



A NAVISTAR COMPANY

2007 MaxxForce™ DT, 9 & 10: Engine Overview

**Study Guide
TMT-120703**

INTERNATIONAL®

©2007 International Truck and Engine Corporation
4201 Winfield Road, Warrenville, IL 60555

All rights reserved.

No part of this publication may be duplicated
or stored in an information retrieval system
without the express written permission of
International Truck and Engine Corporation.

Table of Contents

Introduction	3
Safety	3
 General Information.....	5
Serial Number Location	5
Emissions Label Location.....	5
 Component & System Locations: Sensors.....	7
Camshaft Position Sensor (CMP)	7
Engine Oil Temperature Sensor (EOT)	7
Water In Fuel Sensor (WIF)	7
Manifold Absolute Pressure Sensor (MAP).....	7
Manifold Air Temperature Sensor (MAT)	8
Barometric Absolute Pressure Sensor (BAP).....	8
Crankshaft Position Sensor (CKP)	8
Engine Oil Pressure Sensor (EOP)	8
Exhaust Back Pressure Sensor (EBP).....	9
Engine Coolant Temperature Sensor (ECT).....	9
 Component & System Locations: Front.....	9
EGR Coolant Crossover Tube	9
Fan Drive Hub	9
Coolant Inlet	9
Water Pump Pulley	10
Turbocharger Outlet	10
EGR Exhaust Crossover Tube.....	10
 Component & System Locations: Left Front.....	10
EGR Valve.....	10
Primer Pump.....	11
Fuel Filter Module Drain.....	11

Table of Contents

Component & System Locations: Left..... 11

Intake Throttle Valve.....	11
Electronic Control Module (ECM)	11
Engine Oil Pressure Sensor (EOP)	12
Water In Fuel Sensor (WIF)	12
Fuel Filter Module.....	12

Component & System Locations: Left Rear 15

Intake Air Heater Relays	15
Crankshaft Position Sensor (CKP)	15
Manifold Air Temperature Sensor (MAT)	15
Manifold Absolute Pressure Sensor (MAP)	16
Engine Oil Temperature Sensor (EOT)	16
EGR Cooler (Intake Side)	16

Component & System Locations: Rear 16

Turbine Exhaust Outlet.....	16
Crankshaft Position Sensor (CKP)	17
Fuel Return Fitting.....	17

Component & System Locations: Right Rear 17

EGR Cooler (Exhaust Side)	17
Turbocharger	17
Oil Filter Module	18
EGR Cooler to Exhaust Manifold Connection.....	18

Component & System Locations: Right 18

Crankcase Ventilation Assembly.....	18
EGR Coolant Supply Line.....	18
Valve Cover Vent Tube	19

Table of Contents

Component & System Locations: Right Front	19
Engine Coolant Temperature Sensor (ECT)	19
Vibration Damper	19
Crankcase Ventilation Assembly.....	19
Turbocharger Inlet	19
 Design Features.....	21
Variable Geometry Turbocharger	21
Directional Pistons and Common Bore.....	21
Dual A/C Compressor Pad-Mount	23
Wider Pulley	23
Crankcase Ventilation Assembly.....	23
Dual EGR Coolers	24
Water Cooled EGR Valve	24
Electronic Control Module (ECM)	25
After-Treatment.....	26
Foam Wiring Harness	26
Intake Throttle Valve.....	27
Valve Cover Gasket	27

Introduction

The objective of this program is to provide you with an overview of the 2007 MaxxForce™ DT, MaxxForce™ 9 and MaxxForce™ 10 engines.

This is the first in a series of programs. This program provides general information. Future programs will go into detail about specific components, systems and diagnostic procedures.

To receive credit for this program, you will need to take a post-test via ISIS®/ Education/Service/Online Testing.

Safety

The following instructions are intended to prevent personal injury or death, and to prevent damage to the engine.

Proper service techniques, environmental concerns and safety are the most important parts of the process.

Perform all service procedures inside a well-ventilated, dry shop.

Make sure the vehicle is parked on a flat surface, with the parking brake set and the wheels blocked.

Objectives

Upon the successful completion of this program, you will be able to:

- **Identify the general engine specifications.**
- **Identify component and system locations.**
- **Identify the key design features.**

Be sure that you know the location of properly rated and charged fire extinguishers.

When working on the engine, keep the work area and tools as clean as possible. Also, clean all connections or fittings before disconnecting or removing components.

Use a suitable pan to catch any fluid when disconnecting components.

