Perkins 1200E Series

Models BK, BL, MK and ML

ELECTRICAL & ELECTRONIC A&I GUIDE

1204E-E44TA
1204E-E44TTA
1206E-E66TA
1206E-E70TTA

Four & Six cylinder diesel engines for agricultural, industrial, construction applications

Developed to meet EEC off-road mobile machinery Stage IIIB and EPA off-road Tier 4 Interim legislation **Note:** Information in this manual is preliminary and is subject to change or withdrawal.

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1.0 Introduction and Purpose

This document is intended to provide the information necessary for correct electrical and electronic installation of 1204E or 1206E Industrial engines, into an off-highway machine. Perkins expects that there will be some additions and modifications to this document as the engine program development continues, and as OEM requests for information not currently addressed are added. The Information herein is the property of Perkins and/or its subsidiaries. Without written permission, any copying, transmission to others and any use except that for which it is loaned is prohibited.

1.1 Applicable Engines

The information contained with this document is the best available at the time of authoring and describes the application and installation requirements for a production representative engine and software configuration. During development stages please ensure the Applications Engineering department are consulted before implementing any of the features contained within this document.

Early project engines will not have all the features described in this document enabled. Contact the Electronic Applications Team for latest information on software feature release dates.

1.2 Electronic Applications Contacts

If the information in this document is incomplete, incorrect, or further details are required, then please contact your Applications Engineer.

1.3 Safety

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools in order to perform these functions properly.

The information in this publication was based upon current information at the time of publication. Check for the most current information before you start any job. Perkins dealers will have the most current information.

Improper operation, maintenance or repair of this product may be dangerous. Improper operation, maintenance or repair of this product may result in injury or death.

Do not operate or perform any maintenance or repair on this product until you have read and understood the operation, maintenance and repair information.

Perkins cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are not all inclusive. If a tool, a procedure, a work method or an operating technique

that is not specifically recommended by Perkins is used, you must be sure that it is safe for you and for other people. You must also be sure that the product will not be damaged and / or made unsafe by the procedures that are used.

1.3.1 Warning – Welding

Welding can cause damage to the on engine electronics. The following precautions should be taken before and during welding:

- Turn the engine OFF. Place the ignition keyswitch in the OFF position
- Disconnect the negative battery cable from the battery. If the machine is fitted with a battery disconnect switch then open the switch
- Clamp the ground cable of the welder to the component that will be welded. Place the clamp as close as possible to the weld.
- Protect any wiring harnesses from welding debris and splatter.

DO NOT use electrical components in order to ground the welder. Do not use the ECM or sensors or any other electronic components in order to ground the welder.

1.3.2 Warning - Electrostatic Paint Spraying

The high voltages used in electrostatic paint spraying can cause damage to on engine electronics. The damage can manifest itself through immediate failure of components, or by weakening electronic components causing them to fail at a later date.

The following precautions should be taken when using electrostatic paint spraying techniques on engines:

- Connect all 70 pins of the ECM J1 Connector directly to the spraying booth ground.
- Connect the engine block to ground at 2 points. Ensure that good screwed connections onto bright metal are used.

1.3.3 Warning – Jump Starting

Jump-starting an engine can cause higher than normal voltages to appear across the battery terminals. Care must be taken that this does not exceed the recommended maximum voltage for the ECM.

2.0 Engine & Aftertreatment Component Overview

2.1 Main Engine Sensor and Actuator Details

Component	Sub System	Product Range
A5:E2 Engine ECM	ECM	All
Electronic Unit Injectors	Fuel System	All
Electronic Fuel Lift Pump	Fuel System	
Fuel Temperature Sensor	Fuel System	All
Fuel Rail Pump Control valve	Fuel System	All
Fuel Rail Pressure Sensor	Fuel System	All
Water In Fuel Switch	Fuel System	All
Crank Speed / Timing Sensor	Engine Speed	All
Cam Shaft Speed Sensor	Engine Speed	All
Engine Oil Pressure Sensor	Core Engine System	All
Engine Coolant Temperature Sensor	Core Engine System	All
Barometric pressure Sensor	Core Engine System	All
NRS Inlet Absolute Pressure sensor	NRS System	All
NRS Differential Pressure Sensor	NRS System	1206E-E70TTA only
NRS Outlet Absolute Pressure Sensor	NRS System	1204E and 1206E only
NRS Temperature Sensor	NRS System	All
NRS Metering Valve	NRS System	All
Intake Manifold Temperature Sensor	Air System	All
Intake Manifold Pressure Sensor	Air System	All
Turbocharger Wastegate Regulator Valve	Air System	All
Exhaust back pressure Valve	Emissions System Assist Devices	1204E and 1206E only
Air Intake Throttle Valve	Emissions System Assist Devices	1206E-E70TTA only

