DNV·GL

Certificate No:
TAA000014D

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Engine Safety, Control and Alarm System

with type designation(s)
Large Engine Marine Alarm and Protection System

Issued to
Caterpillar Inc.
Lafayette IN, United States

is found to comply with
DNV GL rules for classification – Ships

Application :

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

Temperature	**B**
Humidity	**B**
Vibration	**B**
EMC	**A**
Enclosure	**Required protection according to the Rules shall be provided upon installation on board**

Issued at **Hamburg** on **2017-04-21**
This Certificate is valid until **2019-10-12**.
DNV GL local station: **New York**

Approval Engineer: **Andrea Grün**

for **DNV GL**

Joannis Papanuskas
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.

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Job Id: **262.1-025181-1**
Certificate No: **TAA000014D**

Product description

Electronic Control Module (ECM): P/N 371-6444-00, S/N 31826106RH
Primary and Secondary ECM: ADEM V A5E4v2 (430-5447 & 440-4776)
Redundancy/ Diversity for Protection functions

Sensors:

- Speed Timing CRANK Sensor: P/N 244-5544
- Speed Timing CAM Sensor (with mounting bracket): P/N 192-1562 with 330-6572 (bracket assembly)
- Speed Timing Turbo Sensor: P/N 291-3979
- Fuel and Oil Pressure Sensor: P/N 349-7378
- Coolant Block Inlet Pressure Sensor: P/N 453-9976
- Fuel Rail Pressure Sensor: P/N 287-1866
- Coolant and Oil Temperature Sensor: P/N 288-3783
- Exhaust Temperature Thermocouple Sensor: P/N 383-2982
- Coolant Level Switch Sensor: P/N 335-7011
- Coolant Level Sensor: P/N 331-7352 and 430-9454

MCS Controller

Supervision: Handles system-level supervision of engine and generator controllers, including Start and Stop commands.

Input: Dual 24VDC power supply (main and backup
4x PT100 – 0 - 800ºC
4x 4-20mA – open & short circuit detection
8x Opto-coupled switched
Magnetic pickup – 4-32Vpp 0-10 khz
Tachometer (direct connection, J1939 and SDU)
10 fixed – 2 configurable switched

- Prelube complete
- Start Disable
- Automatic Mode
- Automatic Start
- Automatic Stop
- Remote Start
- Remote Stop
- Alarm Acknowledge
- Shutdown Override (does not override overspeed protection)

Output: 6x Fixed engine state
4x configurable 24V
2x configurable relays
Aux power supply

Differential Channels (5): Compares any two analog signals hardwired to the MCS Controller or RIO, or transmitted over J1939.

Communications: Serves as communication hub for J1939, RS-485, Ethernet Modbus/TCP and CANOpen
Communicates with SDU, RIO and PAM using RS-232
Displays information transmitted by other modules on these data busses
Translates information from J1939 to RS-485 for shipboard use

Shutdown Unit (SDU): Handles MCS-required shutdown events.
Overspeed test mode.
Modbus RTU & Ethernet interface
Low supply voltage detection

Input: 8x switches with wire-break / short detection
2x magnetic pickup
1x Shutdown coil

Output: Communicates all information to MCS Controller
5x Status relays
- Shutdown
- Crank Cutoff
- Buzzer
- Fault
- Running

