

**Reference Materials:** Note: This exam may contain some "accepted practice" type questions not found in the reference material listed below.

**NFPA 1900:** Standard for Aircraft Rescue and Firefighting Vehicles, Automotive Fire Apparatus, Wildland Fire Apparatus, and Automotive Ambulances (**NFPA 1917 Chapters**) 2024 edition (800) 344-3555 or [www.nfpa.org](http://www.nfpa.org)

**NFPA 1910:** Standard for the Inspection, Maintenance, Refurbishment, Testing and Retirement of In-Service Emergency Vehicles and Marine Firefighting Vessels (**NFPA 1911 Chapters**) 2024 edition (800) 344-3555 or [www.nfpa.org](http://www.nfpa.org)

**Selective Catalytic Reduction** <http://www.dieselforum.org/about-clean-diesel/what-is-scr>

General shop manuals, such as: Ford 1-ton chassis, Freightliner Medium Duty, International/Navistar Medium Duty, Allison Transmission E books 1000 & 200 series

Any service manual for OBD-2, Class 1 Diagnostic Service Codes

### LEARNING OBJECTIVES

1. **Physical Characteristics of an ambulance** - Identify the design requirements as stated in NFPA 1917:
  - a. Height, width, wheel base & length
  - b. Ambulance types
  - c. Ambulance class & configurations
  - d. Weight distribution
  - e. Rearview mirrors
  - f. Cab construction
2. **Cab and Body** - Identify components and location. Describe maintenance and repair of the following:
  - a. Doors, latches & hardware
  - b. Oxygen Systems
    - (1) Maximum leakage
    - (2) Hose requirements
  - c. Dissimilar metals
  - d. Handrails
  - e. Warning light system
    - (1) Do not move light
    - (2) Low voltage
    - (3) Optical devices
  - f. Patient compartment
    - (1) seat belts warning signal
    - (2) Reflective material
  - g. Back up alarm
    - (i) Control
    - (2) Decibels
  - h. Audible warning devices
3. **Chassis** - Describe principles of operation, maintenance, and repair of the following:
  - a. Brakes
    - (1) Hydraulic brake systems & fluid types
      - (a) Fluid level
    - (2) Parking brakes and cables
    - (3) Anti-lock systems
      - (a) Wiring
      - (b) Bleeding
      - (c) Driveline retarder
    - (4) Brake assemblies
      - (a) Rotors
      - (b) Rotor measurements
      - (c) Rotor run out
      - (d) Electronic Stability Control (ESC)
    - (5) Brake retarder installation
  - b. Suspension
    - (1) Tires & wheels
      - (a) Tire balance
      - (b) Tire size
      - (c) Tire air pressure/monitoring system
    - (2) Wheel nuts/torque
    - (3) Air ride height adjustment
    - (4) Approach and departure angles
  - c. Frame
  - d. Steering
    - (1) Symptoms
    - (2) Alignment
4. **Powertrain** - describe principles of operation, maintenance and repair of the following
  - a. Power train control module
    - (a) Service intervals
  - b. Engine
    - (1) Effects of water in fuel
    - (2) Coolant additives
    - (3) Common rail diesel fuel systems
    - (4) Diesel exhaust service
      - (a) After treatment
      - (b) DEF
      - (c) DPF
  - c. Automatic transmissions
    - (1) Torque convertor
      - (a) Components
      - (b) Function
      - (c) Installation
    - (2) Towing vehicle with automatic transmission
    - (3) Manual downshifting
    - (4) Rocking vehicle with automatic transmission
    - (5) Inspection
      - (a) Gauges and indicators
      - (b) Exterior
      - (c) Diagnostic codes
    - (6) Maintenance
      - (a) Purpose
      - (b) Level
      - (c) Types
      - (d) Change intervals
      - (e) Effects of coolant contamination
    - (7) Fluid
      - (a) Purpose
      - (b) Level
      - (c) Types
      - (d) Change intervals
      - (e) Effects of coolant contamination
    - (8) Electronic controls
      - (a) Shift point after calibration
      - (b) Main ECU power and ground wiring
      - (c) Cleaning connectors
      - (d) Effects of electromagnetic interference (EMI)
      - (e) Effects of radio transmitter interference
      - (f) Tow/Haul
      - (g) Reference voltage

- d. Drive line
  - (1) Inspection
  - (2) Driveline angle
  - (3) Driveline phasing
  - (4) Slip joints & U-joints
  - (5) Vibration causes
  - (6) RPM test
  - (7) Full floating
  - (8) Semi floating
- e. Differentials
  - (1) Vibration
- f. Road speed test

