

HN: Turbocharger System

 **WARNING:** While conducting tests on a hot engine take all safety precautions to prevent skin contact with hot engine components. Failure to follow these instructions may result in personal injury.

 **WARNING:** Strict observance of posted speed limits and driving conditions is mandatory when proceeding through the following drive cycles.

Failure to follow these instructions may result in personal injury.

Note: To recreate the original conditions that set the DTC or caused the symptom, the vehicle may require driving.

This pinpoint test is intended to diagnose the following:

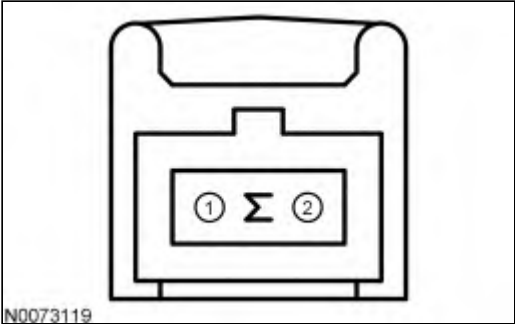
- turbocharger bypass (TCBY) valve (9K378)
- turbocharger bypass 2 (TCBY2) valve (9K378)
- turbocharger wastegate regulating valve bank 1 solenoid 1 (9961 pressure actuated, 9E882 vacuum actuated)
- turbocharger wastegate regulating valve bank 2 solenoid 1 (9961 pressure actuated, 9E882 vacuum actuated)
- turbocharger wastegate motor (9G488)
- wastegate vacuum sensor (9F479)
- leaks or restrictions in the intake air system and charge air cooler (CAC)
- PCM (12A650)

Turbocharger Type

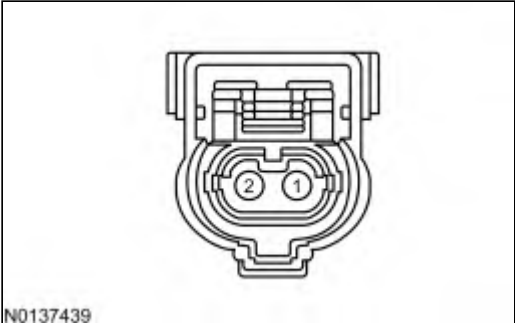
Vehicles	Electric Actuated Wastgate	Pressure Actuated Wastegate	Vacuum Actuated Wastegate (Normally Closed)	Vacuum Actuated Wastegate (Normally Open)
Fusion 1.5L, Transit Connect				X
Aviator, Continental, Edge 2.7L, Explorer 3.0L, F-150 2.7L, Fusion 2.0L, Fusion 2.7L, MKZ, Nautilus 2.7L			X	
Corsair, Edge 2.0L, Escape/Kuga 2.0L, Expedition, Explorer 2.3L, F-150 3.5L, Nautilus 2.0L, Navigator, Ranger 2.3L	X			
All others		X		

Turbocharger Bypass (TCBY) Valve Connector

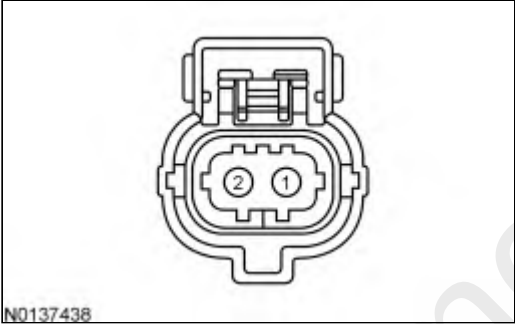
A



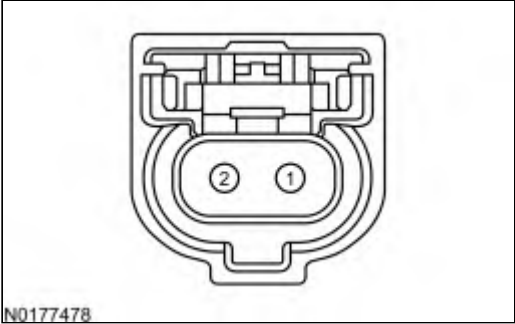
B



C



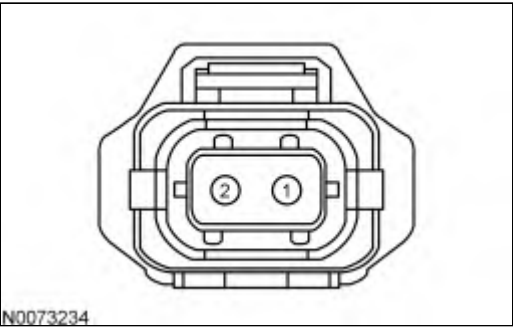
D



Vehicle	Connector	Pin	Circuit
EcoSport	A	2 1	TCBY VPWR

Vehicle	Connector	Pin	Circuit
Expedition, Navigator	B	1	TCBY
		2	VPWR
Flex, Transit	C	2	TCBY
		1	VPWR
Ranger	D	2	TCBY
		1	VPWR
All other vehicles	B	2	TCBY
		1	VPWR

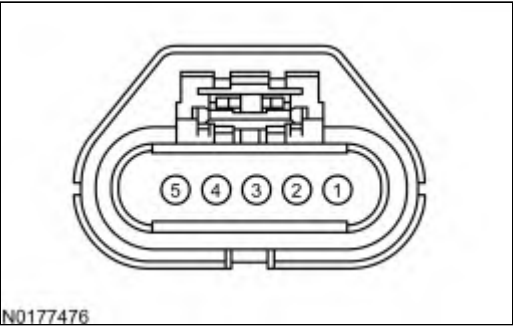
Turbocharger Bypass 2 (TCBY2) Valve Connector



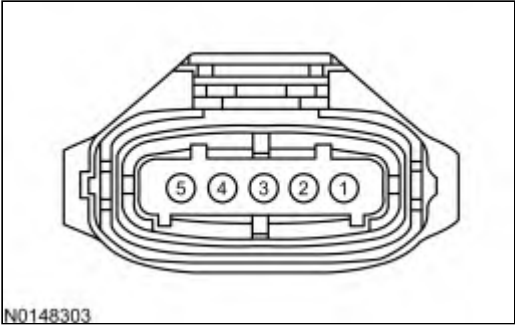
Pin	Circuit
2	TCBY2 (Turbocharger Bypass 2)
1	VPWR (Vehicle Power)

Turbocharger Wastegate Motor Bank 1 Connector

A

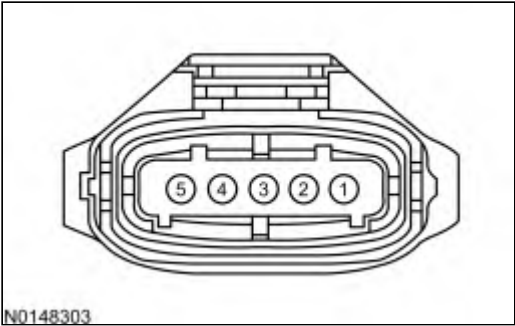


B



Vehicle	Connector	Pin	Circuit
Corsair, Escape/Kuga 2.0L	A	2 1 4 5 3	TCWGM1- TCWGM1+ TCWGP1 SIGRTN VREF
Edge, Nautilus 2.0L	B	2 1 4 5 3	TCWGM1- TCWGM1+ TCWGP1 SIGRTN VREF
Expedition, F-150, Navigator	B	5 1 2 3 4	TCWGM1- TCWGM1+ TCWGP1 SIGRTN VREF
Explorer 2.3L, Ranger 2.3L	A	1 2 4 5 3	TCWGM1- TCWGM1+ TCWGP1 SIGRTN VREF

