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2018 Ford F-350 Super Duty Service and Repair Manual

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ISO 14229 sends 2 additional bytes of information with each DTC (diagnostic trouble code) , a failure type byte and a status byte.

DTC Byte 1		DTC Byte 2		Failure Type Byte		Status Byte	
0000	0100	0010	0000	0000	0000	1111	0101
P0	4	2	0	0	0	F	9

All ISO 14229 DTC (diagnostic trouble code) s are 4 bytes long instead of 3 or 2 bytes long. Additionally, the status byte for ISO 14229 DTC (diagnostic trouble code) s is defined differently than the status byte for previous applications with 3 byte DTC (diagnostic trouble code) s.

Failure Type Byte

The failure type byte is designed to describe the specific failure associated with the basic DTC (diagnostic trouble code) . For example, a failure type byte of 1C means circuit voltage out of range, 73 means actuator stuck closed. When combined with a basic component DTC (diagnostic trouble code) , it allows one basic DTC (diagnostic trouble code) to describe many types of failures.

DTC Byte 1		DTC Byte 2		Failure Type Byte		Status Byte	
0000	0100	0010	0000	0001	1100	1010	1111
P0	1	1	0	1	C	A	F

For example, P0110:1C-AF means IAT (intake air temperature) sensor circuit voltage out of range. The base DTC (diagnostic trouble code) , P0110, means IAT (intake air temperature) sensor circuit, while the failure type byte 1C means circuit voltage out of range. This DTC (diagnostic trouble code) structure was designed to allow manufacturers to more precisely identify different kinds of faults without always having to define new DTC (diagnostic trouble code) numbers.

The PCM (powertrain control module) does not use failure type bytes and always sends a failure type byte of 00 (no sub type information). This is because OBD (on-board diagnostic) II regulations require manufacturers to use 2 byte DTC (diagnostic trouble code) s for generic scan tool communications. Additionally, the OBD (on-board diagnostic) II regulations require the 2 byte DTC (diagnostic trouble code) s to be very specific, so there is no additional information that the failure type byte could provide.

A list of failure type bytes is defined by SAE J2012 but is not described here because the PCM (powertrain control module) does not use the failure type byte.

Status Byte

- 0 - The DTC (diagnostic trouble code) test completed and was not failed on the current or previous monitoring cycle
- 1 - The DTC (diagnostic trouble code) test failed on the current or previous monitoring cycle

Bit 1

- 0 - The DTC (diagnostic trouble code) test has not failed on the current monitoring cycle
- 1 - The DTC (diagnostic trouble code) test failed on the current monitoring cycle

Bit 0

- 0 - The DTC (diagnostic trouble code) is not failed at the time of request
- 1 - The DTC (diagnostic trouble code) is failed at the time of request

For DTC (diagnostic trouble code) s that illuminate the MIL (malfunction indicator lamp) , a confirmed DTC (diagnostic trouble code) means the PCM (powertrain control module) has stored a DTC (diagnostic trouble code) and has illuminated the MIL (malfunction indicator lamp) . If the fault has corrected itself, the MIL (malfunction indicator lamp) may no longer be illuminated but the DTC (diagnostic trouble code) still shows a confirmed status for 40 warm up cycles at which time the DTC (diagnostic trouble code) is erased.

For DTC (diagnostic trouble code) s that do not illuminate the MIL (malfunction indicator lamp) , a confirmed DTC (diagnostic trouble code) means the PCM (powertrain control module) has stored a DTC (diagnostic trouble code) . If the fault has corrected itself, the DTC (diagnostic trouble code) still shows a confirmed status for 40 warm up cycles at which time the DTC (diagnostic trouble code) is erased.

To determine if a test has completed and passed, such as after a repair, information can be combined from 2 bits as follows:

If bit 6 is 0 (the DTC (diagnostic trouble code) test completed this monitoring cycle), and bit 1 is 0 (the DTC (diagnostic trouble code) test has not failed on the current monitoring cycle), then the DTC (diagnostic trouble code) has been evaluated at least once this drive cycle and was a pass.