2.1.1 Electronic Control Module (ECM)

The A5E2 ECM is an electronic control device that governs engine speed, torque output and manages the engines performance and emissions via a number of sensors and actuators. The ECM is situated on the left hand side rear of the engine. The device has two connection sockets, one for the engine wiring harness (J2) and the other for the OEM machine wiring harness (J1). Two versions of the A5E2 ECM are available a fuel cooled and air cooled, the choices of which depends upon the maximum ambient temperature the unit will be exposed to (see mechanical installation guide for details of fuel system connection requirements and temperature restrictions).

2.1.2 Fuel System

The engine fuel system comprises of an electronic lift pump, high pressure fuel pump, electronically controlled unit injectors and a High pressure fuel rail to feed the injectors. The electrical lift pump is used to provide a constant flow of fuel to the engine fuel pump. This pump also provides the user with an electrical priming feature. The fuel pump provides high pressure fuel to the fuel rail. The engine ECM via the fuel pump solenoid controls this fuel pump delivery and the resulting rail pressure. The engine ECM controls the fuel pump solenoid control based upon the inputs received from the fuel temperature sensor (which enables the control to be tailored to the specific fuel characteristics) and the fuel rail pressure sensor (which measures the actual pressure within the fuel rail).

Note: for more information regarding the electrical fuel lift pump and priming feature please see section 8.0 of the mechanical A&I Guide and section 4.0 of this document for electrical installation requirements.

High pressure fuel is delivered to each of the electronically controlled unit injectors which when activated by the engine ECM deliver a controlled measure of fuel for combustion. Voltages applied by the ECM to activate the injectors are high around 70V and the OEM must ensure that any systems sensitive to electromagnetic radiation are not close proximity to the harness components that lead to the injectors.

The engine fuel system is also fitted with a water in fuel switch mounted within the primary filter bowl. This switch is mandatory for all Tier 4 engines to indicate to the operator that the filter water trap is full and needs emptying. This switch is supplied with the engine from the factory but it is the customer's responsibility to connect this component to the ECM J1 connector via the machine wiring harness.

It should be noted that in many cases a fault on any of these sensors, solenoids or switches will cause the engine to derate, or enter a limp home state due to their emissions critical nature.

2.1.3 Engine Speed

The engine is fitted with two Hall effect speed sensors. The first is mounted on the engine to measure the crank speed and position and the other is used

to measure the cam shaft speed, position and engine cycle. The engine uses the crank speed signal during normal engine operation as this signal is more accurate at higher speeds. If the crank shaft speed signal is lost during engine running then the engine will enter a derate condition, however if the engine is cranking the engine will start but be limited to a programmed derate. The cam shaft speed sensor is used to calculate the engine cycle during engine starting and for limp home operation. For this reason if the camshaft speed timing sensor signal is lost the engine will not start, but if the engine is running a fault code will be raised and the engine will continue to run normally.

2.1.4 Core Engine System

There are a number of core engine operation sensors that are used to determine how the engine control system should respond to various conditions. These components include the barometric sensor, coolant temperature sensor and the oil pressure sensor.

The barometric sensor is located near the ECM. The sensor is used to determine atmospheric (barometric) pressure. The atmospheric pressure is used to determine the atmospheric related fuel limits (if any) e.g. at high altitude fuel may be limited during cranking to prevent turbo overspeed.

The coolant temperature sensor measurement is used as an input to the cold start strategy. The sensor reading is also used to determine fuel limits and injection timing at various temperatures to control engine emissions.

The oil pressure sensor measures engine oil pressure in kPa. Oil pressure is used for engine protection whereby if insufficient oil pressure is measured for a given speed, an event for low oil pressure would be raised.