Turbocharger Wastegate Motor Bank 2 Connector

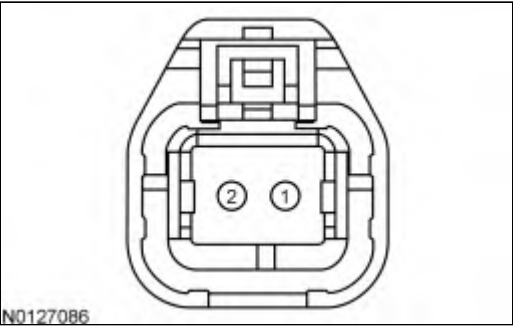


Pin	Circuit
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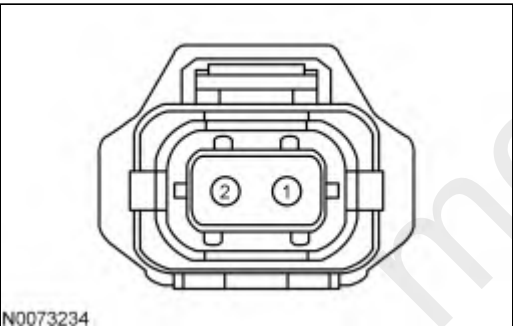
Pin	Circuit
5	TCWGM2- (Turbocharger Wastegate Motor Bank 2 -)
1	TCWGM2+ (Turbocharger Wastegate Motor Bank 2 +)
2	TCWGP2 (Turbocharger Wastegate Position Bank 2)
3	SIGRTN (Signal Return)
4	VREF (Voltage Reference)

Turbocharger Wastegate Regulating Valve Bank 1, Solenoid 1 Connector

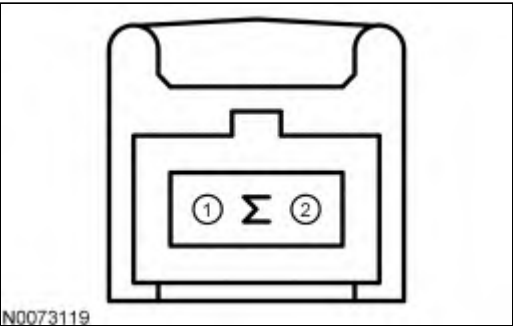
A



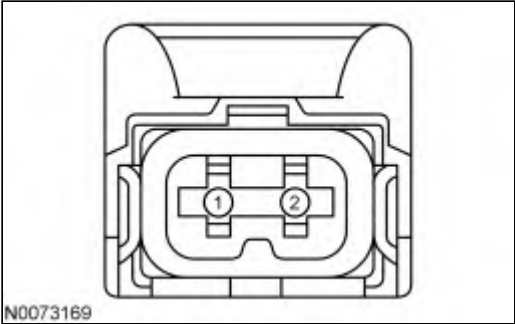
B



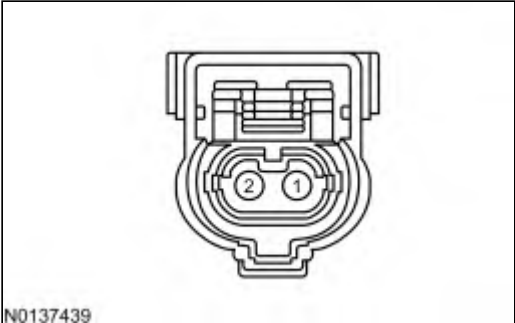
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D

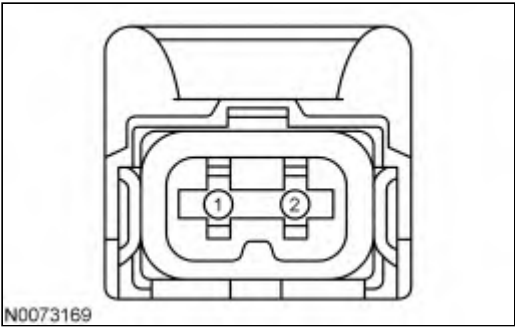


E



Vehicle	Connector	Pin	Circuit
Aviator, EcoSport, Escape/Kuga, Explorer	A	2 1	TCWRVS11 VPWR
Continental, Edge, F-150, Nautilus	B	2 1	TCWRVS11 VPWR
Flex	C	2 1	TCWRVS11 VPWR
Ford GT, Mustang	D	1 2	TCWRVS11 VPWR
Fusion 1.5L, Fusion 2.7L, MKZ 3.0L	E	2 1	TCWRVS11 VPWR
All other vehicles	C	1 2	TCWRVS11 VPWR

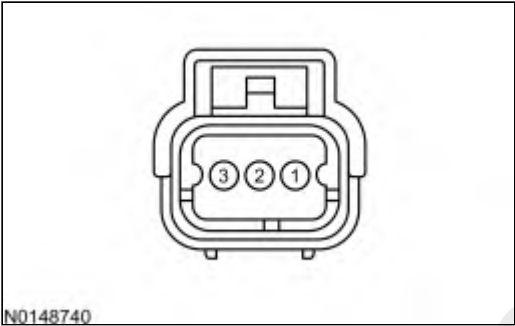
Turbocharger Wastegate Regulating Valve Bank 2, Solenoid 1 Connector



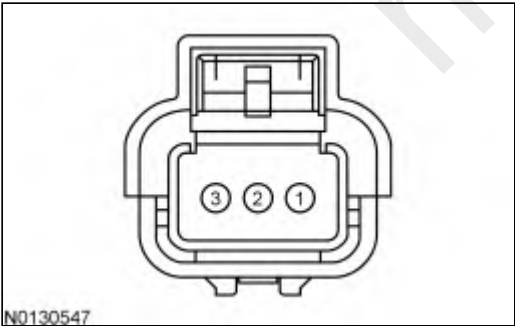
Pin	Circuit
1	TCWRVS21 (Turbocharger Wastegate Regulating Valve Bank 2, Solenoid 1)
2	VPWR (Vehicle Power)

Wastegate Vacuum Sensor Connector

A



B



Vehicle	Connector	Pin	Circuit
Aviator, Explorer	A	2	SIGRTN
		3	WVS
		1	VREF

Vehicle	Connector	Pin	Circuit
All other vehicles	B	2 3 1	SIGRTN WVS VREF

Powertrain Control Module (PCM) Connector

For PCM connector views or reference values, refer to Section 6, Reference Values.