Wear safety glasses and chemical-blocking nitrile gloves when performing work of any kind.

“Be sure to follow each warning, caution and note as they are presented throughout this training program.”

Be sure to follow each warning, caution and note as they are presented throughout this training program.

Warnings indicate procedures and safety measures that must be followed precisely to prevent personal injury or death to your self or other shop personnel, and to prevent damage to the vehicle, equipment or components.

Cautions indicate a procedure that you must follow exactly to prevent equipment or component damage.

Notes indicate operations, procedures or instructions that are important for proper service.

General Information

Serial Number Location

The engine serial number is located on the right hand side of the crankcase in front of the turbocharger. The engine serial number identifies the engine family, the build location, and the sequential build number.

The first serial number for this engine model is 3000000.

Emissions Label Location

The Environmental Protection Agency emissions label is located on the valve cover.

The label includes the following information:

- advertised horsepower rating
- engine model code
- service application
- emission family and control system
- year the engine was certified to meet emission standards

Engine Specifications

Engine Configuration

4-stroke, in-line six cylinder diesel

Valve Configuration

4 valves per cylinder

Displacement

MaxxForce™ DT: 7.6 L
(466 in³)

MaxxForce™ 9 & 10: 9.3 L
(570 in³)

Bore

116.6 mm (4.59 in)

Stroke

MaxxForce™ DT: 119 mm
(4.68 in)

MaxxForce™ 9 & 10: 146 mm
(5.75 in)

Aspiration

VGT Turbocharged and
Charge Air Cooled

Engine Rotation

CCW when facing flywheel

Fuel System

International® Electro-
hydraulic Generation Two
fuel system

Engine Weight (dry)

MaxxForce™ DT: 1,480 lbs.
(671 kg)

MaxxForce™ 9 & 10:
1,560 lbs. (708 kg)

Firing order

1-5-3-6-2-4

[illegible]

Component & System Locations: Sensors

Camshaft Position Sensor (CMP)

The Camshaft Position sensor (CMP) is a magnetic pickup sensor that is used to detect camshaft speed and position.

Engine Oil Temperature Sensor (EOT)

The EOT sensor is a two-wire thermistor used to measure engine oil temperature.

Water-In-Fuel Sensor (WIF)

The WIF sensor is a switch-type sensor that is used to detect water in the fuel filter header. The WIF sensor signal is monitored by the ECM for operation of the amber Water-In-Fuel lamp.

Manifold Absolute Pressure Sensor (MAP)

The MAP sensor is a variable capacitance sensor that is used to detect the intake manifold boost pressure.

“The MAP sensor is a variable capacitance sensor that is used to detect the intake manifold boost pressure.”

Manifold Air Temperature Sensor (MAT)

The MAT sensor is a thermistor-type sensor that is used to detect intake air temperature in the manifold.

Barometric Absolute Pressure Sensor (BAP)

“The Barometric Absolute Pressure sensor is integrated into the ECM.”

The Barometric Absolute Pressure sensor (BAP) is integrated into the ECM.

Crankshaft Position Sensor (CKP)

The Crankshaft Position sensor (CKP) is a magnetic pickup sensor that is used to detect crankshaft speed and position.

Engine Oil Pressure Sensor (EOP)

The EOP sensor is a variable capacitance-type sensor that is used to detect engine oil pressure. The EOP signal is monitored by the ECM for operation of the instrument panel pressure gauge and the engine warning protection system.

Exhaust Back Pressure Sensor (EBP)

The Exhaust Back Pressure sensor is a variable capacitance-type sensor that is used to measure exhaust back pressure in the exhaust manifold.

Engine Coolant Temperature Sensor (ECT)

The ECT sensor is a thermistor-type sensor that is used to detect engine coolant temperature.

Component & System Locations: Front

EGR Coolant Crossover Tube

The EGR coolant crossover tube transfers coolant from the right side EGR cooler to the left-side EGR cooler.

Fan Drive Hub

The fan hub on all 2007 I-6 engines is mounted to the cylinder head.

Coolant Inlet

Coolant from the radiator enters the engine through the coolant inlet.

“The fan hub on all 2007 I-6 engines is mounted to the cylinder head.”

Water Pump Pulley

“The width of the water pump pulleys for all I-6 engines has increased from the previous design.”

The width of the water pump pulleys for all I-6 engines has increased from the previous design.

Turbocharger Outlet

Compressed air from the turbocharger's compressor housing exits the turbocharger outlet and is routed to the charge air cooler.