2.1.5 NRS (Nox Reduction System)

The Nox reduction system is made up of the following components;

NRS Intake Absolute Pressure Sensor
NRS Outlet Absolute Pressure Sensor 1206E & 1204E only
NRS Differential Pressure Sensor 1206E-E70TTA only)
NRS Temperature Sensor
NRS metering Valve

Both the temperature and pressure sensor measurements are required by the engine control system to control NRS metering valve. There a subtle differences between the <130Kw and >130Kw engine NRS pressure measurement. The >130Kw engine range requires the use of the differential pressure sensor as well as an intake absolute pressure sensor, where as the <130Kw engines use the intake and outlet absolute pressure sensors only. The metering valve controls the mass air flow through the Nox reduction system cooler by means of a DC motor and a position sensor.

This part of the engine control system is emissions critical and for this reason the engine may apply a derate if any of these components enter a fault condition.

2.1.6 Air System

The engine air system contains the following electronic components.

Intake Manifold Temperature Sensor
Intake Manifold Pressure Sensor
Turbocharger Wastegate Regulator

The intake manifold pressure sensor measures the air pressure inside the intake manifold, after the turbo and NRS mixer. There are two sensor options dependent upon the choice of rating. The pressure sensor is used in a number of engine management control strategies contained within the engine ECM. The intake manifold temperature sensor measures the temperature of the mixed air inside the inlet manifold. The sensor measurement range is –40 to 150°C

The regulator valve controls the pressure in the intake manifold to a value that is determined by the ECM. The Wastegate regulator provides the interface between the ECM and the mechanical system that regulates intake manifold pressure to the desired value that is determined by the engine software.

2.1.7 Emissions System Assist Devices

The 1204E and 1206E product range are fitted with a low temperature regeneration system which uses an exhaust back pressure valve to control the exhaust gas temperature passing through the DPF. The back pressure valve is controlled by the engine ECM.

The 1206E-E70TTA engine range is fitted with an Air intake throttle valve. This valve is used to assist with the management of engine fuel air ratio. As with the back pressure valve the air intake throttle is controlled by the engine ECM.

2.2 Aftertreatment System Sensor & Actuator Details

Component	Sub System	Product Range
ARD Main Fuel Pressure Control Valve	ARD (Auxiliary Regeneration Device)	1206E-E70TTA only
ARD Pilot Fuel Pressure Control Valve	ARD (Auxiliary Regeneration Device)	1206E-E70TTA only
ARD Main Fuel Pressure Sensor	ARD (Auxiliary Regeneration Device)	1206E-E70TTA only
ARD Pilot Fuel Pressure Sensor	ARD (Auxiliary Regeneration Device)	1206E-E70TTA only
ARD Secondary Air Pressure Sensor	ARD (Auxiliary Regeneration Device)	1206E-E70TTA only
ARD Air Pressure Control Valve	ARD (Auxiliary Regeneration Device)	1206E-E70TTA only
ARD Combustion Detection Temperature Sensor	ARD (Auxiliary Regeneration Device)	1206E-E70TTA only
ARD Ignition Spark Plug	ARD (Auxiliary Regeneration Device)	1206E-E70TTA only
ARD Fuel Injector Heater Relay	ARD (Auxiliary Regeneration Device)	1206E-E70TTA only
ARD Fuel Injector Heater Wire	ARD (Auxiliary Regeneration Device)	1206E-E70TTA only
Aftertreatment ID module	DPF (Diesel Particulate Filter)	All
DPF Intake Pressure Sensor	DPF (Diesel Particulate Filter)	1206E-E70TTA only
DPF Intake Temperature Sensor	DPF (Diesel Particulate Filter)	All

2.2.1 ARD (Auxiliary Regeneration Device) System

The engine Aftertreatment systems supplied with engine >130Kw are designed with a High temperature regeneration system, which includes both the aftertreatment DPF and an ARD (Auxiliary Regeneration Device). All engine supplied below the 130Kw break point are supplied with a low temperature regeneration system, which does not require the use of the ARD.

The ARD is used to elevate the engine exhaust gas temperature to levels at which a regeneration of the DPF can take place. This process involves the use of a both a pilot and a main fueling event supplied by a single nozzle and a spark plug to ignite the delivered fuel within the engine exhaust system. The various sensors and actuators housed in and around the ARD unit are used to control / measure the air and fuel supplied for combustion.