Vehicle	Connector	Pin	Circuit
Aviator, Explorer 3.0L, F-150 2.7L	306 PIN	E5 E7 E15 E80	SIGRTN WVS TCWRVS11 TCBY
Continental 2.0L, Fusion 2.0L, MKZ 2.0L	198 PIN	E20 E35 E16 E3	SIGRTN WVS TCWRVS11 TCBY
Continental 2.7L, Continental 3.0L, Fusion 2.7L	198 PIN	E20 B33 E16 E3	SIGRTN WVS TCWRVS11 TCBY
EcoSport 1.0L Automatic Transmission, Fusion 1.5L	198 PIN	E16 E3	TCWRVS11 TCBY
EcoSport 1.0L Manual Transmission	198 PIN	E47	TCWRVS11
Edge 2.0L, Nautilus 2.0L	198 PIN	E47 E46 E17 E16 E6	TCWGM1- TCWGM1+ TCWGP1 TCWRVS11 TCBY
Edge 2.7L	306 PIN	E13 B7 B15 E80	SIGRTN WVS TCWRVS11 TCBY
Escape/Kuga 1.5L, Mustang, Transit Connect	198 PIN	E2 E6	TCWRVS11 TCBY

Vehicle	Connector	Pin	Circuit
Expedition, F-150 3.5L High Output, Navigator	198 PIN	E77 E78 E23 E14 E15 E22 E75	TCWGM2- TCWGM2+ TCWGP2 TCWGM1- TCWGM1+ TCWGP1 TCBY
F-150 3.5L	306 PIN	E82 E61 E27 E108 E87 E7 E80	TCWGM2- TCWGM2+ TCWGP2 TCWGM1- TCWGM1+ TCWGP1 TCBY
Flex	198 PIN	E16 E19 E3	TCWRVS11 TCBY2 TCBY
Ford GT	198 PIN	E19 E3 E4 E2	TCWRVS21 TCWRVS11 TCBY2 TCBY
MKZ 3.0L	198 PIN	B18 B33 E16 E3	SIGRTN WVS TCWRVS11 TCBY
Nautilus 2.7L	306 PIN	E20 B7 B15 E80	SIGRTN WVS TCWRVS11 TCBY
Transit	306 PIN	E15 E80	TCWRVS11 TCBY
All other vehicles	198 PIN	E47 E46 E17 E6	TCWGM1- TCWGM1+ TCWGP1 TCBY

HN1 CHECK FOR DIAGNOSTIC TROUBLE CODES (DTCS)

Note: This pinpoint test is designed to diagnose multiple components in the same test steps, only measure the circuits that apply to the vehicle and component being diagnosed.

Note: Diagnose and repair all circuit DTCs before diagnosing DTCs P0234 or P0299.

Note: Diagnose and repair all circuit DTCs before diagnosing any range or performance DTCs.

Are DTCs P0034, P0035, P00C1, P00C2, P0234, P0243, P0244, P0245, P0246, P0247, P0248, P0249, P0250, P0299, P100F, P1011, P1012, P1013, P1014, P1015, P1016, P25B3, P25B4, P25B5, P25B6, P2AB7, P2AB8, P2AB9, P2ABA,

P2ABB, P2ABC, P2ABD, or P2ABE present?

Yes	For DTCs P0034, P0035, P00C1, P00C2, P0234, P0245, P0246, P0299, P100F, P1011, P1012, P1013, P1014, P1015 or P1016, GO to HN2 . For all others, GO to HN29 .
No	For Corsair, Edge 2.0L, Escape/Kuga 2.0L, Expedition, Explorer 2.3L, F-150 3.5L, Nautilus 2.0L, Navigator, and Ranger 2.3L symptoms without DTCs, GO to HN37 . For all other symptoms without DTCs, GO to HN12 . For all others, RETURN to Section 3, Symptom Charts for further direction.

HN2 VISUALLY INSPECT THE TURBOCHARGER SYSTEM

- Visually inspect the turbocharger system for:
 - correct vacuum supply system hose connections and routing
 - correct vacuum turbocharger wastegate control hose connection and routing
 - correct pressure turbocharger wastegate control hose connection and routing
 - correct vacuum turbocharger bypass control hose connection and routing
 - leaks around tubing and intake manifold
 - correct electrical connections
 - damaged or leaking exhaust system
 - turbocharger oil leaks. Refer to the Workshop Manual Section 303-04, Fuel Charging and Controls — Turbocharger.
 - damaged or restricted turbocharger oil return tubes. Refer to the Workshop Manual Section 303-04, Fuel Charging and Controls — Turbocharger.
 - damaged turbocharger. Refer to the Workshop Manual Section 303-04, Fuel Charging and Controls — Turbocharger.
 - turbocharger wastegate linkage damaged or disconnected
 - turbocharger wastegate linkage retainer damaged or disconnected

Do the visual inspections reveal any concerns?

Yes	REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	For DTC P100F, GO to HN3 . For DTCs P1011, P1012, P1013, P1014, P1015 or P1016, GO to HN4 . For all others, GO to HN5 .

HN3 SENSOR CORRELATION

- Ignition ON, engine OFF.
- Access the PCM and monitor the BARO (PRESS), MAP (PRESS), TCBP (PRESS) and WGATE_PRES (PRESS) PIDs.

Is the WGATE_PRES PID reading within 6.77 kPa (0.98 psi) of the other PID readings?

Yes	GO to HN5 .
No	CHECK the turbocharger wastegate vacuum system hoses for restrictions. REPAIR as necessary. If no concerns are present, INSTALL a new Wastegate Vacuum Sensor. Clear the PCM DTCs. REPEAT the self-test.

HN4 CHECK FOR VREF AT THE SENSOR

- Ignition OFF.
- Wastegate Vacuum Sensor connector disconnected.
- Ignition ON, engine OFF.
- Measure the voltage between:

(+) Wastegate Vacuum Sensor Connector, Harness Side	(-) Wastegate Vacuum Sensor Connector, Harness Side
VREF	SIGRTN

Is the voltage between 4.5 - 5.5 V?

Yes	GO to HN6 .
No	GO to Pinpoint Test C .

HN5 CHECK FOR VOLTAGE AT THE COMPONENT

Note: This step applies to multiple components, only measure the circuits that apply to the vehicle and component being diagnosed.

- Ignition OFF.
- For the TCBY valve,
- TCBY Valve connector disconnected.
- Ignition ON, engine OFF.
- Measure the voltage between:

(+) TCBY Valve Connector, Harness Side	(-)
VPWR	Ground

- For the TCBY2 valve,
- TCBY2 Valve connector disconnected.
- Ignition ON, engine OFF.
- Measure the voltage between:

(+) TCBY2 Valve Connector, Harness Side	(-)
VPWR - Pin 1	Ground

- For the turbocharger wastegate regulating valve bank 1, solenoid 1,
- Turbocharger Wastegate Regulating Valve Bank 1, Solenoid 1 connector disconnected.
- Ignition ON, engine OFF.
- Measure the voltage between:

(+) Turbocharger Wastegate Regulating Valve Bank 1, Solenoid 1 Connector, Harness Side	(-)
VPWR	Ground

- For the turbocharger wastegate regulating valve bank 2, solenoid 1,
- Turbocharger Wastegate Regulating Valve Bank 2, Solenoid 1 connector disconnected.
- Ignition ON, engine OFF.
- Measure the voltage between:

(+) Turbocharger Wastegate Regulating Valve Bank 2, Solenoid 1 Connector, Harness Side	(-)
VPWR - Pin 2	Ground

Is the voltage greater than 10.5 V?

