules for classification - Ships

Application :

propulsion, multi engine plant / auxiliary / emergency

Products approved by this certificate are accepted for installation on all vessels classed by DNV GL.

Rating 551 kW at 2300 rpm, additional ratings see page two

This Certificate is valid until **2020-12-31**.

Issued at **Høvik** on **2017-11-08**
DNV GL local station: **Stockholm** for **DNV GL**

Approval Engineer: **Dag Harald Williksen**

Oddvar Deinboll
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid.
The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

Job Id: **262.1-011453-5**
Certificate No: **TAM000004Z**
Revision: **2**

Product description

four stroke, in-line engine, non-reversible, trunk-piston, with supercharging

Cylinder bore : 130
Piston stroke : 160
No. of cylinders : 6

Application/Limitation

Rated power [kW/cyl.]	405	405	551	426	426
Rated speed [rpm]	1800	2100	2300	1500	1800
Mean effective pressure [bar]	21.2	18.2	22.6	26.7	22.3
Max. firing pressure [bar]	184	179	202	186	172
Definition	Propulsion			Auxiliary / Emergency	

Type Approval documentation

Tests carried out

Documentation:

Test report titel	DI13 77M Type Test Report
Place of test	SCANIA AB, Södertälje, Cell F7
Date of test	2011-04-06 until 2011-06-07

Test engine:

Model	DI13 M
Serial no.	6413590, 6323014, 6323014
No. of cylinders	6

Marking of product

The product to be marked with manufacturer's name or trademark and type number identification.

Periodical assessment

For retention of the Type Approval, a DNV GL surveyor shall perform an assessment after 2 years and after 3.5 years to verify that the conditions of the type approval are complied with. A renewal assessment will be performed at renewal of the certificate.

In cases where the Type Approved product is manufactured at other companies, the Periodical Assessment shall verify that the Type Approval applicant has a quality control system for consistent production at their licensees/subcontractors. Furthermore, Periodical Assessment shall be carried out randomly at these companies.

Other Conditions

Engine safety, control and monitoring systems, including sensors and actuators are not covered by this type approval certificate. Documentation for engine safety, control including speed governing and monitoring systems shall be submitted for approval according to TAA000011C, TAA0000HZ and TAA00000K5.

Electric cables and cabling are not covered by this approval and must be verified to comply with the requirement of DNV Rules for Ships/ High, Speed Light Craft and Naval Surface Craft Pt.4 Ch.8 - Electrical Installation.

Flexible hoses with couplings to be type approved by DNV.

END OF CERTIFICATE

DNV·GL

TYPE APPROVAL CERTIFICATE

Certificate No:
TAA00000MT
Revision No:
1

This is to certify:

That the Engine Safety, Control and Alarm System

with type designation(s)
Nogva Motor Computer V2, Shut Down Unit SDU-1

Issued to
NOGVA MOTORFABRIKK A/S
SØVIK, Norway

is found to comply with
DNV GL rules for classification – Ships, offshore units, and high speed and light craft

Application :

Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV GL.

Location classes:

Type	Temperature	Humidity	Vibration	EMC	Enclosure
Nogva Motor Computer V2	**A**	**B**	**A**	**B**	**1)**
Shut Down Unit SDU-1	**A**	**B**	**A**	**B**	**1)**

1) Required protection according to relevant rules shall be provided upon installation on board.

Issued at **Høvik** on **2019-03-19**
This Certificate is valid until **2021-03-18**.
DNV GL local station: **Ålesund**

for **DNV GL**

Approval Engineer: **Krzysztof Aleksander Jankowski**

Jan Tore Grimsrud
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid.
The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

© DNV GL 2014. DNV GL and the Horizon Graphic are trademarks of DNV GL AS.

Job Id: **262.1-006714-6**
Certificate No: **TAA00000MT**
Revision No: **1**

Place of manufacture

Siemens Bømlo AS,
Ternetangen,
5420 Rubbestadnes,
Bømlo kommune,
Hordaland Fylke,
Kingdom of Norway

Product description

Nogva Motor Computer V2 (control and monitoring system) and SDU-1 (safety unit) form a engine safety, control and monitoring system intended for DNV GL Type Approved, 4-stroke, diesel engines series listed in Table 1.