2.2.2 DPF System

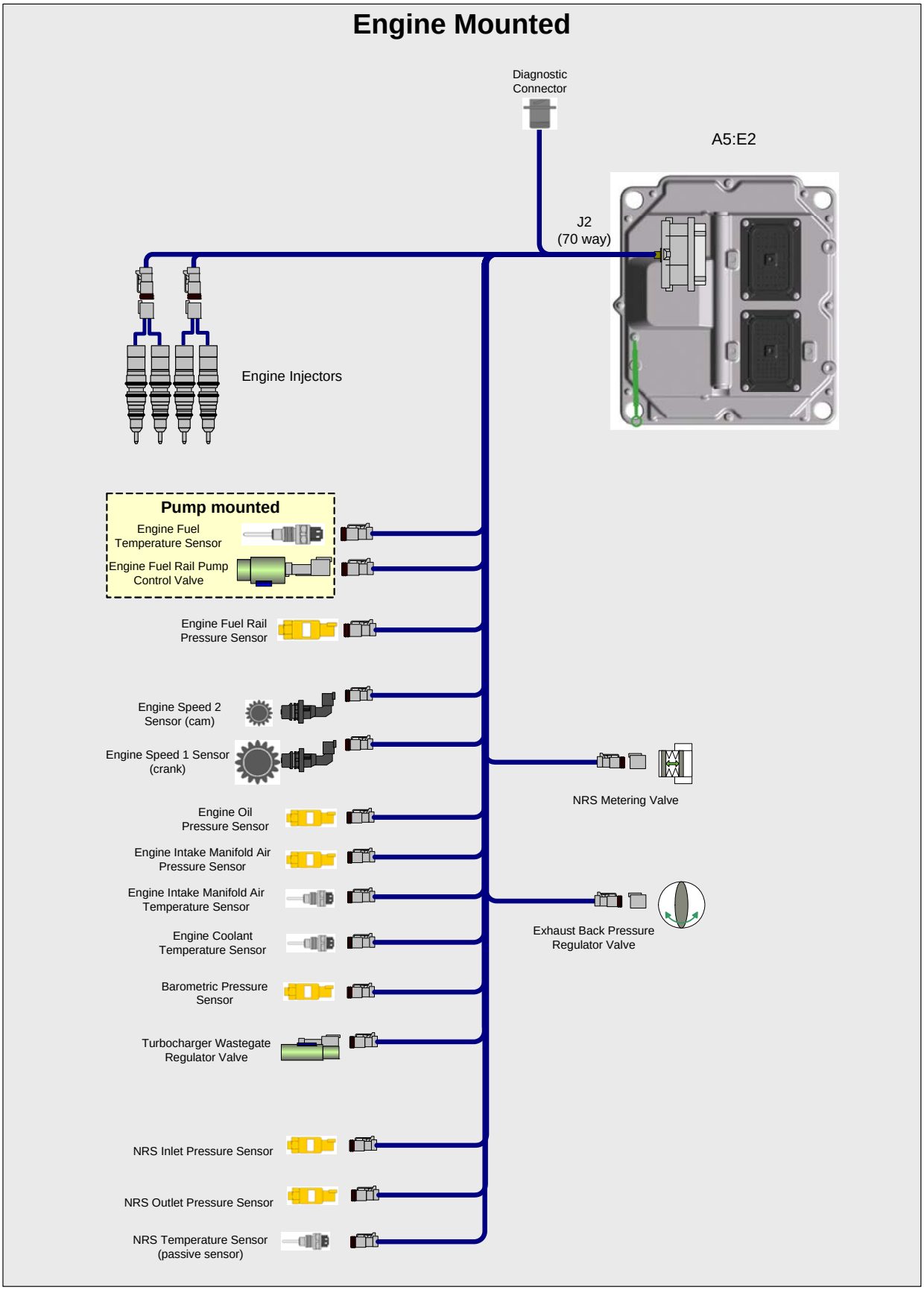
The Diesel Particulate Filter Intake Temperature Sensor measures exhaust temperature entering the Particulate Trap. This is used to help determine when conditions are right for the system to regenerate the DPF. This sensor is used to help control emissions.