Yes	GO to HN6 .
No	REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test.

HN6 CHECK FOR AN OPEN

Note: This step applies to multiple components, only measure the circuits that apply to the vehicle and component being diagnosed.

- Ignition OFF.
- PCM connector disconnected.
- For the TCBY valve,
- Measure the resistance between:

(+) TCBY Valve Connector, Harness Side	(-) PCM Connector, Harness Side
TCBY	TCBY

- For the TCBY2 valve,
- Measure the resistance between:

(+) TCBY2 Valve Connector, Harness Side	(-) PCM Connector, Harness Side
TCBY2 - Pin 2	TCBY2

- For the turbocharger wastegate regulating valve bank 1, solenoid 1,
- Measure the resistance between:

(+) Turbocharger Wastegate Regulating Valve Bank 1, Solenoid 1 Connector, Harness Side	(-) PCM Connector, Harness Side
TCWRVS11	TCWRVS11

- For the turbocharger wastegate regulating valve bank 2 solenoid 1,
- Measure the resistance between:

(+) Turbocharger Wastegate Regulating Valve Bank 2, Solenoid 1 Connector, Harness Side	(-) PCM Connector, Harness Side
TCWRVS21 - Pin 1	TCWRVS21

- For the wastegate vacuum sensor,
- Measure the resistance between:

(+) Wastegate Vacuum Sensor Connector, Harness Side	(-) PCM Connector, Harness Side
WVS	WVS
SIGRTN	SIGRTN

Are the resistances less than 5 ohms?

Yes	GO to HN7 .
No	REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test.

HN7 CHECK FOR A SHORT TO GROUND

Note: This step applies to multiple components, only measure the circuits that apply to the vehicle and component being diagnosed.

- Ignition OFF.
- For the TCBY valve,
- Measure the resistance between:

(+) TCBY Valve Connector, Harness Side	(-)
TCBY	Ground

- For the TCBY2 valve,
- Measure the resistance between:

(+) TCBY2 Valve Connector, Harness Side	(-)
TCBY2 - Pin 2	Ground

- For the turbocharger wastegate regulating valve bank 1 solenoid 1,
- Measure the resistance between:

(+) Turbocharger Wastegate Regulating Valve Bank 1, Solenoid 1 Connector, Harness Side	(-)
TCWRVS11	Ground

- For the turbocharger wastegate regulating valve bank 2 solenoid 1,
- Measure the resistance between:

(+) Turbocharger Wastegate Regulating Valve Bank 2, Solenoid 1 Connector, Harness Side	(-)
TCWRVS21 - Pin 1	Ground

- For the wastegate vacuum sensor,
- Measure the resistance between:

(+) Wastegate Vacuum Sensor Connector, Harness Side	(-)
WVS	Ground

Is the resistance greater than 10K ohms?

Yes	GO to HN8 .
No	REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test.

HN8 CHECK FOR A SHORT TO VOLTAGE

Note: This step applies to multiple components, only measure the circuits that apply to the vehicle and component being diagnosed.

- Ignition ON, engine OFF.
- For the TCBY valve,
- Measure the voltage between:

(+) TCBY Valve Connector, Harness Side	(-)
TCBY	Ground

- For the TCBY2 valve,
- Measure the voltage between:

(+) TCBY2 Valve Connector, Harness Side	(-)
TCBY2 - Pin 2	Ground

- For the turbocharger wastegate regulating valve bank 1 solenoid 1,
- Measure the voltage between:

(+) Turbocharger Wastegate Regulating Valve Bank 1, Solenoid 1 Connector, Harness Side	(-)
TCWRVS11	Ground

- For the turbocharger wastegate regulating valve bank 2 solenoid 1,
- Measure the voltage between:

(+) Turbocharger Wastegate Regulating Valve Bank 2, Solenoid 1 Connector, Harness Side	(-)
TCWRVS21 - Pin 1	Ground

- For the wastegate vacuum sensor,
- Measure the voltage between:

(+) Wastegate Vacuum Sensor Connector, Harness Side	(-)
WVS	Ground

Is any voltage present?

Yes	REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test.
No	For DTCs P1011, P1012, P1013 or P1014, GO to HN10 . For all others, GO to HN9 .

HN9 CHECK THE COMPONENT RESISTANCE

Note: This step applies to multiple components, only measure the circuits that apply to the vehicle and component being diagnosed.

- Ignition OFF.
- For the TCBY valve,
- Measure the resistance between:

(+) TCBY Valve Connector, Component Side	(-) TCBY Valve Connector, Component Side
TCBY	VPWR

- For the TCBY2 valve,
- Measure the resistance between:

(+) TCBY2 Valve Connector, Component Side	(-) TCBY2 Valve Connector, Component Side
TCBY2 - Pin 2	VPWR - Pin 1

- For the turbocharger wastegate regulating valve bank 1 solenoid 1,
- Measure the resistance between:

(+) Turbocharger Wastegate Regulating Valve Bank 1, Solenoid 1 Connector, Component Side	(-) Turbocharger Wastegate Regulating Valve Bank 1, Solenoid 1 Connector, Component Side
TCWRVS11	VPWR

- For the turbocharger wastegate regulating valve bank 2 solenoid 1,
- Measure the resistance between:

(+) Turbocharger Wastegate Regulating Valve Bank 2, Solenoid 1 Connector, Component Side	(-) Turbocharger Wastegate Regulating Valve Bank 2, Solenoid 1 Connector, Component Side
TCWRVS21 - Pin 1	VPWR - Pin 2

Are the resistances between 5 - 60 ohms?

Yes	GO to HN10 .
No	INSTALL a new component. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test.

HN10 CHECK THE WIRING HARNESS

Note: This step applies to multiple components, only measure the circuits that apply to the vehicle and component being diagnosed.

- Ignition OFF.
- PCM connector connected.
- For the TCBY valve,
- TCBY Valve connector connected.

- Ignition ON, engine OFF.
- Access the PCM and monitor the TURBO_BP1_STAT (MODE) PID.
- For the TCBY2 valve,
- TCBY2 Valve connector connected.
- Ignition ON, engine OFF.
- Access the PCM and monitor the TURBO_BP2_STAT (MODE) PID.
- For the turbocharger wastegate regulating valve bank 1 solenoid 1,
- Turbocharger Wastegate Regulating Valve Bank 1, Solenoid 1 connector connected.
- For the turbocharger wastegate regulating valve bank 2 solenoid 1,
- Turbocharger Wastegate Regulating Valve Bank 2, Solenoid 1 connector connected.
- Ignition ON, engine OFF.
- Access the PCM and monitor the TWGATE_STAT (MODE) PID.
- For the wastegate vacuum sensor,
- Wastegate Vacuum Sensor connector connected.
- Ignition ON, engine OFF.
- Access the PCM and monitor the WGATE_PRES_F (MODE) PID.
- For the Corsair, Edge 2.0L, Escape/Kuga 2.0L, Expedition, Explorer 2.3L, F-150 3.5L, Nautilus 2.0L, Navigator, and Ranger 2.3L wastegate,
- Ignition ON, engine OFF.
- Access the PCM and monitor the WGATE_A_POS_PCT (PER) and WGATE_B_POS_PCT (PER) PIDs.
- While observing the PID, wiggle, shake, and bend small sections of the wiring harness while working from the component to the PCM.