EGR Exhaust Crossover Tube

The EGR exhaust crossover tube transfers the exhaust gases from the right-side EGR cooler to the EGR manifold.

Component & System Locations: Left Front

EGR Valve

The EGR valve is located between the two EGR coolers in order to minimize sticking and fouling of the valve. The EGR valve meters the cooled exhaust gases going into the intake manifold, in order to reduce Oxides of Nitrogen emissions.

Primer Pump

The primer pump is used to pump fuel to the filter housing, in order to prime the fuel system.

Fuel Filter Module Drain

The fuel filter module drain is used to drain the module of water or contaminants.

Component & System Locations: Left

Intake Throttle Valve

The intake throttle valve is controlled by the ECM. The throttle valve is used to increase the efficiency of the after-treatment system's soot reduction process. The soot reduction process is called "regeneration."

"The soot reduction process is called 'regeneration.'"

Electronic Control Module (ECM)

On 2007 I-6 engines, the IDM and ECM have been integrated into one unit.

Engine Oil Pressure Sensor (EOP)

The EOP sensor is a variable capacitance-type sensor that is used to detect engine oil pressure. The EOP signal is monitored by the ECM for operation of the instrument panel pressure gauge and the engine warning protection system.

Water-In-Fuel Sensor (WIF)

“The WIF sensor signal is monitored by the ECM for operation of the amber Water-In-Fuel lamp.”

The WIF sensor is a switch-type sensor that is used to detect water in the fuel filter header. The WIF sensor signal is monitored by the ECM for operation of the amber Water-In-Fuel lamp.

Fuel Filter Module

The following components are mounted on the Fuel Filter module:

- Fuel Pressure Diagnostic Port
- Engine Fuel Pressure Sensor
- Fuel Heater (optional)
- Primer Pump

NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

[illegible]

Component & System Locations: Left Rear

Intake Air Heater Relays

The intake air heater relays are used to energize the grids of the intake air heater elements. The intake air heater elements assist the engine in cold weather starting by heating the air that is drawn into the engine.

Large diameter red wires run from the relays to the intake air heater element connections, located at the base of the inlet mixing duct.

“The intake air heater elements assist the engine in cold weather starting by heating the air that is drawn into the engine.”

Crankshaft Position Sensor (CKP)

The Crankshaft Position sensor (CKP) is a magnetic pickup sensor that is used to detect crankshaft speed and position.

Manifold Air Temperature Sensor (MAT)

The MAT sensor is a thermistor-type sensor that is used to detect intake air temperature in the manifold.

Manifold Absolute Pressure Sensor (MAP)

The MAP sensor is a variable capacitance sensor that is used to detect the intake manifold boost pressure.

Engine Oil Temperature Sensor (EOT)

The EOT sensor is a two-wire thermistor sensor used to measure engine oil temperature.

EGR Cooler (Intake Side)

“The EGR cooler reduces the temperature of exhaust gas recirculation gases by transferring heat from the gases to the engine coolant.”

The EGR cooler reduces the temperature of exhaust gas recirculation gases by transferring heat from the gases to the engine coolant.

Component & System Locations: Rear

Turbine Exhaust Outlet

The turbine exhaust outlet allows exhaust gases to flow from the turbocharger to the after-treatment system and the exhaust system.

Crankshaft Position Sensor (CKP)

The Crankshaft Position sensor (CKP) is a magnetic pickup sensor used to detect crankshaft speed and position.

Fuel Return Fitting

2007 I-6 engines return excess fuel relieved by the fuel pressure regulator back to the fuel tank, through a fitting on the fuel filter module.

Component & System Locations: Right Rear

EGR Cooler (Exhaust Side)

The EGR cooler reduces the temperature of exhaust gas recirculation gases by transferring heat from the gases to the engine coolant.

Turbocharger

The 2007MY turbocharger has both updated internals and a redesigned actuator. The turbocharger assembly consists of the turbocharger, the actuator, the actuator linkage, and the actuator harness and connector.

“The 2007MY turbocharger has both updated internals and a redesigned actuator.”

Oil Filter Module

The oil filter module consists of the oil cooler, the oil filter, the oil pressure regulator and the oil thermostatic valve.

The oil cooler reduces engine oil temperature by transferring heat to the engine coolant.

EGR Cooler to Exhaust Manifold Connection

The EGR mounting flange is a rigid connection for added support and durability.