The Diesel Particulate Filter Intake Pressure Sensor measures exhaust gas pressure before the Particulate Trap and is only required for engines fitted with a high temperature regeneration system. This is used to control ARD combustion during an active regeneration of the DPF. This sensor is used to help control emissions. This sensor also provides an indication of when the DPF intake pressure gets very high so that appropriate events can be triggered to protect the after-treatment system.

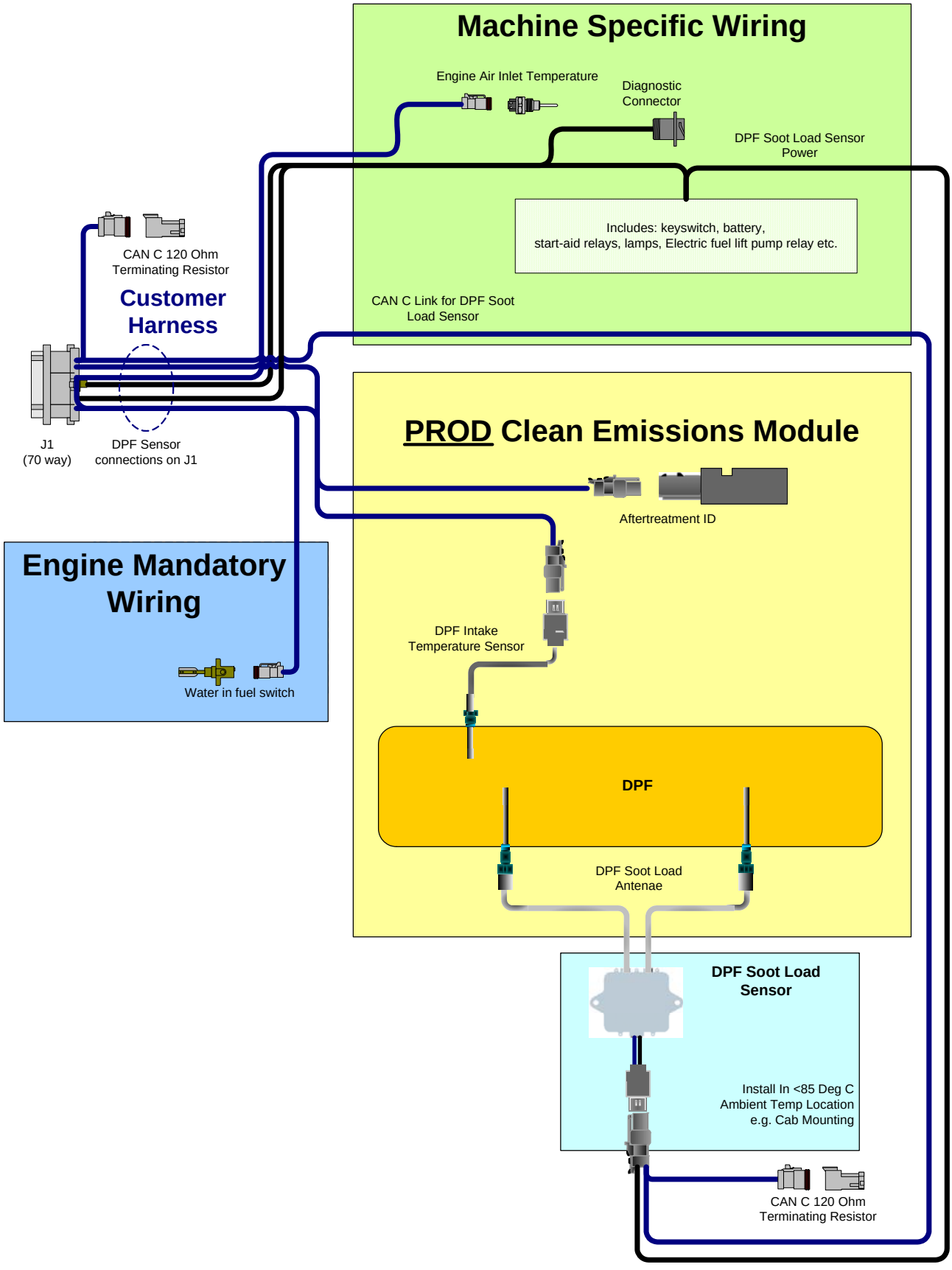
Other components such as the Aftertreatment ID module and the DPF Soot Load sensor are also required for the engine regeneration system to operate correctly. These components are discussed in more detail in section 6 of this document.