Is there a change in the PID reading?

Yes	ISOLATE the concern. REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	GO to HN11 .

HN11 INTERMITTENT CHECK

Note: This step applies to multiple components, only measure the circuits that apply to the vehicle and component being diagnosed.

- For the TCBY,
- Access the PCM and monitor the TURBO_BP1_STAT (MODE) PID.
- For the TCBY2,
- Access the PCM and monitor the TURBO_BP2_STAT (MODE) PID.
- For the turbocharger wastegate regulating valve solenoids,
- Access the PCM and monitor the TWGATE_STAT (MODE) PID.
- For the wastegate vacuum sensor,
- Access the PCM and monitor the WGATE_PRES_F (MODE) PID.
- For the Corsair, Edge 2.0L, Escape/Kuga 2.0L, Expedition, Explorer 2.3L, F-150 3.5L, Nautilus 2.0L, Navigator, and Ranger 2.3L wastegate,
- Access the PCM and monitor the WGATE_A_POS_PCT (PER) and WGATE_B_POS_PCT (PER) PIDs.
- While observing the PID, carry out the following:
 - lightly tap on the suspect component to simulate road shock
 - wiggle the suspect component connector

Is there a change in the PID reading?

Yes	INSTALL a new component in question. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test.
No	For DTCs P1011, P1012, P1013, P1014, P1015 or P1016, GO to HN27 . For all others, GO to HN12 .

HN12 TURBOCHARGER SYSTEM PERFORMANCE CONCERNS

Note: For a performance concern related to a plugged or restricted exhaust, GO to [HF8](#).

Note: Diagnose circuit concerns prior to range or performance concerns.

Note: Visually inspect the vehicle for aftermarket accessories and performance modifications (exhaust system, turbocharger, performance chip). Refer to Section 1 [Engine Control \(EC\) System](#), Modifications to OBD Vehicles.

- Ignition OFF.
- Check the air filter element and housing for contamination, restrictions or water intrusion.
- Disconnect the air intake and check for restrictions or water intrusion.
- Visually inspect the turbocharger system for:
 - correct vacuum supply system hose connections and routing
 - correct vacuum turbocharger wastegate control hose connection and routing
 - correct pressure turbocharger wastegate control hose connection and routing
 - correct vacuum turbocharger bypass control hose connection and routing
 - leaks around the tubing and the intake manifold
 - correct electrical connections
 - damaged or leaking exhaust system
 - turbocharger oil leaks. Refer to the Workshop Manual Section 303-04, Fuel Charging and Controls — Turbocharger.
 - damaged or restricted turbocharger oil return tubes. Refer to the Workshop Manual Section 303-04, Fuel Charging and Controls — Turbocharger.
 - damaged turbocharger. Refer to the Workshop Manual Section 303-04, Fuel Charging and Controls — Turbocharger.
- Check the charge air cooler (CAC) system for leaks (hoses and cooler).
- Check the CAC and intake air system for restrictions.
- Check for aftermarket exhaust accessories and performance modifications.
- Visually inspect the exhaust system for the following:
 - leaks, cracks, or punctures upstream of the turbocharger
 - aftermarket accessories and performance modifications
 - tailpipe modifications that increase the exhaust restriction
 - restricted exhaust

Is a concern present?

Yes	REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	GO to HN13 .

HN13 CHECK THE CHARGE AIR COOLER (CAC) AND INTAKE AIR SYSTEMS FOR LEAKS AND RESTRICTIONS

Note: Remember to reinstall the sensor, reconnect the CAC tube to the throttle body and remove the plastic bag from the air filter at the completion of this step.

- Disconnect the CAC tube from the throttle body.
- Use a suitable method to temporarily plug the CAC tube outlet.
- Place the air filter in a plastic bag to prevent air flow out the intake port and reinstall it in the vehicle.
- Remove the IAT sensor from the ducting between the air filter housing and the turbocharger.
- Connect the Rotunda Smoke Machine, Fuel Evaporative Emission System Tester 218-00001 (522) or equivalent to the intake air system using an appropriate adapter.
- Fill the intake air system with smoke.
- Check the intake air system for leaks and restrictions.

Are any leaks or restrictions present?

Yes	REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	GO to HN14 .

HN14 CHECK BYPASS VALVE OPERATION

Note: For vehicles without the RPM command PID, use the accelerator pedal to hold the engine RPM at approximately 2,000 RPM.

Note: The TCBP PID value may decrease by 0.97 KPa (0.14 psi) or less when the TCBY valve is commanded ON.

- Ignition ON, engine running.
- Access the PCM and control the TURBO_BPASS (MODE) PID.
- Access the PCM and control the TURBO_BPASS_2 (MODE) PID.
- Command the TURBO_BPASS PID and the TURBO_BPASS_2 PID to OFF.
- For the Corsair, Edge 2.0L, Escape/Kuga 2.0L, Expedition, Explorer 2.3L, F-150 3.5L, Nautilus 2.0L, Navigator, and Ranger 2.3L wastegate,
- Access the PCM and monitor the WGATE_A_POS_PCT (PER) and WGATE_B_POS_PCT (PER) PIDs.
- For all others,
- Access the PCM and control the TURBO_WGATE (PER) PID.
- Command the TURBO_WGATE PID duty cycle to 100% (Aviator, Continental, Edge, Explorer 3.0L, F-150 2.7L, Fusion 2.0L, Fusion 2.7L, MKZ, Nautilus) or 0% (all others).
- Access the PCM and monitor the TCBP (PRESS) PID.
- Access the PCM and control the RPMDSD (RPM) PID.
- Command the RPM PID to the maximum RPM.
- Record the TCBP PID reading.
- Command the TURBO_BPASS and the TURBO_BPASS_2 PIDs ON and record the TCBP PID reading.

Does the TCBP PID reading decrease when the bypass valves are commanded ON?

Yes	For Corsair, Edge 2.0L, Escape/Kuga 2.0L, Expedition, Explorer 2.3L, F-150 3.5L, Nautilus 2.0L, Navigator, and Ranger 2.3L, GO to HN29 . For all others, GO to HN15 .
No	For EcoSport 1.0L, Fusion 2.0L, MKZ 2.0L, and Transit Connect, GO to HN19 . For all others, INSTALL a new TCBY solenoid. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test.

HN15 CHECK WASTEGATE OPERATION

Note: For vehicles without the RPM command PID, use the accelerator pedal to hold the engine RPM at approximately 2,000 RPM.