If bit 6 is 0 (the DTC (diagnostic trouble code) test completed this monitoring cycle) and bit 0 is 0 (the DTC (diagnostic trouble code) test is not failed at the time of request), then the most recent test result for that DTC (diagnostic trouble code) was a pass.

The status byte bits can be decoded as a 2 digit hexadecimal number, and displayed as the last 2 digits of the DTC (diagnostic trouble code) , for example for DTC (diagnostic trouble code) P0110:1C-AF, AF represents the status byte info.

Status Byte	
A equals 1010	F equals 1111

described by the appropriate monitor found under the OBD (on-board diagnostic) Monitor Exercised column.

Federal OBD (on-board diagnostic) requires that all vehicles comply with 0.5 mm (0.020 inch) EVAP (evaporative emission) system requirements in addition to meeting the 1.0 mm (0.040 inch) EVAP (evaporative emission) system monitoring requirements. Some vehicles will use the engine off 0.5 mm (0.020 inch) EVAP (evaporative emission) monitor rather than the 1.0 mm (0.040 inch) EVAP (evaporative emission) monitor to set I/M Readiness.

For the EVAP (evaporative emission) system monitor to run, the ambient air temperature must be between 4.4 to 37.8°C (40 to 100°F), and the altitude below 2,438 meters (8,000 feet). If the OBD (on-board diagnostic) monitors must be completed in these conditions, the PCM (powertrain control module) must detect them once (twice on some applications) before the EVAP (evaporative emission) system monitor can be bypassed and OBD (on-board diagnostic) monitors readied. The EVAP (evaporative emission) Monitor Bypass procedure is described in the following drive cycle.

Use a scan tool to carry out the OBD (on-board diagnostic) drive cycle. Refer to the scan tool manufacturer's instruction manual for each described function.

Drive Cycle Recommendations

NOTICE

Strict observance of posted speed limits and attention to driving conditions are mandatory when proceeding through the following drive cycles. Failure to follow these instructions may result in personal injury.

A. Most OBD (on-board diagnostic) monitors complete more readily using a steady foot driving style during cruise or acceleration modes. Operating the throttle in a smooth fashion minimizes the time required for monitor completion.

B. The fuel tank level should be between 1/2 and 3/4 full with 3/4 full being the most desirable.

C. The EVAP (evaporative emission) purge flow monitor can operate only during the first 30 minutes of engine operation. When executing the procedure for this monitor, stay in part throttle mode and drive in a smooth fashion to minimize fuel slosh.

D. The EVAP (evaporative emission) 0.508 mm (0.020 inch) leak check monitor runs after the ignition is turned OFF. The vehicle must be driven to complete the EVAP (evaporative emission) purge flow monitor to increase the temperature of the fuel in the fuel tank.

E. When bypassing the EVAP (evaporative emission) engine soak times, the PCM (powertrain control module) must remain powered (ignition ON) after clearing the continuous DTC (diagnostic trouble code) s and relearning emission diagnostic information.