2.3 System Component Diagrams and Schematics

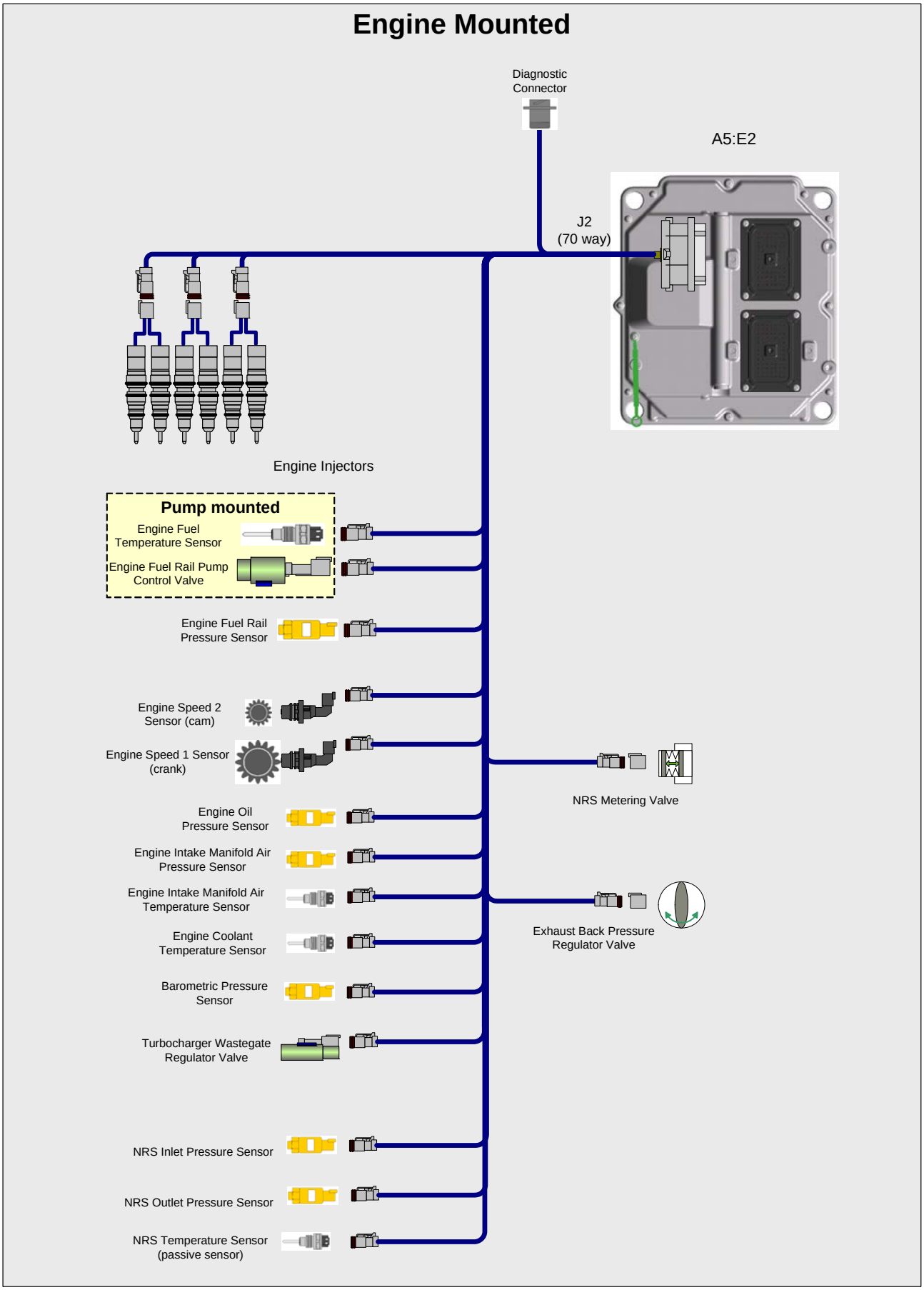
2.3.1 1204E-E44TA Factory Installed Wiring and Components



2.3.2 1204E-E44TA Customer Installed Aftertreatment Wiring & Components



2.3.3 1206E-E66TA Factory Installed Wiring and Components



2.3.4 1206E-E66TA Customer Installed Aftertreatment Wiring & Components