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Introduction

Welcome to the Navistar training course for the Cylinder Performance Analyzer (CPA) tool. This course is intended to inform technicians how to perform pre-programmed tests, as well as user defined tests.

Objectives

Upon completion of this course, you will be able to:

- Define the purpose of the CPA tool
- Identify the components of the CPA tool
- Use the CPA tool software in the correct order
- Assemble the CPA tool hardware in accordance with pre-determined instructions
- Test engine electrical systems in accordance with pre-determined instructions
- Create case files based on test findings

CPA Tool Overview

The CPA tool is a four channel oscilloscope that is used to detect faults in various components. When used with the proper software, the CPA tool helps technicians diagnose engine systems by monitoring electrical signals from various engine mounted sensors.

THE CPA TOOL IS A SENSITIVE AND SOPHISTICATED PIECE OF EQUIPMENT AND SHOULD NEVER BE STORED IN THE ENGINE COMPARTMENT. ANY EXTERIOR DAMAGE MAY ADVERSELY AFFECT THE FUNCTIONALITY OF THE TOOL AND CAUSE FLAWED TEST RESULTS.
WARNING

NEVER PERFORM A ROAD TEST WITH THE CPA TOOL INSTALLED ON VEHICLES EQUIPPED WITH A MAXXFORCE® DT, 9, AND 10 (EPA 10) WITH HD-OBD ENGINE BECAUSE IT MAY STALL WITHOUT WARNING, POTENTIALLY RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY, AND/OR DEATH. THE ONLY ENGINES ALLOWED TO HAVE A CPA TOOL ROAD TEST WITHOUT THE ASSISTANCE OF NAVISTAR® TECHNICAL SERVICES ARE THE EPA 04 DT ENGINES, THE EPA 07 MAXXFORCE® DT, 9, AND 10, AND THE EPA 10 MAXXFORCE® DT, 9, AND 10 WITHOUT HD-OBD.

The CPA tool can be used to diagnose multiple engines; some of which are shown here.

- DT466, DT570, and HT570 (EPA 04)
- MaxxForce® DT, 9, and 10 (EPA 07)
- MaxxForce® DT, 9, and 10 (EPA 10) with and without HD-OBD

CPA Tool Components

Most current CPA tool kits include, but are not limited to the following components:

- Cylinder Performance Analyzer (CPA)
- USB Cable
- Camshaft Position Sensor (CMP) Tee Harness
- Crankshaft Position Sensor (CKP) Tee Harness
- High Pressure Oil Pump (HPOP) Harness
- (3) Extension Harness
- (3) 2-pin Banana Plug
Cylinder Performance Analyzer Tool Instruction Update

CPA Tool Setup

**CAUTION**

SECURE THE CPA TOOL AND RELATED WIRING AWAY FROM HOT AND MOVING ENGINE PARTS WITH CABLE TIES WHILE PERFORMING TESTS.

**NOTE**

IT MAY BE NECESSARY TO REMOVE THE OPERATOR’S SIDE QUARTER FENDER, ENGINE COVER, AND/OR PASSENGER’S SIDE INNER FENDER TO CONNECT SENSOR TEE HARNESSES, DEPENDING ON APPLICATION.

There are a variety of sensors that can be connected to the CPA tool and knowing how to properly connect them is very important. Some sensor tee harnesses must be connected in line between the sensor and the engine harness, while other sensor tee harnesses only need to be connected to the sensor.

For example, the sensor tee harness for the CMP must be connected in line between the sensor and the engine harness. This allows the vehicle to be driven while the CPA tool is connected.

However, when connecting the CPA to the Injection Control Pressure (ICP) connector for a stationary test, the engine harness does not need to be connected. For specific information on how to connect to a sensor, always refer to the latest tool instructions.
After connecting a sensor tee harness to the vehicle it must be connected to the CPA tool. Ensure that the connections to the CPA tool are secure, and cannot come in contact with other BNC connecters. After connecting the CPA tool to engine sensors, route the tool leads into the cab, being sure to keep all components away from any possible sources of radio frequency interference. Having the CPA tool inside the cab allows you to perform any needed tests while also being able to start and stop the engine quickly and safely. Channels one and two are each equipped with a signal adjustment knob which may need to be adjusted to properly communicate with the version of the CPA program being used. When connecting the CPA tool to a computer with the USB cable, ensure the light on the CPA tool is flashing. To find the most current sensor tee harness installation or knob adjustment instructions, refer to the latest tool information located on Navistar’s Service Portal.

