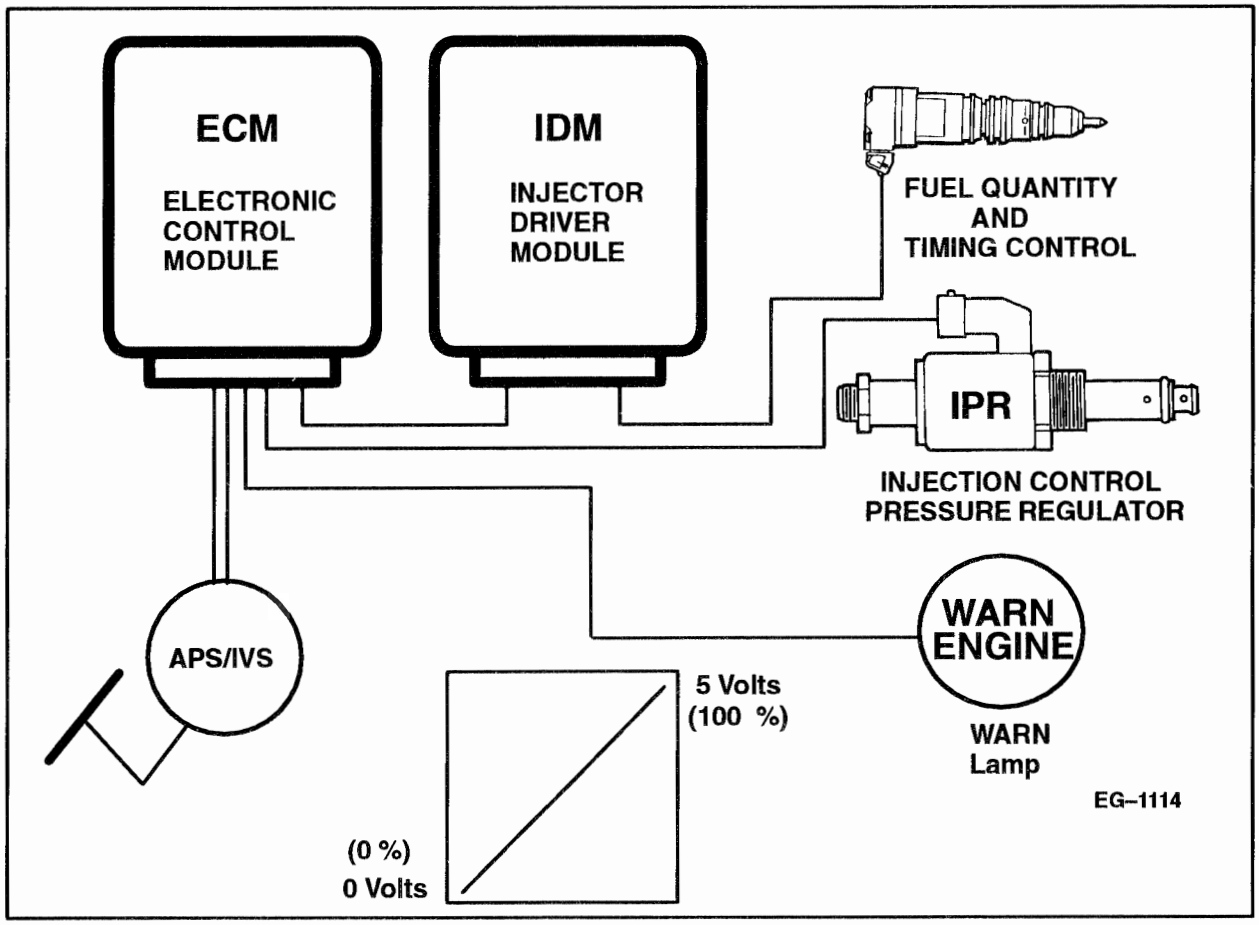
ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

ACCELERATOR PEDAL POSITION SENSOR/IVS SWITCH (APS/IVS)

APS/IVS PEDAL POSITION SENSOR / IDLE VALIDATION SWITCH



SIGNAL FUNCTIONS

The Accelerator Pedal Position Sensor (APS) is a potentiometer type sensor which, when supplied with a 5 volt reference signal from the Electronic Control Module (ECM), provides a linear analog voltage signal that indicates the driver's demand for power.