		monitor.
EVAP (evaporative emission)	6. Cruise at 77 to 104 km/h (48 to 65 mph) for 10 minutes (avoid sharp turns and hills). NOTE: To initiate the monitor, the throttle should be at part throttle, EVAPDC must be greater than 75%, and FLI must be between 15 and 85%, and for fuel tanks over 25 gallons FLI must be between 30 and 85%.	Executes the EVAP (evaporative emission) purge flow monitor if the ambient air temperature is between 4.4 to 37.8°C (40 to 100°F).
Catalyst	7. Drive in stop and go traffic conditions. Decelerate at closed throttle and then moderately accelerate from each stop. Include 5 different constant cruise speeds, ranging from 40 to 72 km/h (25 to 45 mph) over a 10 minute period.	Executes the catalyst monitor.
EGR (exhaust gas recirculation)	8. From a stop, idle for 30 seconds, accelerate to 72 km/h (45 mph) at 1/2 to 3/4 throttle, cruise at steady throttle for 1 minute. Repeat idle, acceleration and cruise 3 times.	Executes the EGR (exhaust gas recirculation) monitor.
CCM (Engine)	9. Bring the vehicle to a stop. Idle with the transmission in drive (neutral for M/T) for 2 minutes.	Executes the idle air control portion of the comprehensive component monitor (CCM).
CCM (Transmission)	10. For M/T, accelerate from 0 to 80 km/h (0 to 50 mph), and continue to step 11. For A/T, from a stop and in overdrive, moderately accelerate to 80 km/h (50 mph) and cruise for greater than 15 seconds. Stop the vehicle and repeat without overdrive to 64 km/h (40 mph) cruising for greater than 30 seconds. While at 64 km/h (40 mph), activate the overdrive, accelerate to 80 km/h (50 mph) and cruise for greater than 15 seconds. Stop for at least 20 seconds and repeat step 10 five times.	Executes the transmission portion of the CCM.
Misfire, Fuel And Deceleration Fuel Shut Off Rear HO2S (heated oxygen sensor) Monitors	11. From a stop, accelerate to 104 km/h (65 mph), hold steady throttle for 5 seconds, then decelerate at closed throttle to 64 km/h (40 mph) (no brakes), accelerate from 64 km/h (40 mph) to 104 km/h (65 mph), hold steady throttle for 5 seconds, repeat deceleration 5 times.	Allows learning for the misfire monitor, and completion of the deceleration fuel shut off

A MIL (malfunction indicator lamp) was required to illuminate and alert the driver of the concern and the need to repair the emission control system. A DTC (diagnostic trouble code) was required to assist in identifying the system or component associated with the concern.

Starting with the 1994 model year, both CARB and the Environmental Protection Agency (EPA) mandated enhanced OBD (on-board diagnostic) systems, commonly known as OBD (on-board diagnostic) II. The objectives of the OBD (on-board diagnostic) II system are to improve air quality by reducing high in use emissions caused by emission related concerns, reducing the time between the occurrence of a concern and its detection and repair, and assisting in the diagnosis and repair of emission related problems.

OBD II Systems

The OBD (on-board diagnostic) II system monitors virtually all emission control systems and components that can affect tailpipe or evaporative emissions. In most cases, concerns must be detected before emissions exceed 1.5 times the applicable 120,000 or 150,000 mile emission standards. Partial zero emission vehicles (PZEV) and super ultra low emission vehicles (SULEV-II) can use 2.5 times the standard in place of the 1.5 times the standard. If a system or component exceeds emission thresholds or does not operate within a manufacturer's specifications, a DTC (diagnostic trouble code) is stored and the MIL (malfunction indicator lamp) is illuminated within 2 drive cycles.

The OBD (on-board diagnostic) II system monitors for concerns either continuously (regardless of driving mode) or non-continuously (once per drive cycle during specific drive modes). A pending DTC (diagnostic trouble code) is stored in the PCM (powertrain control module) KAM (keep alive memory) when a concern is initially detected. Pending DTC (diagnostic trouble code) s are displayed as long as the concern is present. The OBD (on-board diagnostic) regulations require a complete concern free monitoring cycle to occur before erasing a pending DTC (diagnostic trouble code) . This means that a pending DTC (diagnostic trouble code) is erased on the next power up after a concern free monitoring cycle. However, if the concern is still present after 2 consecutive drive cycles, the MIL (malfunction indicator lamp) is illuminated. Once the MIL (malfunction indicator lamp) is illuminated, 3 consecutive drive cycles without a concern being detected are required to extinguish the MIL (malfunction indicator lamp) . The DTC (diagnostic trouble code) is erased after 40 engine warm up cycles once the MIL (malfunction indicator lamp) is extinguished.