**CPA Tool Operation**

The CPA tool is used with special Engine Cylinder Performance Analyzer software. Some on-screen buttons and menus in this software are present on most of the screens you will navigate through. Let’s take a look at some of the buttons and menus you will come across while using the CPA software.

**Menu Bar**

The menu bar includes the “FILE”, “TOOLS”, and “HELP” buttons. While the menu bar will be visible on every screen, the “FILE” and “TOOLS” buttons may not always be available.

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**WARNING**

NEVER ALLOW THE METAL SENSOR TEE HARNESS CONNECTORS (BNC CONNECTORS) OR THE CPA PORTS TO CONTACT METAL, OTHER SENSOR TEE HARNESS CONNECTORS, OR GROUND. DOING SO MAY CAUSE THE ENGINE TO STALL WITHOUT WARNING, POTENTIALLY RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY, AND/OR DEATH.
The "FILE" menu has options to either view all of the data that has been saved by the CPA tool, or to close the CPA software.

The “TOOLS” menu offers the ability to check the status of the connection between the CPA tool and the computer being used, re-register the CPA software, view the Warranty Authorization Code (WAC) history for the computer you are using, and perform specially grouped tests.

In the “HELP” menu, you can find out which version of the CPA software your computer is using, activate new CPA components, and access a copy of the CPA tool instructions.

**Information Fields**

The preferred method of opening the CPA software is through the ServiceMaxx software. However, some versions of ServiceMaxx may not have a link to the CPA software. If you are unable to open the CPA software from ServiceMaxx, it can be opened from the computer’s "START" menu.

To get some practice performing tests with the CPA tool, let’s take a moment to look at the tests that can be performed with the CPA tool. Starting in ServiceMaxx, open the “TESTS” tab in the menu bar at the top of the screen, then select “CYLINDER PERFORMANCE ANALYZER” from the drop down menu. You can see that launching the CPA software from ServiceMaxx while connected to a vehicle will automatically populate the vehicle information fields.
The “OPERATOR” field and the “CUSTOMER COMPLAINT” field need to be filled in manually as they change with every vehicle. If you would like extra help navigating through the CPA tool, select the "SHOW 'HELP' TIPSTRIP" checkbox. This option will show more detail when the mouse is hovered over an item in the software. After verifying the vehicle information is accurate, select “PROCEED” to continue.

When first opening the CPA tool, this warning will alert you to the dangers of performing road tests on vehicles equipped with certain engines. It is possible to prevent the message from being shown again during the current session by checking this box. Most warnings will have this option to streamline the testing process.
Warning:

When testing a 2013 HD OBD MaxxForce DT, 9 or 10 the CPA Tool and harnesses must only be connected when the vehicle is parked and the parking brake is set.

The only engine that can have CPA Tool road test without the assistance of Navistar Technical Services is the EPA 2004 DT, 2007 & 2010 MaxxForce DT, 9 & 10.

NEVER DRIVE the vehicle with the CPA breakout cables connected to these engines.

The engine may stall without warning.
CPA Home Screen

1. Dealership and Vehicle Information
2. Test List
3. Test Descriptions
4. “DATA FILE TO SAVE”
5. “STOP TEST” Button
6. “START TEST” Button
7. Test Summary
8. Graphed Sensor Data
9. Cylinder Representation
10. Engine Speed History

This is the home screen of the CPA tool. Let’s take a moment to introduce you to it. The ”DEALERSHIP AND VEHICLE INFORMATION FIELD" will display some of the information that was gathered when the CPA software was initially launched. The “TEST LIST” will allow you to cycle through a list of diagnostic tests that can be used to diagnose a variety of concerns. The "BRIEF TEST DESCRIPTION" and "DETAILED TEST DESCRIPTION" fields allow you to enter information that may be helpful for Navistar® Technical Services. The “DATA FILE TO SAVE” field shows the naming structure for the current test, as well as the location the file will be saved in. At the end of a test, the “TEST SUMMARY” field will show test results as well as a recommendation as to what should be done next. The "GRAPHED SENSOR DATA" displays a waveform of the signal from the sensor that is connected. Once the information is recorded, you can zoom in and out of the pattern as well as scroll left and right. After a test is completed, the "CYLINDER REPRESENTATION" field will turn green, red, or cyan depending on the results of the test. This field is used to visually aid the test summary. These colors indicate that the CPA tool has determined either there is no defect found (green), a defect has been found that requires further diagnosis (red), or there is high engine speed fluctuation and no faults associated with a particular cylinder (cyan).
Finally, the “ENGINE SPEED HISTORY” field will show how the engine speed varied throughout the course of the test.