The Idle Validation Switch (IVS) is a 0/12 volt switch that provides the ECM with a redundant signal to verify when the pedal is in the idle position.

Fuel Quantity and Timing Control – The APS signal is used in calculating desired fuel quantity and injector timing.

Injection Control Pressure – Accelerator pedal position is one of the controlling variables in the calculation of desired injection control pressure.

FAULT DETECTION/MANAGEMENT

Any detected malfunction of the APS or IVS sensor circuit will illuminate the WARN ENGINE lamp.

An APS signal that is detected out of range high or low by the ECM will cause the engine to ignore the APS signal and will only allow the engine to operate at low idle.

If a disagreement in the state of IVS and APS is detected by the ECM and the ECM determines that it is an IVS fault, the ECM will only allow a maximum of 50% APS to be commanded.

If a disagreement in the state of IVS and APS is detected by the ECM and the ECM can not discern if it is an APS or IVS fault or if it is an APS fault, the engine will be allowed to operate at low idle only.

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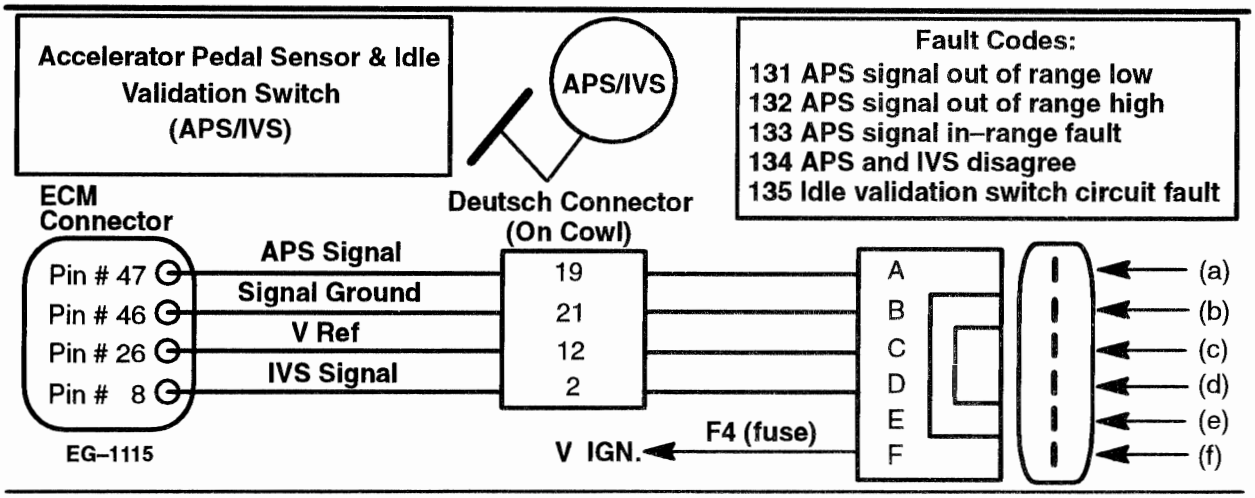

After removing connectors always check for damaged pins, corrosion, loose terminals etc.

Connector Checks to Chassis Ground

(Check with Sensor Connector Disconnected and Ignition key off, all accessories off)

Test Points	Spec.	Comments
A to Grd.	> 1000 ohms	Resistance less than 1000 ohms indicates a short to ground.
B to Grd.	< 5 ohms	Resistance to chassis ground, check with key off, > than 5 ohms harness is open.
C to Grd.	> 1000 ohms	Resistance less than 1000 ohms indicates a short to ground.
D to Grd.	> 1000 ohms	Resistance less than 1000 ohms indicates a short to ground.