In addition to specifying and standardizing much of the diagnostics and MIL (malfunction indicator lamp) operation, OBD (on-board diagnostic) requires the use of a standard DLC (data link connector) , standard communication links and messages, standardized DTC (diagnostic trouble code) s and terminology. Examples of standard diagnostic information are freeze frame data and inspection/maintenance (I/M) readiness indicators.

Freeze frame data describes data stored in KAM (keep alive memory) at the point the concern is initially detected and the pending DTC (diagnostic trouble code) is stored. Freeze frame data consists of parameters such as engine RPM (revolutions per minute) , engine load, vehicle speed or throttle position. Freeze frame data is updated when the concern is detected again on a subsequent drive cycle and a confirmed DTC (diagnostic trouble code) is stored; however, a previously stored freeze frame is overwritten if a higher priority clearing DTC (diagnostic trouble code) s, running the OBD (on-board diagnostic) Drive Cycle ensures that all monitors complete, the Permanent DTC (diagnostic trouble code) Driving Cycle completes, inspection/maintenance (I/M) readiness codes are set to a ready status and any permanent DTC (diagnostic trouble code) s are erased. A permanent DTC (diagnostic trouble code) cannot be erased by clearing the KAM (keep alive memory) . The intended use of the permanent DTC (diagnostic trouble code) is to prevent vehicles from passing an in use inspection simply by disconnecting the battery or clearing the DTC (diagnostic trouble code) s with a scan tool prior to the inspection. The presence of permanent DTC (diagnostic trouble code) s at an inspection without the MIL (malfunction indicator lamp) illuminated is an indication that a correct repair was not verified by the on board monitoring system.

Power and Ground Signals

Accelerator Pedal Position Reference Voltage (APPVREF)

The APPVREF is a consistent positive voltage (5 volts plus or minus 0.5 volt) circuit.

Accelerator Pedal Position Return (APPRTN)

The APPRTN is a return path for APPVREF circuit.

Electronic Throttle Control Reference Voltage (ETCREF)

The ETCREF is a consistent positive voltage (5 volts plus or minus 0.5 volt) circuit.

Electronic Throttle Control Return (ETCRTN)

The ETCRTN is a return path for ETCREF circuit.

Gold Plated Pins

Some engine control hardware has gold plated pins within the connectors and mating harness connectors to improve electrical stability for low current draw circuits and to enhance corrosion resistance. The engine control (EC) components equipped with gold plated pins vary by vehicle application. Only replace gold plated pins with new gold plated pins.

Keep Alive Power (KAPWR)

The KAPWR provides a constant voltage input independent of ignition switch state to the PCM. This voltage is used by the PCM (powertrain control module) to maintain the KAM (keep alive memory) .

Power Ground (PWRGND)

The PWRGND circuits provides a return path for the PCM (powertrain control module) vehicle power (VPWR) circuits.

Signal Return (SIGRTN)

The SIGRTN is a dedicated return path for VREF applied components.

Variable Reluctance Sensor Return (VRSRTN)

The VCT (variable camshaft timing) system has 4 operational modes: idle, part throttle, wide open throttle (WOT), and default mode. At idle and low engine speeds with closed throttle, the PCM (powertrain control module) determines the phase angle based on airflow, engine oil temperature and engine coolant temperature. At part and wide open throttle the PCM (powertrain control module) determines the phase angle based on engine RPM (revolutions per minute) , load, and throttle position. The VCT (variable camshaft timing) system provides reduced emissions and enhanced engine power, fuel economy and idle quality. In addition, some VCT (variable camshaft timing) system applications can eliminate the need for an external EGR (exhaust gas recirculation) system. The elimination of the EGR (exhaust gas recirculation) system is accomplished by controlling the overlap time between the intake valve opening and exhaust valve closing.