**Standard Testing**

**NOTE**

THE ONLY STANDARD TESTS THAT WILL PRODUCE A WARRANTY AUTHORIZATION CODE (WAC) ARE THE "COLD IDLE" TEST, "HOT IDLE" TEST, AND THE "FULL LOAD TO HIGHWAY SPEED" TEST IF THERE IS A COMBUSTION PROBLEM. THE "SIGNAL CHECK" WILL NOT PRODUCE A WAC AS IT IS CONSIDERED TO BE PART OF THE SETUP PROCESS.

Most of the pre-programmed tests are performed from the home screen. Standard tests can be performed without the assistance of Navistar® Technical Services. The engine should be running before starting any standard test. The four standard tests are:

- Cold Idle
- Signal Check
- Hot Idle
- Full Load to Highway Speed

From the main screen, tests in the "TEST LIST" can be selected either with the arrows on the left, or by selecting it from the drop down menu.

**Cold Idle Test**

The "COLD IDLE" test detects faults with cylinder combustion during idle speed, and is usually performed if the customer complaint includes a misfire during a cold idle. When required, the "COLD IDLE" test should be performed prior to the "SIGNAL CHECK".
Now you must enter information into the “BRIEF TEST DESCRIPTION” and “DETAILED TEST DESCRIPTION” fields before starting the test. Remember, these description fields are used to inform Navistar® Technical Services of important information the CPA tool does not record. For this test, we must first connect the camshaft position sensor and crankshaft position sensor tee harnesses to the sensors, engine harness, and the CPA tool. The engine must also be allowed to cold soak before the test can be started. Refer to the latest tool information located on Navistar’s Service Portal for instructions to properly perform a cold soak. To start the test, click the button in the bottom left corner labeled “START TEST”. Before the test will start, an instruction screen appears to show the steps that must be taken to properly perform the test.
The test will automatically end when it is completed. At the end of most tests, a text box will appear to give you a final chance to add details about what happened during the test before the results are saved. There will be a timer in this text box that counts down the time until the box automatically closes. It is possible to stop the timer by clicking in the text box. Once the desired text has been entered, click the "RETURN" button to save the added details and view the test summary on the CPA home screen. At the end of a test, the results will be displayed in the "TEST SUMMARY" field with recommendations of any further actions that needs to be taken. Remember, green cylinders indicate no defects were found.

### Signal Check

The "SIGNAL CHECK" ensures the information from the Crankshaft Position (CKP) Sensor and Camshaft Position (CMP) Sensor are being read properly by the CPA program and are not distorted. The "SIGNAL CHECK" must be performed before the "FULL LOAD TO HIGHWAY SPEED" test or any other test that involves the vehicle being driven. With the CMP and CKP sensors connected, ensure the engine is running and click the "START TEST" button. Once the test has begun, follow the on-screen instructions.

### Hot Idle Test

The "HOT IDLE" test detects faults with cylinder combustion once the engine is idling and the coolant is above the specified temperature. Always refer to the latest CPA tool instructions for the specified coolant temperature. The "SIGNAL CHECK" should be performed prior to the "HOT IDLE" test. To perform the "HOT IDLE" test, the CPA tool must be set up the same way the "COLD IDLE" test was set up. The only difference is the temperature the engine coolant must be at while performing the test. Now that the engine is up to operating temperature we can perform the "HOT IDLE" test. Refer to the latest tool information located on Navistar's Service Portal for the engine temperature necessary to run the "HOT IDLE" test.

### Full Load to Highway Speed Test

The "FULL LOAD TO HIGHWAY SPEED" test is used to detect faults with cylinder combustion during acceleration. Select the "FULL LOAD TO HIGHWAY SPEED" test from the "TEST LIST". Ensure the engine is running before clicking the "START TEST" button and beginning the "FULL LOAD TO HIGHWAY SPEED" test. After agreeing to proceed, the test will automatically start. From a stopped position, safely accelerate the vehicle at 100% throttle to obtain local highway speed. This test can be performed on a dynamometer if local streets do not provide proper conditions.

The test should automatically stop when the vehicle reaches highway speed and the software has collected the appropriate amount of data. As it did before a text box will appear to give you a final chance to add details about what happened during the test before the results are saved. Click in the text box before the timer runs out. Once the desired text has been entered, click the "RETURN" button to
save the extra details and view the "TEST SUMMARY" on the CPA home screen. As with the other tests, a summary will be generated with instructions for any further action that may be needed.