Connector Signal Checks (Check with Sensor Connector Disconnected and Ignition Key On)

Test Points	Spec.	Comments
A to Grd.	0 – .25 volts	If greater than .25 volts signal ground wire is shorted to V Ref or battery.
B to Grd.	0 – .25 volts	Signal ground no voltage expected.
C to Grd.	5 ± .5 volts	VRef check key on, if VRef not present check open/short to grd #26 to C, see VRef circuit.
D to Grd.	0 – .25 volts	If greater than .25 volts signal ground wire is shorted to V Ref or battery.
F to Grd.	12 ± 1.5 volts	< 10.5 v check for poor connection, 0 v check for open/short to grd circuit or blown fuse.

Harness Resistance Checks (Check with breakout box installed on engine harness only)

Test Points	Spec.	Comments
#47 to A	< 5 ohms	Resistance from 60 pin connector to harness connector – APS Signal
#46 to B	< 5 ohms	Resistance from 60 pin connector to harness connector – Signal Ground
#26 to C	< 5 ohms	Resistance from 60 pin connector to harness connector – V Ref
#8 to D	< 5 ohms	Resistance from 60 pin connector to harness connector – IVS Signal
V IGN. to F	< 5 ohms	Resistance from V IGN. power to harness connector

Operational Voltage Checks

(Check with breakout box and the EST tool installed key "ON")

	APS Test Points (+) #47 to (–) #46		IVS Test Points (+) #8 to (–) #46		
Position	Voltage	% APS	Voltage	% APS	Comments
Low Idle	.25 to .8 V	0 %	0 volts	0 %	IVS voltage should toggle just off low idle position.
High Idle	3 to 4.5 V	98–100%	12 ± 1.5 v	98–100%	If APS measures only 50% and volt signal in spec., IVS fault detected.

Fault Code Descriptions

131 APS signal was less than 0.146 volts for more than 0.5 seconds *
132 APS signal was greater than 4.56 volts for more than 0.5 second *
133 APS signal in–range fault *
134 APS and IVS agree *
135 Idle validation switch circuit fault – 50% APS only.
*** – IF FAULT CODE IS SET, ENGINE OPERATION WILL DEFAULT TO RUN AT LOW IDLE SPEED ONLY.**

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APS/IVS EXTENDED SYSTEM DESCRIPTION

Navistar electronic engines use an electronic accelerator pedal assembly that includes a Accelerator Position Sensor (APS) and Idle Validation Switch (IVS). These two functions are integrated into one component mounted on the pedal. The accelerator pedal assembly is serviceable to the extent that the APS/IVS switch can be replaced without replacing the complete assembly.

The engine Electronic Control Module (ECM) determines the position of the accelerator pedal by processing the input signals from the Accelerator Position Sensor (APS) and Idle Validation Switch (IVS).

ACCELERATOR POSITION SENSOR (APS)

Refer to circuit diagram on page 6 for the following discussion.

The ECM sends a regulated 5 volt signal through ECM connector (379) terminal 26 to APS connector (382) terminal C. The APS then returns a variable voltage signal (depending on pedal position) from APS connector (382) terminal A to the ECM at terminal 47. The APS is grounded from connector (382) terminal B to the ECM signal ground terminal 46.

APS AUTO–CALIBRATION

The ECM learns the lowest and highest pedal positions by reading and storing the minimum and maximum voltage levels from the APS. In this manner the ECM "auto- calibrates" the system to allow maximum pedal sensitivity. The ECM auto-calibrates as the key is ON, but when the key is turned OFF, these values are lost. When the key is turned on again, this process starts over. When the pedal is disconnected (or new one installed), the pedal does not need to be calibrated, as the calibration happens when the key is turned on.