Table 1. Diesel engine series

Maker	Engine series
John Deere	4045, 6068, 6081, 6090, 6135
Scania	DI9, DI12, DI13, DI16
Cummins	6CTA8.3, KTA19, QSK19, KTA38, QSK38, KTA50, QSK50, QSK60

Table 2. System hardware components

Name	Description	Product ID
IO-P	I/O Box - Control and monitoring unit for propulsion engines	571
IO-G	I/O Box - Control and monitoring unit for genset engines	573
SDU-1	Shut Down Unit	577
T2 Terminal	Remote control unit with display (interchangeable with T-3)	542
T3 Terminal	Remote control unit with color display (interchangeable with T-2)	576

Table 3. System software and firmware versions

Product name	Product ID	Major Version	Minor Version
Basic software	568	6	XX
IO-P	571	4	XX
IO-G	573	4	XX
SDU-1	577	4	XX
T2 Terminal	542	4	XX
T3 Terminal	576	4	XX

XX - minor changes not affecting DNV GL Rules requirements (bug fix, etc.)

Software number is built as: ProductID.Major Version.Minor Version - e.g. for Basic software 568.6.XX

Maintenance of software and firmware versions is described in document: "Note from Software Release MCV2 Motorcomputer" (Siemens Doc No: 10121713, Rev. 03, dated:2018-12-20)

Software control

When the type approved software is revised (affecting all future deliveries) DNV GL is to be informed by forwarding updated software version documentation. If the changes are judged to affect functionality for which rule requirements apply a new functional type test may be required and the certificate may have to be renewed to identify the new software version.

Application/Limitation

1. This certificate is valid only for systems applications made and delivered by production facilities listed under Place of Manufacture for engines series listed under Product Description in Table 1, provided they hold a valid DNV GL Type Approval Certificate.
2. The Type Approval covers hardware and software listed under Product description.
3. I/O Box and SDU-1 units are equipped with internal short circuit protection.

4. The system is suitable for use in multi-engine propulsion plants, auxiliary or emergency duties only.
5. Software parameterisation is done according to "ND1022 Software Description" (Rev.0, dated 2013-10-11) and will vary for each engine type.
6. For emergency generator applications only I/O Box and SDU-1 are in use.
7. List of Control and Monitored points (with defined alarm, load reductions and shutdowns, including identification of which automatic safety actions can be overridden) settings shall be in accordance with engine intended function (propulsion, auxiliary, etc.) and shall comply with vessel main class and relevant class notations requirements from DNV GL Rules.
8. System shall be delivered in accordance with documents:
   a) For auxiliary and generator engines applications: "NOGVA Motor Computer V2-G Interface EMS, Terminal T3" (doc. no.: T91-06913, Rev.A, dated: 2018-11-24)
   b) For propulsion engines applications: "Nogva Motorcomputer V2-P Interface EMS, Terminal T3, Shut Down Unit SDU1 (doc. no.: T91-06926, Rev.A, dated: 2019-03-07)
9. Case-by-case approval and system certification may be requested if the Approval conditions and Application/Limitations are not met.

Approval conditions

The following documentation of the actual application is to be submitted as document "**Approval Template for Nogva Motor Computer V2 and SDU-1 according to TAA00000MT**" for approval in each case:

- Reference to this DNV GL Type Approval Certificate
- Reference to valid hardware DNV GL Type Approval Certificate numbers, if they are different than the ones listed on table under Product description
- Information about engine type and intended use (propulsion, auxiliary, etc.)
- Software versions used in specific delivery
- Confirmation that Application/Limitation point 7 is fulfilled
- Confirmation that Application/Limitation point 8 "a)" or "b)" is fulfilled

Product certificate

As long as the units are covered by this Type Approval, a product certificate according to Pt.4 Ch.9 Sec.1 will **not be** required for system applications made and delivered with accordance to requirements listed in this Type Approval Certificate. Correct configuration and set up for each delivery to be tested during commissioning after installation.

Application software control

All changes in software are to be recorded as long as the system is in use on board. Documentation of major changes is to be forwarded to DNV GL for evaluation and approval before implemented on board.

Type Approval documentation

Tests carried out

Applicable tests according to Standard for Certification No. 2.4, April 2006.

Marking of product

Manufacturer: NOGVA MOTORFABRIKK A/S
Model name: As listed under Product description
Serial number: Unique for each delivered item

Periodical assessment

The scope of the periodical assessment is to verify that the conditions stipulated for the type are complied with, and that no alterations are made to the product design or choice of systems, software versions, components and/or materials.

The main elements of the assessment are:

- Ensure that type approved documentation is available
- Inspection of factory samples, selected at random from the production line (where practicable)

- Review of production and inspection routines, including test records from product sample tests and control routines
- Ensuring that systems, software versions, components and/or materials used comply with type approved documents and/or referenced system, software, component and material specifications
- Review of possible changes in design of systems, software versions, components, materials and/or performance, and make sure that such changes do not affect the type approval given
- Ensuring traceability between manufacturer's product type marking and the type approval certificate

A renewal assessment will be performed at renewal of the certificate.

END OF CERTIFICATE