- Ignition ON, engine running.
- Access the PCM and control the TURBO_BPASS (MODE) PID.
- Access the PCM and control the TURBO_BPASS_2 (MODE) PID.
- Command the TURBO_BPASS PID and the TURBO_BPASS_2 PID to OFF.
- Access the PCM and control the TURBO_WGATE (PER) PID.
- Command the TURBO_WGATE PID duty cycle to 100% (Aviator, Continental, Edge, Explorer 3.0L, F-150 2.7L, Fusion 2.0L, Fusion 2.7L, MKZ, Nautilus) or 0% (all others).
- Access the PCM and monitor the TCBP (PRESS) PID.
- Access the PCM and control the RPMDSD (RPM) PID.
- Command the RPM PID to the maximum RPM.
- Record the TCBP PID reading.

- Command the TURBO_WGATE PID duty cycle to 0% (Aviator, Continental, Edge, Explorer 3.0L, F-150 2.7L, Fusion 2.0L, Fusion 2.7L, MKZ, Nautilus) or 100% (all others) and record the TCBP PID reading.

Does the TCBP PID reading increase from the initial recorded value?

Yes	GO to HN26 .
No	For Aviator, Continental, EcoSport 1.0L, Edge 2.7L, Explorer 3.0L, F-150 2.7L, Fusion, MKZ, Nautilus 2.7L, and Transit Connect, GO to HN22 . For all others, GO to HN16 .

HN16 CHECK TURBOCHARGER PRESSURE WASTEGATE ACTUATOR OPERATION

NOTICE: Do not exceed 103.4 kPa (15 psi) of pressure applied to the turbocharger actuators, excessive pressure will damage the actuators.

- Disconnect the turbocharger wastegate control hose from the turbocharger wastegate actuator.
- Record each of the turbocharger wastegate actuator linkage positions.
- Using a suitable hand pump with pressure gauge, pressurize the turbocharger wastegate actuator to 82.7 kPa (12 psi).

Does each turbocharger wastegate actuator linkage move from the starting position and does the pressure remain steady?

Yes	GO to HN17 .
No	GO to HN18 .

HN17 CHECK PRESSURE SYSTEM TO THE TURBOCHARGER WASTEGATE ACTUATOR

NOTICE: Do not exceed 103.4 kPa (15 psi) of pressure applied to the turbocharger actuators, excessive pressure will damage the actuators.

- Disconnect the pressure supply hose from the inlet of the turbocharger wastegate regulating valve solenoid.
- Disconnect the pressure control hose from the outlet of the turbocharger wastegate regulating valve solenoid.
- Using a suitable adaptor, connect the pressure supply hose to the pressure control hose.
- Disconnect the turbocharger wastegate pressure supply hose from the high pressure tube.
- Using a suitable hand pump with pressure gauge, pressurize the turbocharger wastegate pressure supply hose to 48.3 kPa (7 psi).

Does each turbocharger wastegate actuator linkage move from the starting position and does the pressure remain steady?

Yes	INSTALL a new turbocharger wastegate regulating valve solenoid in question. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls, Turbocharger. Clear the PCM DTCs. REPEAT the self-test.
No	A pressure system leak or restriction is the cause of the concern. DIAGNOSE the turbocharger wastegate pressure system leak or restriction. REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.

HN18 CHECK THE TURBOCHARGER WASTEGATE ACTUATOR LINKAGE FOR DAMAGE OR OBSTRUCTIONS

- Attempt to manually activate the suspect actuator.

Can the suspect actuator be activated manually?

Yes	INSTALL a new turbocharger wastegate actuator. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls. Clear the PCM DTCs. REPEAT the self-test.
No	Visually inspect the suspect turbocharger wastegate actuator linkage for damage or obstructions. Repair as necessary. If no turbocharger wastegate actuator linkage concerns are present, INSTALL a new turbocharger assembly. Refer to the Workshop Manual Section 303-04, Fuel Charging and Controls. Clear the PCM DTCs. REPEAT the self-test.

HN19 CHECK THE TURBOCHARGER BYPASS VALVE SOURCE VACUUM

- Disconnect the vacuum supply tube from the vacuum pump.
- Using the DSL ENG Pressure Test Kit 014-00761 or equivalent, measure the vacuum at the vacuum pump.
- Ignition ON, engine running.
- Record the vacuum.

Is the vacuum greater than 33.86 kPa (10 in-Hg)?

Yes	GO to HN20 .
No	DIAGNOSE a loss of vacuum. REFER to the Workshop Manual Section 206-00, Brake System. Clear the PCM DTCs. REPEAT the self-test.

HN20 CHECK THE BYPASS VALVE

- Disconnect the vacuum control tube from the TCBY valve.
- Using the DSL ENG Pressure Test Kit 014-00761 or equivalent, apply 33.86 kPa (10 in-hg) of vacuum to the TCBY valve.

Does the vacuum remain steady?

Yes	GO to HN21 .
No	INSTALL a new TCBY valve. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls, Turbocharger. Clear the PCM DTCs. REPEAT the self-test.

HN21 CHECK THE VACUUM SYSTEM

- Disconnect the vacuum supply tube from the inlet of the TCBY solenoid.
- Disconnect the vacuum control tube from the outlet of the TCBY solenoid.
- Using a suitable adaptor, connect the vacuum supply tube to the vacuum control tube.
- Disconnect the vacuum supply tube from the vacuum pump.
- Using the DSL ENG Pressure Test Kit 014-00761 or equivalent, apply 33.86 kPa (10 in-hg) of vacuum to the vacuum supply tube.

Does the vacuum remain steady?

Yes	INSTALL a new TCBY solenoid. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls, Turbocharger. Clear the PCM DTCs. REPEAT the self-test.

No	A vacuum system leak or restriction is the cause of the concern. DIAGNOSE the vacuum system leak or restriction. REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
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HN22 CHECK THE TURBOCHARGER WASTEGATE SOURCE VACUUM

- Disconnect the vacuum supply tube from the vacuum pump.
- Using the DSL ENG Pressure Test Kit 014-00761 or equivalent, measure the vacuum at the vacuum pump.
- Ignition ON, engine running.
- Record the vacuum.

Is the vacuum greater than 33.86 kPa (10 in-Hg)?

Yes	GO to HN23 .
No	DIAGNOSE a loss of vacuum. REFER to the Workshop Manual Section 206-00, Brake System. Clear the PCM DTCs. REPEAT the self-test.

HN23 CHECK TURBOCHARGER VACUUM WASTEGATE ACTUATOR OPERATION

- Disconnect the turbocharger wastegate control hose from the turbocharger wastegate actuator.
- Record each of the turbocharger wastegate actuator linkage positions.
- Using the DSL ENG Pressure Test Kit 014-00761 or equivalent, apply 33.86 kPa (10 in-hg) of vacuum to the turbocharger wastegate actuator.

Does each turbocharger wastegate actuator linkage move from the starting position and does the pressure remain steady?

Yes	GO to HN24 .
No	GO to HN25 .