IDLE VALIDATION SWITCH (IVS)

The ECM expects to receive one of two signals through ECM connector (379) terminal 8 from APS/IVS connector (382) terminal D:

- 0 volts when the pedal is at the idle posltion.
- 12 volts when the pedal is depressed.

The Idle Validation Switch receives 12 volt ignition voltage from 10A fuse F4 (H1 with FBC). When the pedal is NOT in the idle position (throttle applied), the IVS sends a 12 volt signal to the ECM.

The ECM compares the inputs it receives at terminals 47 and 8 from the APS/IVS to verify when the pedal is in the idle position. If the APS signal at terminal 47 indicates throttle is being applied, then the ECM expects to see 12 volts at IVS terminal 8. If the APS signal at terminal 47 indicates throttle is not applied, then the ECM expects to see 0 volts at the IVS terminal 8. The timing process is critical between the APS and the IVS sensors. For this reason, it is very difficult to determine if the APS/IVS assembly is working properly using a volt-ohmmeter.

ECM DIAGNOSTICS

When the key is ON, the ECM continuously monitors the APS/IVS circuits for expected voltages. It also compares the APS and IVS signals for conflict. If the signals are not what the ECM expects to see, Fault codes will be set.

FLASH CODE *131*
ATA CODE PID 91 FMI 4 –
ECM: *APS OUT OF RANGE LOW*

The ORL (out of range low) code 131 is set if the ECM detects a voltage lower than 0.146 volts at terminal 47. Possible causes include: a short to ground or an open in circuit 99B. This code is displayed by either the Prolink EST or using the Engine Warn Light to flash codes.

When code 131 is active, the ECM restricts engine speed to idle and turns the Engine Warning Light ON. If the condition causing code 131 is intermittent and the condition is no longer present, the code will become inactive and normal engine operation will resume. If code 131 is active, perform Testing APS Circuits on page 8.

FLASH CODE *132*
ATA CODE PID 91 FMI 3 –
ECM: *APS OUT OF RANGE HIGH*

The ORH (out of range high) code 132 is set if the ECM detects a voltage greater than 4.56 volts at terminal 47. Possible cause: short to VREF or 12 volts in circuit 99B. This code is displayed by either the Prolink EST or using the Engine Warn Light to flash codes.

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APS/IVS EXTENDED SYSTEM DESCRIPTION (Continued)

FLASH CODE *132*
ATA CODE PID 91 FMI 3 –
ECM: *APS OUT OF RANGE HIGH* (Continued)

When code 132 is active, the ECM restricts engine speed to idle and turns the Engine Warn Light ON. If the condition causing code 132 is intermittent and the condition is no longer present, the code will become inactive and normal engine operation will resume. If code 132 is active, perform Testing APS Circuits on page 8.

FLASH CODES *133, 134 AND 135*
APS IN-RANGE FAULTS

The ECM checks the voltage output of the APS by comparing the APS signal with the IVS signal. APS and IVS signals can disagree in two cases:

- The APS signal indicates the pedal is pressed down to accelerate, but the IVS signal indicates idle position.
- The APS signal indicates the pedal has been released to allow the engine to return to idle, but the IVS signal indicates off-idle position of the pedal.

If the ECM detects either of the above conditions, the ECM attempts to isolate the source of conflict. If code(s) 133, 134 and/or 135 are active, perform Testing IVS Circuits on page 7 and Testing APS Circuits on page 8.

FLASH CODE *133*
ATA CODE PID 91 FMI 2 –
ECM: *APS IN RANGE FAULT*

If the IVS signal is changing and the APS signal is constant, the ECM assumes APS is the conflict source and sets code 133. Engine rpm is restricted to idle and the Engine Warn Light is turned ON.

FLASH CODE *134*
ATA CODE PID 91 FMI 7—
ECM: *APS/IVS DISAGREE*

If neither the APS or IVS is changing, or both are changing or the ECM cannot determine the faulty code in specified time, then code 134 is set, engine rpm is restricted to idle and the Engine Warn Light is turned ON.