**Intermediate Testing**

**NOTE**

SOME TESTS MAY INCLUDE EXTENDED PERIODS OF CRANKING WHICH CAN QUICKLY DRAIN THE BATTERY. ALWAYS POSITION BATTERY CHARGERS AS FAR FROM THE CPA TOOL AS POSSIBLE TO REDUCE RADIO FREQUENCY INTERFERENCE.

**Control Buttons**

The "HIGH PRESSURE OIL PUMP (HPOP) TEST" has buttons to "START" and "ABORT/STOP" the selected mini test, "QUIT" the whole HPOP test, select a saved test, and confirm you want to "REVIEW A FORMER TEST" that has been saved. There is also a time slider that is used to review a specific point in the saved test.

**High Pressure Oil Pump Test Screen**

Some grouped tests, such as the "HIGH PRESSURE OIL PUMP (HPOP)" test shown here, have an alternate test screen. While the layout of this screen is different, it contains similar information to the CPA home screen.
High Pressure Oil Pump Home Screen

1. Dealership and Vehicle Information
2. Test Notes
3. Test Type List
4. Outlined Instructions
5. Saved Data Information
6. “START TEST” Button
7. “ABORT TEST” Button
8. “REVIEW FORMER TEST” Button
9. “QUIT” Button
10. Access Saved Files Button
11. Time Slider Bar
12. Graphed Sensor Data
13. Dynamic Instructions

The "DEALERSHIP AND VEHICLE INFORMATION", "TEST NOTES", "DATA FILE TO SAVE", and "GRAPHED SENSOR DATA" fields are the same as the CPA home screen, but let’s take a look at some of the other fields. The “TEST TYPE LIST” for this type of testing will change on its own as you progress though the tests making up the overall procedure. Any test that is currently available to be performed will be in black, while unavailable tests are in grey. The "INSTRUCTIONS" field displays what type of action will be required to complete the test, when it will need to be done, and how long it will need to be performed. The "SUMMARY TEXT BOX" will display information in a similar manner to the "TEST SUMMARY" field shown before, including test results and recommendations. The "SUMMARY TEXT BOX" also doubles as a "DYNAMIC INSTRUCTION" field which will change throughout the test to inform you which step you are on, and when it is time to move on to the next step.

Some pre-programmed tests are designed to diagnose certain components. One example of this is the “HPOP TEST”. These types of tests consist of multiple mini tests which are used to narrow down the cause of an issue. The process for performing an intermediate test is similar to performing one of the standard tests, but the CPA screen layout is different. To access these tests, select the “TOOLS” tab on the menu bar at the top of the screen. For this example, we will perform part of the “HIGH PRESSURE OIL PUMP (HPOP) TEST".
Before performing the HPOP test, you must first connect the proper sensor harnesses.

To determine the proper harness configuration, refer to the setup information by holding the “SHIFT” key and clicking in the "SUMMARY TEXT BOX".

The "GRAPHED SENSOR DATA" field will change to display specific instructions for the test that is currently selected. Holding the "SHIFT" key and clicking in the same field again will show extra information that may be needed. It is possible to navigate between the two screens by holding the...
"SHIFT" key and clicking in the "SUMMARY TEXT BOX". Clicking in the "SUMMARY TEXT BOX" without holding the "SHIFT" key will return the sensor graphs to the screen.

Once the proper connections have been made, start the test. After starting the test, you will be asked to confirm the test you would like to perform. If you would like to select another test, you can do so at this point through the drop down menu. Turn the ignition switch to the "OFF" position, and click the "PROCEED" button to start the test, or the "CANCEL" button to go back.

![Test Interface]

**NOTE**

IT MAY NOT BE NECESSARY TO PERFORM ALL OF THE TESTS IN THE HPOP TEST. IF THE SOFTWARE DETECTS A FAULT IN THE HIGH PRESSURE OIL PUMP DURING ANY OF THE TESTS, A WAC WILL BE GENERATED. ANY OTHER FAULTS WILL BE DISPLAYED IN THE "SUMMARY TEXT BOX". IF NO FAULT IS FOUND, THE SOFTWARE WILL RECOMMEND PERFORMING THE NEXT TEST IN THE SERIES.

Once you start the test, the "SUMMARY TEXT BOX" will display the first step of the test. As the test continues, the "SUMMARY TEXT BOX" will change to display the necessary actions to complete the test. For training purposes, this test has been shortened from its normal length. The test ends with a summary of the diagnostic results, as well as instructions for any further action that may be needed.
No WAC Mode

“NO WAC MODE” CAN BE ENABLED WHEN THE NEXT TEST CANNOT BE PERFORMED BECAUSE SOMETHING UNUSUAL HAPPENED DURING THE PRESENT TEST.