Component & System Locations: Right

Crankcase Ventilation Assembly

“The crankcase ventilation assembly uses centrifugal force in order to separate oil vapor from the blow-by gases exiting the crankcase.”

The crankcase ventilation assembly uses centrifugal force in order to separate oil vapor from the blow-by gases exiting the crankcase.

EGR Coolant Supply Line

EGR coolant enters the rear of the right-side EGR cooler through the coolant supply line.

Valve Cover Vent Tube

The valve cover vent tube directs air and oil vapor from the valve cover to the crankcase ventilation assembly.

Component & System Locations: Right Front

Engine Coolant Temperature Sensor (ECT)

The ECT sensor is a thermistor-type sensor that is used to detect engine coolant temperature.

Vibration Damper

All 2007 I-6 engines use a common rubber vibration damper.

Crankcase Ventilation Assembly

The crankcase ventilation assembly uses centrifugal force in order to separate oil vapor from the blow-by gases exiting the crankcase.

Turbocharger Inlet

Crankcase blow-by gases exit the crankcase ventilation assembly and enter the turbocharger inlet.

This image shows a full page of blank, lined paper. It features approximately 30 horizontal blue or grey lines spaced evenly apart, typical of notebook paper. The lines extend across the entire width of the page, leaving small margins at the top and bottom. There are no vertical lines, text, or other markings on the page.

Design Features

Variable Geometry Turbocharger

The 2007MY turbocharger has both updated internals and a redesigned actuator. The turbocharger assembly consists of the turbocharger, the actuator, the actuator linkage, and the actuator harness and connector.

The ECM sends signals to actuator based on exhaust back pressure, engine speed, required fuel quantity, boost, and altitude. In the 2007, the actuator and ECU communicate over the engine CAN line.

The actuator linkage connects the actuator to the pivot shaft that moves the internal vanes.

The turbocharger has moveable internal vanes that direct the flow of exhaust gases at the turbine wheel.

Directional Pistons and Common Bore

2007 I-6 engines all share a common bore size of 116.6 mm (4.59 in).

“The turbocharger has moveable internal vanes that direct the flow of exhaust gases at the turbine wheel.”

The MaxxForce™ DT has a stroke of 119 mm (4.68 in) for a displacement of 466 cubic inches (7.6 L).

The MaxxForce™ 9 and 10 gain their increase in displacement with a stroke of 146 mm (5.75 in). MaxxForce™ 9 and 10 engines share a displacement of 570 cubic inches (9.3 L).

“For model year 2007, the MaxxForce™ 9 and 10 pistons are one-piece steel construction.”

For decreased emissions, I-6 pistons feature a centralized combustion chamber bowl that has been optimized for each displacement. In addition, for model year 2007, the MaxxForce™ 9 and 10 pistons are one-piece steel construction.

All 2007 I-6 engines have directional pistons.

The MaxxForce™ DT piston has an offset piston pin to reduce the tendency of piston slap.

The piston pins for the MaxxForce™ 9 and 10 are not offset, but are directional due to the location of an under-crown oil hole that provides oil to the pin joint.

Note the position of the pistons in the crankcase. The MaxxForce™ DT piston has an arrow that must point to the front of the engine when assembled.

The MaxxForce™ 9 and 10 pistons are marked “CAMSIDE”. The CAMSIDE marking must be on the camshaft side of the engine when the pistons are installed.

Dual A/C Compressor Pad-Mount

The A/C compressor is pad mounted to provide for easy removal and servicing.

Pad mounting allows a single belt to drive the alternator, water pump and A/C compressor, resulting in lower maintenance costs.

A new auxiliary bracket allows for dual A/C compressors to mount at the same location.

Wider Pulley

2007 I-6 engines use 10-groove pulleys instead of the previous 8-groove pulleys. The new pulleys match the wider belt, which can carry higher accessory loads and has an extended life.

“2007 I-6 engines use 10-groove pulleys instead of the previous 8-groove pulleys.”

Crankcase Ventilation Assembly

2007 I-6 engines are equipped with a closed crankcase ventilation system. A centrifugal crankcase

breather is mounted to the right front of the crankcase. The breather is driven by lube oil pressure and is maintenance free. Crankcase gases exit the valve cover and enter the breather. Centrifugal force removes the oil vapor from the gases before they enter the turbocharger inlet.

Dual EGR Coolers

“2007 I-6 engines use dual EGR coolers in order to meet the increased demand for exhaust gas recirculation.”