FLASH CODE *135*
ATA CODE SID 230 FMI 11–
ECM: *IVS CIRCUIT FAULT*

If the APS is changing and IVS is constant, the ECM assumes IVS is the conflict source and sets flash code 135. In this case the ECM limits the APS signal to a lower value, which provides less than full rpm, but does not limit engine rpm to idle. The Engine Warn Light is not turned ON.

Note that codes 133, 134 and 135 are caused by an intermittent condition, the codes remain ACTIVE until the vehicle has been shutdown and restarted. They do not recover without cycling the key switch.

TROUBLESHOOTING

The APS and IVS circuits operate with low current levels. When troubleshooting, pay special attention to the connectors.

BEFORE PERFORMING ANY TEST

Inspect connectors for pushed back, damaged, corroded or dirty terminals, as well as making sure that the terminals and wires are properly crimped. Make sure the connectors are properly joined together. Also check for any damage to the wiring and make sure system grounds are clean and tight.

TESTING APS/IVS CIRCUITS

- If flash codes 131 or 132 are present, perform Testing APS Circuits on page 8. If flash codes 133, 134 or 135 are present, perform Testing IVS Switch & Circuits on page 7.

These tests systematically check the APS and IVS circuits for:

A. Short circuits to ground.

B. Short circuits to unwanted voltage sources.

C. Open circuits or excessive circuit resistance.

D. Proper feeds and grounds.

Note: The tests performed on the accelerator pedal assembly check for shorts, opens and correct resistance values, but do not check for proper timing between the two functions. If all of the circuits between the ECM and the accelerator pedal assembly check good (Testing IVS Circuits on page 7) and APS Circuits on page 8, then the APS/IVS accelerator switch should be replaced.

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ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

ACCELERATOR PEDAL POSITION SENSOR/IVS SWITCH (APS/IVS)