HN24 CHECK THE VACUUM SUPPLY HOSE FROM THE VACUUM PUMP TO THE TURBOCHARGER WASTEGATE ACTUATOR

- For the turbocharger wastegate regulating valve bank 1 solenoid 1,
- Disconnect the vacuum supply hose from the inlet of the turbocharger wastegate regulating valve solenoid.
- Disconnect the vacuum control hose from the outlet of the turbocharger wastegate regulating valve solenoid.
- Using a suitable adaptor, connect the vacuum supply hose to the vacuum control hose.
- Disconnect the turbocharger wastegate vacuum supply hose from the vacuum pump.
- Using the DSL ENG Pressure Test Kit 014-00761 or equivalent, apply 33.86 kPa (10 in-hg) of vacuum to the vacuum supply hose.
- For the turbocharger wastegate regulating valve bank 2 solenoid 1,
- Disconnect the vacuum supply hose from the inlet of the turbocharger wastegate regulating valve solenoid.
- Disconnect the vacuum control hose from the outlet of the turbocharger wastegate regulating valve solenoid.
- Using a suitable adaptor, connect the vacuum supply hose to the vacuum control hose.
- Disconnect the turbocharger wastegate vacuum supply hose from the vacuum pump.
- Using the DSL ENG Pressure Test Kit 014-00761 or equivalent, apply 33.86 kPa (10 in-hg) of vacuum to the vacuum supply hose.

Does each turbocharger wastegate actuator linkage move from the starting position and does the vacuum remain steady?

Yes	INSTALL a new turbocharger wastegate regulating valve solenoid in question. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls, Turbocharger. Clear the PCM DTCs. REPEAT the self-test.
No	A vacuum system leak or restriction is the cause of the concern. DIAGNOSE the turbocharger wastegate vacuum system leak or restriction. REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.

HN25 CHECK THE TURBOCHARGER WASTEGATE ACTUATOR LINKAGE FOR DAMAGE OR OBSTRUCTIONS

- Attempt to manually activate the suspect actuator.

Can the suspect actuator be activated manually?

Yes	INSTALL a new turbocharger wastegate actuator. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls, Turbocharger. Clear the PCM DTCs. REPEAT the self-test.
No	Visually inspect the suspect turbocharger wastegate actuator linkage for damage or obstructions. Repair as necessary. If no turbocharger wastegate actuator linkage concerns are present, INSTALL a new turbocharger assembly. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls, Turbocharger. Clear the PCM DTCs. REPEAT the self-test.

HN26 TURBOCHARGER COMPRESSOR WHEEL CHECK

- Inspect the turbocharger compressor wheel and housing for the following:
 - ability to spin freely
 - noise while spinning
 - damage to vanes on the compressor wheel
 - out of balance condition
 - debris in housing

Is a concern present?

Yes	INSTALL a new turbocharger assembly. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls, Turbocharger. Clear the PCM DTCs. REPEAT the self-test.
No	GO to HN28 .

HN27 CHECK THE WASTEGATE VACUUM SENSOR

Note: A vacuum system leak may be internal or external to the vacuum system. Make sure to diagnose the entire vacuum system if a leak or restriction is the cause of the concern.

- Ignition ON, engine OFF.
- Access the PCM and monitor the WGATE_V (VOLT) PID.
- Record the PID value.
- Disconnect the wastegate vacuum tube from the vacuum port on the turbocharger wastegate vacuum sensor.
- Using a suitable hand pump with gauge, apply 34.47 kPa (5 in-Hg) vacuum to the wastegate vacuum sensor port.
- Record the PID value.

Does the PID value change when vacuum is applied?

Yes	A vacuum system leak or restriction is the cause of the concern. DIAGNOSE the vacuum system leak or restriction. REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	INSTALL a new Wastegate Vacuum Sensor. REFER to the Workshop Manual Section 303-04, Fuel Charging And Controls. Clear the PCM DTCs. REPEAT the self-test.

HN28 CHECK FOR CORRECT SYSTEM OPERATION

- Disconnect all the PCM connectors.
- Visually inspect for:
 - pushed out pins

- corrosion
- Connect all the PCM connectors and make sure they seat correctly.
- Carry out the PCM self-test.
- Verify the concern is still present.

Is the concern still present?

Yes	INSTALL a new PCM. REFER to Section 2, Flash Electrically Erasable Programmable Read Only Memory (EEPROM) , Programming the VID Block for a Replacement PCM.
No	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

HN29 CHECK THE TURBOCHARGER WASTEGATE ACTUATORS

Note: The turbocharger wastegate motor requires slow constant force to move the turbocharger wastegate linkage.

- Ignition OFF.
- Visually inspect the turbocharger wastegate linkage for damage or disconnections.
- Visually inspect the turbocharger wastegate system for obstructions or linkage restrictions.
- With constant pressure, slowly push the turbocharger wastegate linkage towards the turbocharger wastegate motor then pull the linkage away from the turbocharger wastegate motor.
- Check the turbocharger wastegate motor, the wiring harness, and connectors for the following:
 - damaged housing
 - damaged connectors
 - crossed TCWGM circuits
 - pushed out pins
 - corrosion
 - incorrect connections

Is a concern present?

Yes	REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	GO to HN30 .

HN30 CHECK THE VREF AND SIGRTN CIRCUITS

Note: The following steps apply to multiple components, only measure the circuits that apply to the vehicle and component being diagnosed.

Note: In the following measurement note the polarity of the probes.

- Ignition OFF.
- Turbocharger Wastegate Motor Bank 1 connector disconnected.
- Turbocharger Wastegate Motor Bank 2 connector disconnected.
- Ignition ON, engine OFF.
- For DTCs P0243, P0244, P25B3, P25B4, P2AB7, P2AB8, P2AB9 or P2ABD,
- Measure the voltage between:

(+) Turbocharger Wastegate Motor Bank 1 Connector, Harness Side	(-) Turbocharger Wastegate Motor Bank 1 Connector, Harness Side
VREF	SIGRTN

- For all others,
- Measure the voltage between:

(+) Turbocharger Wastegate Motor Bank 2 Connector, Harness Side	(-) Turbocharger Wastegate Motor Bank 2 Connector, Harness Side
VREF - Pin 4	SIGRTN - Pin 3

Is the voltage between 4.5 - 5.5 V?

Yes	GO to HN31 .
No	GO to Pinpoint Test C .

HN31 CHECK FOR AN OPEN CIRCUIT

- Ignition OFF.
- PCM connector disconnected.
- For DTCs P0243, P0244, P25B3, P25B4, P2AB7, P2AB8, P2AB9 or P2ABD,
- Measure the resistance between:

(+) Turbocharger Wastegate Motor Bank 1 Connector, Harness Side	(-) PCM Connector, Harness Side
TCWGP1	TCWGP1
TCWGM1+	TCWGM1+
TCWGM1-	TCWGM1-

- For all others,
- Measure the resistance between:

(+) Turbocharger Wastegate Motor Bank 2 Connector, Harness Side	(-) PCM Connector, Harness Side
TCWGP2 - Pin 2	TCWGP2
TCWGM2+ - Pin 1	TCWGM2+
TCWGM2- - Pin 5	TCWGM2-

Are the resistances less than 5 ohms?

Yes	GO to HN32 .
No	REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test.