Vehicle Speed Limiter

The PCM (powertrain control module) disables some or all of the fuel injectors whenever a vehicle over speed condition is detected. The purpose of the vehicle speed limiter is to prevent damage to the powertrain. Once the driver reduces the excessive vehicle speed, the engine returns to the normal operating mode. No repair is required. However, the technician should clear the DTC (diagnostic trouble code) s and inform the customer of the reason for the DTC (diagnostic trouble code) .

Either excessive wheel slippage caused by sand, gravel, rain, mud, snow, ice or excessive RPM (revolutions per minute) increase in neutral may cause the vehicle speed limiter to activate even though the vehicle has not exceeded the maximum speed limit.

Component Description

Camshaft Position (CMP) Sensor

The CMP (camshaft position) sensor detects the position of the camshaft. The CMP (camshaft position) sensor identifies when piston number 1 is on its compression stroke. A signal is then sent to the PCM (powertrain control module) and used for synchronizing the sequential firing of the fuel injectors. Coil on plug (COP) ignition applications use the CMP (camshaft position) sensor signal to select the correct ignition coil to fire.

Engines with 4 camshafts and with VCT are equipped with 4 CMP sensors. The 4 sensors identify the position of each camshaft.

The 4 sensor system uses the following CMP sensor signal circuit names:

- CMP11 - bank 1, sensor 1 (intake camshaft)
- CMP12 - bank 1, sensor 2 (exhaust camshaft)
- CMP21 - bank 2, sensor 1 (intake camshaft)
- CMP22 - bank 2, sensor 2 (exhaust camshaft)

Crankshaft Position (CKP) Sensor

Crankshaft Position System

303-14A Electronic Engine Controls - 2.7L EcoBoost (238kW/324PS)	***2022 F-150***
Diagnosis and Testing	***Procedure revision date: 10/30/2020***

Crankshaft Position System

Diagnostic Trouble Code (DTC) Chart

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices.

REFER to: Diagnostic Methods

(100-00 General Information, Description and Operation).

Diagnostic Trouble Code Chart

Module	DTC (diagnostic trouble code)	Description	Action
PCM (powertrain control module)	P0315:00	Crankshaft Position System Variation Not Learned: No Sub Type Information	GO to Pinpoint Test JD
PCM (powertrain control module)	P0335:00	Crankshaft Position Sensor A Circuit: No Sub Type Information	GO to Pinpoint Test JD
PCM (powertrain control module)	P0339:00	Crankshaft Position Sensor A Circuit Intermittent: No Sub Type Information	GO to Pinpoint Test JD

control module) P0335:00	Type Information	pulse is missing for greater than a calibrated number of camshaft revolutions when the camshaft speed exceeds the equivalent speed of engine idle or the starter motor is engaged. An inactive CKP (crankshaft position) signal causes a no start condition. Monitor the RPM PID (parameter identification) while cranking the engine. A value of 0 RPM (revolutions per minute) indicates a CKP (crankshaft position) concern.
PCM (powertrain control module) P0339:00	Crankshaft Position Sensor 'A' Circuit Intermittent: No Sub Type Information	Sets when the PCM (powertrain control module) detects several erratic PIP (profile ignition pick-up) pulses have occurred in the CKP (crankshaft position) sensor signal within a calibrated time period when the camshaft speed exceeds the equivalent speed of engine idle or the starter motor is engaged.
PCM (powertrain control module) P033F:00	Crankshaft/Camshaft Loss Of Synchronization: No Sub Type Information	Sets when the PCM (powertrain control module) detects the input signal from the CKP (crankshaft position) sensor or the CMP (camshaft position) sensor is erratic.

Possible Sources

- CKP (crankshaft position) sensor circuitry concern
- Crankshaft pulse wheel
- CKP (crankshaft position) sensor (6C315)
- PCM (powertrain control module) (12A650)

Pinpoint Test Steps available in the on-line Workshop Manual.