CIRCUIT DIAGRAM

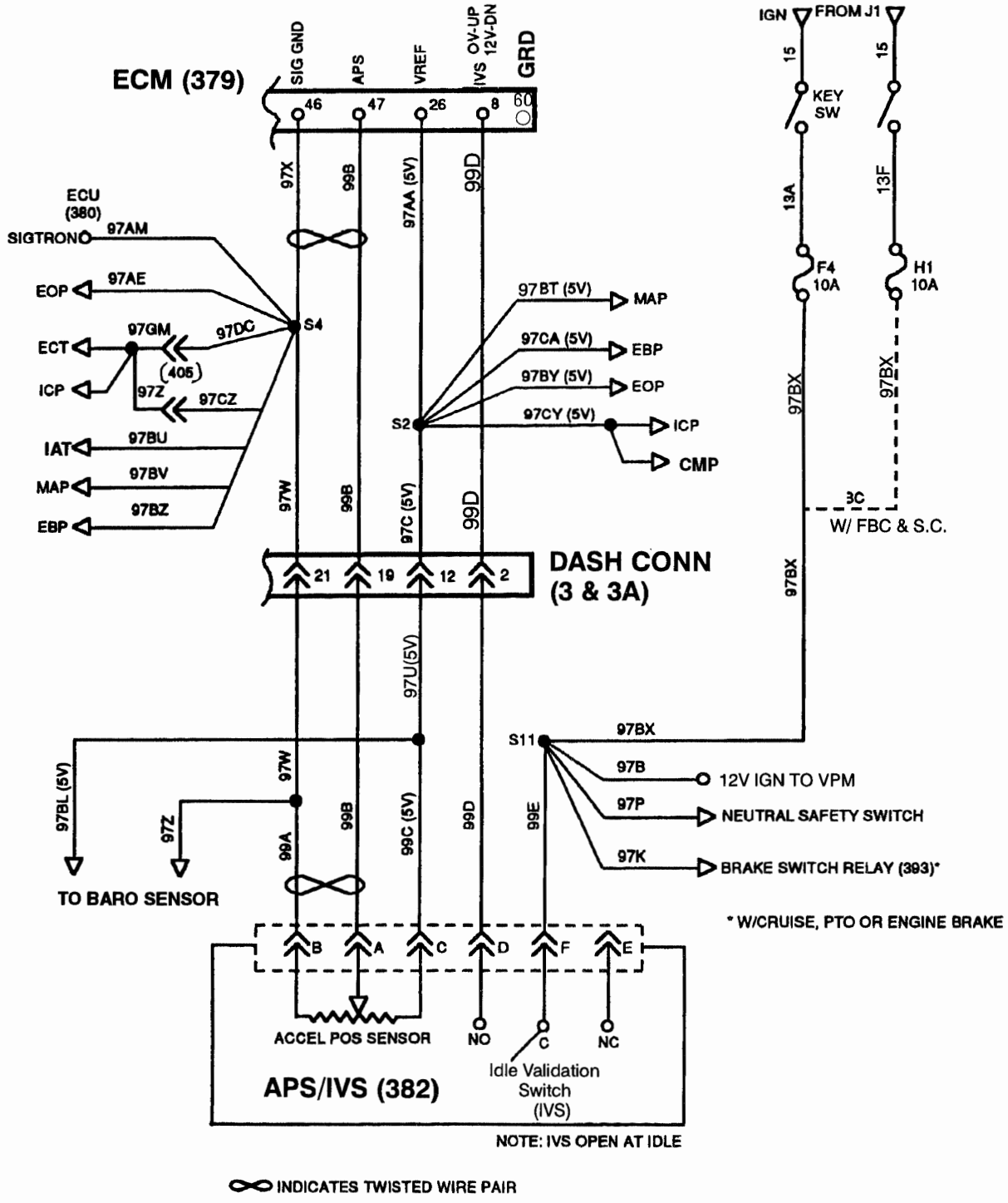

Figure 3.5–1 APS/IVS System

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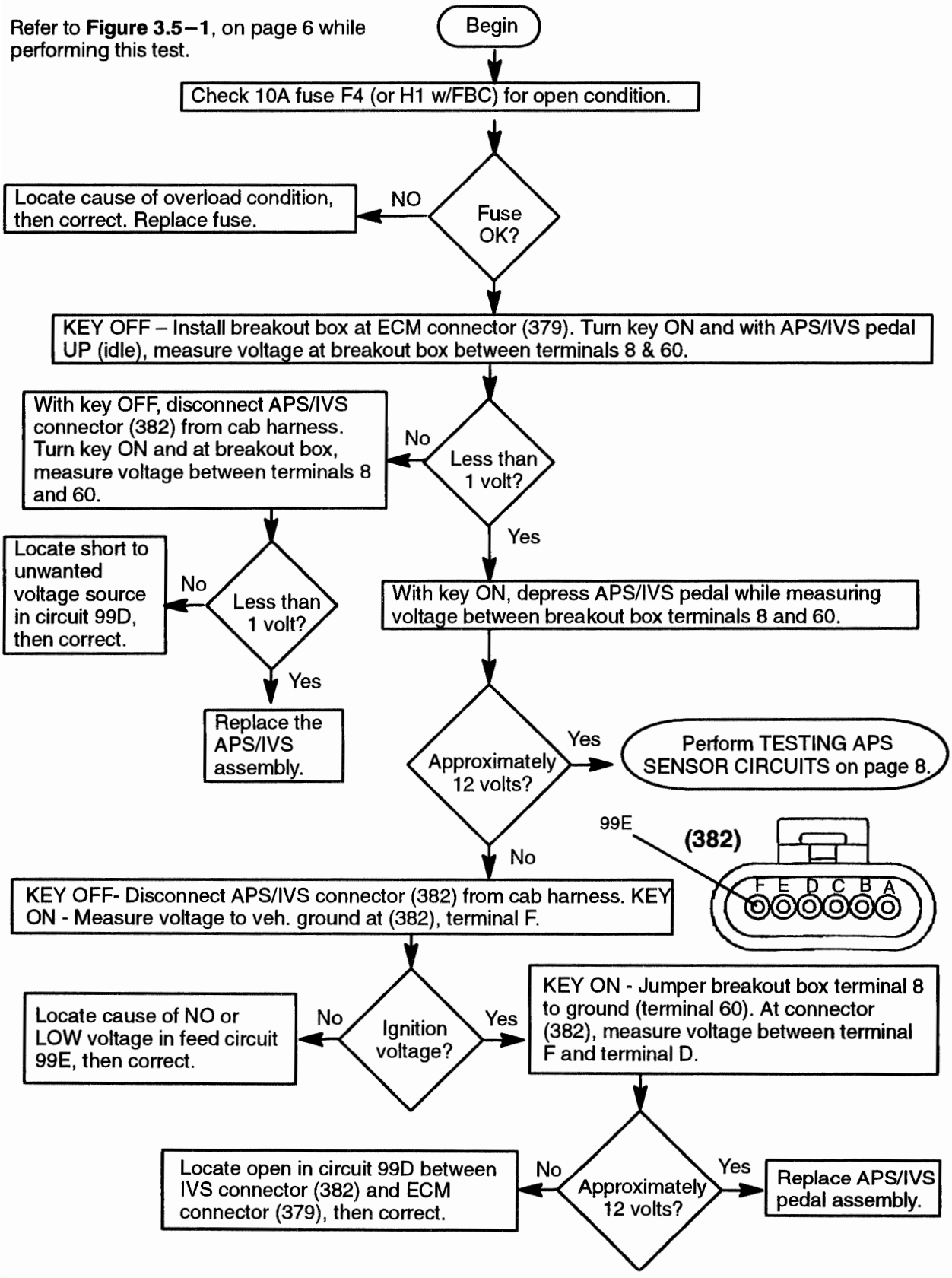
TESTING (IVS) IDLE VALIDATION SWITCH AND CIRCUITS

Refer to **Figure 3.5–1**, on page 6 while performing this test.



ACCELERATOR PEDAL POSITION SENSOR/IVS SWITCH (APS/IVS)

TESTING ACCELERATOR POSITION SENSOR (APS) CIRCUITS

Refer to **Figure 3.5–1**, on page 6 while performing this test.

Note: Perform this test if codes131 or 132 are present. If codes 133, 134 or 135 are present, perform test of IVS circuits on page 7 **before** performing this test.

BEGIN

KEY OFF - Install breakout box to ECM harness connector (379), **but do not connect to ECM**. Disconnect APS/IVS (382) from cab harness.

KEY ON - At breakout box, measure voltage between terminal 60 (GRD) and terminals 8, 26, 46, 47.

Voltage less than 1 volt at each terminal?

No → Locate short to unwanted voltage source in circuit(s) where more than 1 volt is present, then repair.

Yes

KEY OFF - At breakout box, measure resistance between terminal 60 (GRD) and terminals 8, 26, 46, and 47.

Resistance is 100K ohms or more?

No → Locate short to ground in circuit where terminal resistance is less than 100K ohms, then repair.

Yes

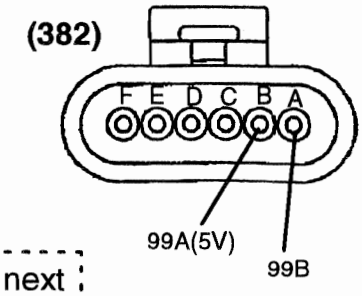
KEY OFF - At breakout box, measure resistance between terminals 8, 26, 46, 47.

Resistance is 100K ohms or more?

No → Locate short between any circuits where resistance is less than 100K ohms, then repair.

Yes

See next page



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TESTING ACCELERATOR POSITION SENSOR (APS) CIRCUITS (Continued)