A “WARRANTY AUTHORIZATION CODE (WAC)” is a special code that will authorize you to perform specific repairs that are covered under the vehicle’s warranty. For convenience purposes, Warranty Authorization Codes have been converted from 30 digit codes to four and five digit codes. In order to receive a Warranty Authorization Code, the mini tests must be performed and completed in a specific order.

If a test cannot be performed or completed in order, enable “NO WAC MODE” to move on to a different test, however no WAC will issued in this mode. Select the box next to the title "NO WAC MODE" to enable this mode. When enabling “NO WAC MODE” a warning is displayed to remind you that a WAC will not be issued, and that the test results can be attached to a case file if necessary.

After enabling "NO WAC MODE", it is possible to perform the series of tests in any order, and still receive the normal posttest information in the "SUMMARY TEXT BOX".
Advanced Testing

**NOTE**

BECAUSE “USER DEFINED” AND “RECORDER” TESTS ARE ONLY TO BE PERFORMED WITH THE ASSISTANCE OF NAVISTAR® TECHNICAL SERVICES, A WAC WILL NOT BE CREATED FROM THIS TYPE OF TESTING. THEREFORE, A CASE FILE MUST BE OPENED PRIOR TO PERFORMING THE REPAIR.

In addition to the previously covered functions, the test list also has advanced tests titled “USER DEFINED” and “RECORDER”. These options are only to be used at the request of Navistar® Technical Services. Under the instruction of Navistar® Technical Services, it is possible to use the CPA tool to monitor a wider range of sensors and engines.
While Technical Services will guide you through the testing procedure specific to the complaints being diagnosed, let’s take a moment to see how a test would be setup if a “USER DEFINED” test had been requested. Open the drop down menu under the "TEST LIST" heading by clicking on the name of the currently selected test, then select “USER DEFINED” from the “TEST LIST”. To monitor three or more signals at once, you must check the boxes for “SENSOR 3” and/or “SENSOR 4” to activate monitoring of the extra channels. Now we must specify the sensor being monitored by selecting it from the drop down menu to the right of the channel it will be connected to. If the sensor needed is not listed, select “USER DEFINED” from the drop down menu. Then enter the sensor type in the text box that appears when this selection is made.

When contacting Navistar® Technical Services, it may be necessary to monitor sensors through a breakout harness rather than a special cable that connects directly to the CPA tool. To monitor a sensor using a breakout harness, you will need to connect a 2-pin Banana Plug to the proper test ports of the breakout harness. The other end of the 2-pin banana plug should then be connected to the CPA tool with an extension cable. With everything connected you are ready to continue the test with the aid of Navistar® Technical Services. When the test is complete you will be given the opportunity to add additional details of the test.
Results

NOTE

A STANDARD TEST WILL ONLY PRODUCE A WAC IF A DEFECT IS FOUND TO BE ASSOCIATED WITH UP TO TWO CYLINDERS. IF DEFECTS ARE FOUND IN THREE CYLINDERS OR MORE NAVISTAR TECHNICAL SERVICES MUST BE CONTACTED.

At the end of a test, the software will automatically save the test results, and then display a test summary. The summary displays the diagnostic findings of the test, recommendations for further actions, and details of the diagnostic findings. If the CPA software detected a valid fault, a WAC will be generated. The WAC given provides authorization to replace specific parts, and must be included on the repair order to request warranty reimbursement. Always check Navistar's Service Portal for the most current policy regarding Warranty Authorization Codes.

Saved Data

The files saved by the CPA tool will be located in a folder titled “ENGINE CYLINDER PERFORMANCE ANALYZER” (the default location for this folder is on the desktop). The "FILE" button on the menu bar also has a shortcut to the folder with the saved tests. This allows you to review past tests and saved files.

Uploading CPA Results

NOTE


To submit saved files for review by Technical Services, you must first access the case file home page. From there, select the “BROWSE” button. Next, select the proper CPA file to upload from the “ENGINE CYLINDER PERFORMANCE ANALYZER” folder. Before submitting the case file, ensure that the proper .zip file is listed under the “ATTACHMENTS” section.
Conclusion

Always store the components of the CPA tool in their provided cases when testing is complete.

This concludes the Navistar® training course on the Cylinder Performance Analyzer (CPA) Tool. Thank you for your participation.

Notes

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