HN32 CHECK FOR A SHORT TO GROUND

- For DTCs P0243, P0244, P25B3, P25B4, P2AB7, P2AB8, P2AB9 or P2ABD,
- Measure the resistance between:

(+) Turbocharger Wastegate Motor Bank 1 Connector, Harness Side	(-)
TCWGP1	Ground
TCWGM1+	Ground
TCWGM1-	Ground

- For all others,

- Measure the resistance between:

(+) Turbocharger Wastegate Motor Bank 2 Connector, Harness Side	(-)
TCWGP2 - Pin 2	Ground
TCWGM2+ - Pin 1	Ground
TCWGM2- - Pin 5	Ground

Are the resistances greater than 10K ohms?

Yes	GO to HN33 .
No	REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test.

HN33 CHECK FOR CIRCUITS SHORTED TOGETHER

- For DTCs P0243, P0244, P25B3, P25B4, P2AB7, P2AB8, P2AB9 or P2ABD,
- Measure the resistance between:

(+) Turbocharger Wastegate Motor Bank 1 Connector, Harness Side	(-) Turbocharger Wastegate Motor Bank 1 Connector, Harness Side
TCWGP1	VREF
TCWGP1	SIGRTN
TCWGP1	TCWGM1+
TCWGP1	TCWGM1-
TCWGM1+	TCWGM1-
TCWGM1+	VREF
TCWGM1+	SIGRTN
TCWGM1-	VREF
TCWGM1-	SIGRTN

- For all others,
- Measure the resistance between:

(+) Turbocharger Wastegate Motor Bank 2 Connector, Harness Side	(-) Turbocharger Wastegate Motor Bank 2 Connector, Harness Side
TCWGP2 - Pin 2	SIGRTN - Pin 3
TCWGP2 - Pin 2	VREF - Pin 4
TCWGP2 - Pin 2	TCWGM2+ - Pin 1
TCWGP2 - Pin 2	TCWGM2- - Pin 5
TCWGM2+ - Pin 1	TCWGM2- - Pin 5
TCWGM2+ - Pin 1	VREF - Pin 4
TCWGM2+ - Pin 1	SIGRTN - Pin 3
TCWGM2- - Pin 5	VREF - Pin 4
TCWGM2- - Pin 5	SIGRTN - Pin 3

Are the resistances greater than 10K ohms?

Yes	GO to HN34 .
No	REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test.

HN34 CHECK FOR A SHORT TO VOLTAGE

- Ignition ON, engine OFF.
- For DTCs P0243, P0244, P25B3, P25B4, P2AB7, P2AB8, P2AB9 or P2ABD,
- Measure the voltage between:

(+) Turbocharger Wastegate Motor Bank 1 Connector, Harness Side	(-)
TCWGP1	Ground
TCWGM1+	Ground
TCWGM1-	Ground

- For all others,
- Measure the voltage between:

(+) Turbocharger Wastegate Motor Bank 2 Connector, Harness Side	(-)
TCWGP2 - Pin 2	Ground
TCWGM2+ - Pin 1	Ground
TCWGM2- - Pin 5	Ground

Is any voltage present?

Yes	REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test.
No	GO to HN35 .

HN35 CHECK THE INTERNAL RESISTANCE OF THE TURBOCHARGER WASTEGATE MOTOR

- Ignition OFF.
- For DTCs P0243, P0244, P25B3, P25B4, P2AB7, P2AB8, P2AB9 or P2ABD,
- Measure the resistance between:

(+) Turbocharger Wastegate Motor Bank 1 Connector, Component Side	(-) Turbocharger Wastegate Motor Bank 1 Connector, Component Side
TCWGM1+	TCWGM1-

- For all others,
- Measure the resistance between:

(+) Turbocharger Wastegate Motor Bank 2 Connector, Component Side	(-) Turbocharger Wastegate Motor Bank 2 Connector, Component Side

(+) Turbocharger Wastegate Motor Bank 2 Connector, Component Side	(-) Turbocharger Wastegate Motor Bank 2 Connector, Component Side
TCWGM2+ - Pin 1	TCWGM2- - Pin 5

Is the resistance between 1 - 90 ohms?

Yes	GO to HN36 .
No	INSTALL a new turbocharger wastegate motor in question. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls, Turbocharger. RESET the keep alive memory. REFER to Section 2, Resetting The Keep Alive Memory (KAM) .

HN36 CHECK FOR AN INTERMITTENT CONCERN

- Ignition OFF.
- Turbocharger Wastegate Motor Bank 1 connector connected.
- Turbocharger Wastegate Motor Bank 2 connector connected.
- PCM connector connected.
- Ignition ON, engine OFF.
- Access the PCM and monitor the WGATE_A_POS_PCT (PER) and WGATE_B_POS_PCT (PER) PIDs.
- While observing the PIDs for percentage changes, wiggle, shake, and bend small sections of the wiring harness while working from each turbocharger wastegate motor to the PCM.

Is a concern indicated?

Yes	REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	GO to HN37 .

HN37 CHECK THE TURBOCHARGER WASTEGATE POSITION OPEN AND CLOSED PERCENTAGES

Note: Certain failure mode effects management (FMEM) operating strategies may limit vehicle function in the event of a harness or component concern and may prevent the wastegates from operating correctly.

Note: Make sure the accelerator pedal is fully applied and fully released when recording the PID values.

Note: The PCM will command the turbocharger wastegate motors to follow the applied accelerator pedal position, until the accelerator pedal is fully released.

- Ignition ON, engine OFF.
- Clear the PCM DTCs.
- Ignition OFF.
- Ignition ON, engine OFF.
- Access the PCM and monitor the WGATE_A_POS_PCT (PER) and WGATE_B_POS_PCT (PER) PIDs.
- Press the accelerator pedal fully to the floor. Wait 3 seconds, then record the PID values.
- Release the accelerator pedal and immediately record the PID values.

Turbocharger Wastegate Position Sensor Signal Percentages

Accelerator Pedal	Wastegate Position Sensor PID Value
Accelerator Pedal Fully Applied	90.0 to 100.0
Accelerator Pedal Fully Released	0.0 to 10.0

Are the recorded PID values within range of the accelerator pedal fully applied and the accelerator pedal fully

released values?

Yes	GO to HN38 .
No	INSTALL a new turbocharger wastegate motor in question. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls, Turbocharger. RESET the keep alive memory. REFER to Section 2, Resetting The Keep Alive Memory_(KAM) .

HN38 CHECK FOR CORRECT OPERATION

- Disconnect all the PCM connectors.
- Disconnect the turbocharger wastegate motor 1 and turbocharger wastegate motor 2 connectors.
- Visually inspect for:
 - pushed out pins
 - corrosion
- Connect all the PCM connectors, the turbocharger wastegate motor connectors. Make sure the connectors are seated correctly.
- Carry out the PCM self-test.
- Verify the concern is still present.

Is the concern still present?

Yes	For DTCs P2ABD or P2ABE, GO to Pinpoint Test Z . For all others, INSTALL a new turbocharger wastegate motor in question. REFER to the Workshop Manual Section 303-04D Fuel Charging and Controls, Turbocharger. RESET the keep alive memory. REFER to Section 2, Resetting The Keep Alive Memory_(KAM) .
No	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.