Application/Limitation

1. The Type Approval covers hardware listed under product description. When the hardware is used in applications to be classed by DNV GL, documentation for the actual application is to be submitted for approval by the manufacturer in each case. Reference is made to DNV GL rules for classification of ships Pt.4 Ch.9 Control and monitoring systems."
2. This certificate is valid only for systems made and delivered by Caterpillar Inc. from production centers listed under "Place of complete system manufacture (final assembly)" for Caterpillar engine series listed under product description and provided they hold a valid DNV Type Approval Certificate.
3. The system intended only for multi-engine propulsion plants, auxiliary and emergency generator purposes.
4. Sufficient mechanical protection and correct installation of sensors to be verified for each installation during onboard survey.
5. Specifications for routine test and maintenance of sensors according to class rules to be available on-board after installation.
6. List of control & monitored points (including alarms, shutdowns, set points, etc.) shall be according to the engine's intended function (propulsion, auxiliary genset, emergency genset, etc.) and shall comply with the vessel's main class requirements in DNV GL Rules for Ships, Part 4 Chapter 3 Section 1 Table 10, 11, 12 and, if Ship Rules and E0 notation apply, Part 6 Chapter 2 Section 2 Table 4, 8. If the vessel has electric propulsion the requirements in Pt.4 Ch.8 Sec.12 shall also be taken into consideration.
7. Power supply arrangement shall be like shown in document "A5: E4v2 Type Approval Test Plan and Report" Version 1.6 dated 07-11-2014.
8. In case of differences between listed below documentation required for approval and documents submitted for approval will be found, the system documentation needs to be case-by-case approved and system certification may be required. Approval fee or certification fee will be applied. Documentation required by documentation type code I200 stated in DNV GL Rules for Ships Pt.1 Ch.3 Sec.3 [2] Discipline I will then additionally need to be submitted.
9. If, during approval or on board survey, differences will be found between actual delivery setup (difference in alarms and safety actions, firmware versions, sensors setup, monitoring functions, etc.) and setup required by this Type Approval certificate for specific vessel notations and main class, then the system needs to be case-by-case approved and system certification may be required. Approval fee or certification fee will be applied. Documentation required by documentation type code I200 stated in DNV GL Rules for Ships Pt.1 Ch.3 Sec.3 [2] Discipline I will then additionally need to be submitted.Approval Conditions (propulsion and emergency engines only)

The following documentation of the actual application is to be submitted for approval in each case:

- Reference to this Type Approval Certificate
- Information about engine type and intended use (propulsion, auxiliary, etc.)
- Software versions used in specific delivery
- Configuration file used in specific delivery
- System block diagram showing overall system layout
- Power supply arrangement (may be part of block diagram)
- List of control & monitored points (indications, alarms, load reductions, shutdowns etc.)
- Test program for certification (only if product certification is required by applicable rule set)

Product certificate
If required by the applicable rule set, each delivery of the application system is **to be** certified according to Pt.4 Ch.9 Sec.1. The certification test is to be performed at the manufacturer of the application system, preferably at the engine/system application maker integrating control, monitoring and safety system, before the system is shipped to the yard. After the certification the clause for application software control will be put into force.

Clause for application function control
All changes in software are to be recorded as long as the system is in use on board. The records of all changes are to be forwarded to DNV GL for evaluation and approval. Major changes in the software are to be approved before being installed in the computer. Certification of Application Functions may be required.

Software update notification
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.

Type Approval documentation

Test report:
- 1303390-01 dated 02-01-2014
- 1303391-01dated 27-12-2013

A5E4v2 A5:E4v2 Type Approval Test Plan and Report v1.6 (7 Nov. 2014)
- ETR1403948-01
- ETR1403949-01

349-7378 C280 Marine Alarm and Protection Test Procedure v1.1 (5/20/2013)
- ETR1301468-01A
- ETR1301467-01

453-9976 Part Number 453-9976 Type Approval Test v1.00 (23 June 2015)
- ETR1501346-01
- ETR1501348-01

Test procedure:
- EC 29 Test Procedure C175 Portion Version 1.0 dated 19-11-2013
- EC 29 Test Procedure C175 Portion Version 1.2 dated 01-07-2014
- Potential Failure Modes & Effects Analysis dated 11-10-2011

MCS Alarm and Protection dated 12-11-2013; C175 System Overview
Large Engine Alarm and protection System Version 1.0
MCS SOFTWARE QUALITY dated 25-05-2012
Drawing 430-9454 Version 04-D
Technical Documentation Coolant Level Sensor V 1.0 dated 29-08-2014

Tests carried out

Applicable tests according to DNV GL Class Guideline 0339, November 2016.
Functional Performance Test according to A5: E4v2 Type Approval Test Plan and Report" Version 1.6 dated 07-11-2014.
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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.

Periodical assessment is to be performed after 2 years and after 3.5 years. A renewal assessment will be performed at renewal of the certificate.

END OF CERTIFICATE