2007 I-6 engines use dual EGR coolers in order to meet the increased demand for exhaust gas recirculation, which is used to meet the 2007 emission standards.

The dual EGR design uses parallel coolant and exhaust gas flow instead of the previous counter-flow system. Parallel flow reduces the coolant boiling in the EGR coolers.

In 2007, EGR coolers mount to a flange on the exhaust manifold. This provides greater stiffness for the system and improves service.

Water Cooled EGR Valve

The EGR valve is a variable position electromechanical valve that controls the flow of exhaust gases into the intake air stream.

The EGR valve housing is now water cooled. Cooling the valve protects the valve's electronics from overheating.

The EGR valve is installed in the EGR manifold on the top front of the engine. The valve is located at a point in the system where exhaust temperatures are high enough to reduce fouling and minimize sticking of the mechanical parts of the valve.

The EGR valve now incorporates the function of the EGR drive module, which allows the valve to communicate directly with the ECM over the engine CAN line.

“The EGR valve now incorporates the function of the EGR drive module.”

Electronic Control Module (ECM)

The Electronic Control Module, or ECM, is located on the left rear of the crankcase. The ECM uses sensor inputs to control actuators for both the fuel and air management systems.

The ECM for 2007 has combined the function of the ECM and IDM. The 2007 ECM has three connections, compared to the previous design of the independent ECM and IDM with seven connections.

“The ECM for 2007 has combined the function of the ECM and IDM.”

After-Treatment

“All 2007 I-6 engines require an after-treatment system in order to reduce the amount of particulate matter in the engine’s exhaust.”

All 2007 I-6 engines require an after-treatment system in order to reduce the amount of particulate matter in the engine’s exhaust. The after-treatment system is made up of a Diesel Oxidation Catalyst (DOC), a Diesel Particulate Filter (DPF), three exhaust temperature sensors, and a differential pressure sensor.

Both the DPF and DOC are constructed of ceramic materials with a wash coat of precious metals. The DOC reacts with unburned fuel in the exhaust to reduce the hydrocarbons and raise the exhaust gas temperature.

The DPF acts as a filter to catch the particulate matter, or soot, from the exhaust gases. The soot quantity increases in the DPF until the system raises the temperature in the DPF and the soot is converted to ash. Eventually, the ash level will increase to the point where the DPF must be removed from the vehicle and serviced.

Foam Wiring Harness

The wiring harness on the MaxxForce™ DT, 9 and 10 is a form-fitted foam harness. The robust foam construction helps resist chafing of the wires while maintaining

clearance from moving components.
This harness is not serviceable.
To prevent damage, it should not
be bent more than 90 degrees.

Intake Throttle Valve

The intake throttle valve is mounted on the inlet and EGR mixer duct on the left side of the engine.

The intake throttle valve has a variable position throttle plate that the ECM can close to restrict intake air flow. The restricted airflow, in combination with additional fuel injected into the cylinders, reacts in the DOC to raise the temperature in the DPF to burn the collected soot into ash.

Valve Cover Gasket

The valve cover gaskets on the MaxxForce™ DT, 9 and 10 have been redesigned. The new valve cover gasket has a total of four connectors that pass through the gasket. The previous design had a connector for each injector and sensor underneath the valve cover. The new design allows all of the sensors and the injector wiring to be routed through the four connectors, located on the left rear of the valve cover gasket.

“The new design allows all of the sensors and the injector wiring to be routed through the four connectors.”

Conclusion

This concludes the overview program for the MaxxForce™ DT, MaxxForce™ 9, and MaxxForce™ 10 engines.

To receive credit for this program, you will need to take a post-test via ISIS®/ Education/Service/Online Testing.

Thank you for your participation.

NOTES

This image shows a full page of blank, lined paper. It features approximately 28 horizontal blue or grey lines spaced evenly apart, typical of notebook paper. The lines extend across the entire width of the page, leaving small margins at the top and bottom. There are no vertical lines, text, or other markings on the page.

NOTES

This image shows a full page of blank handwriting practice paper. It features approximately 30 evenly spaced horizontal blue lines across the entire page, providing a guide for letter height and placement. The lines are uniform in color and thickness, set against a plain white background. There are no margins, text, or other markings present.

NOTES

[illegible]

NOTES

This image shows a full page of blank, lined paper. It features approximately 30 horizontal blue or grey lines spaced evenly apart, typical of notebook paper. The lines extend across the entire width of the page, leaving small margins at the top and bottom. There are no vertical lines, text, or other markings on the page.