**5. Troubleshooting & Diagnostics** -Understand accepted practices of the following:

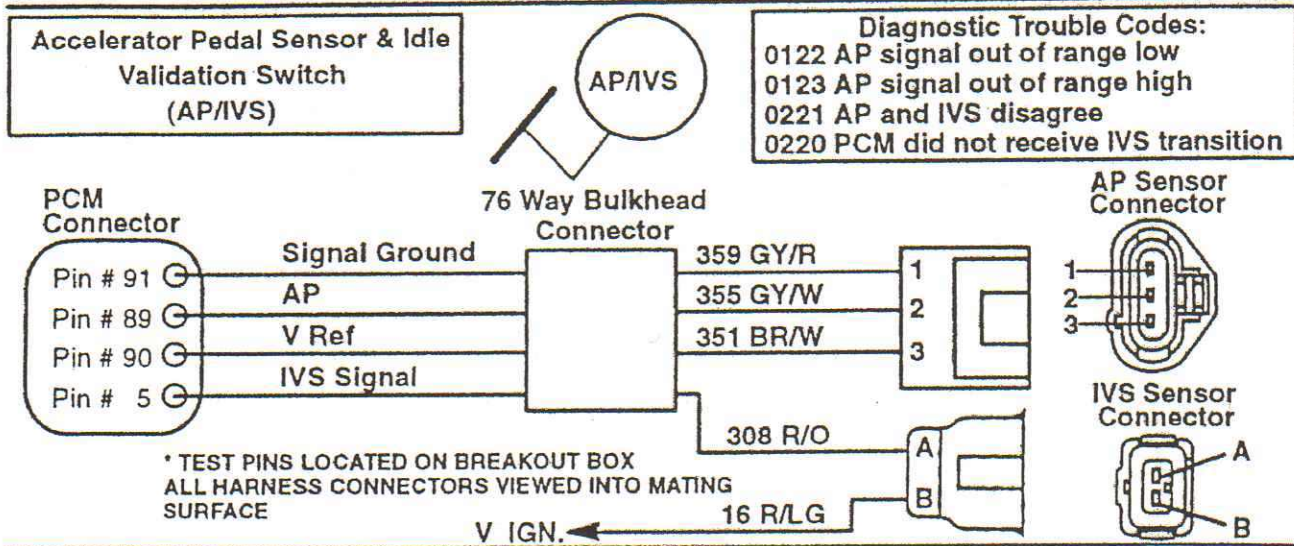
- a. Retrieving and interpreting diagnostic codes
  - (1) Breakout box
  - (2) Diagnostic Trouble Codes (DTC)
- b. Interpret diagnostic charts and service manuals
  - (1) Idle Validation Switch wiring
- c. Understanding schematic drawings
- d. Using diagnostic equipment
  - (1) Multi-meter uses
- e. Road testing for driveability problems
- f. Transmission
  - (1) Fluid
    - (a) Levels
    - (b) Contamination
    - (c) Effects of coolant contamination
    - (d) Fluid level too high
    - (e) Metal contaminated fluid
  - (2) Effects of a clogged breather
  - (3) Adjustments
    - (a) Linkage
    - (b) Shift points
  - (4)
  - (5) Electronic controls
    - (a) Multiple fault code
    - (b) Troubleshooting steps
    - (c) Cause of not shifting into gear
    - (d) Effect of poor battery connections
    - (e) Effects of water in connectors
    - (f) Historical code use
  - (6) Output shaft seal and yoke
  - (7) Stall test
  - (8) Troubleshooting procedure
    - (a) basic
    - (b) no code troubleshooting
  - (9) Leak diagnoses
  - (10) causes of overheating
- g. Welding precautions
- h. Driveline
  - (1) Vibration
  - (2) Driveline test
- i. Engine
  - (1) Leaks diagnoses
  - (2) Slow cranking
  - (3) Glow plug diagnostics
  - (4) Effects of clogged air filter
  - (5) Cause of pressure buildup in radiator
  - (6) Effect of incorrect muffler installation
- j. Differential
  - (1) Chattering noise
- k. Troubleshooting steps
- l. Brakes
  - (1) ABS braking systems
  - (2) Brake testing
  - (3) Boosters

**6. Safety** - Identify and describe the following:

- a. Safety procedures
  - (1) Use of wheel chocks
  - (2) Proper lifting & support equipment
  - (3) Right to know law
- b. Out of Service criteria
  - (1) Hydraulic brakes
  - (2) Engine oil leaks
  - (3) Automatic transmission
  - (4) Identifying out of service vehicle or component
  - (5) body mounts
  - (6) windshield wipers
- c. Equipment Storage and Mounting



# ELECTRONIC CONTROL SYSTEM DIAGNOSTICS



### Connector Checks to Ground (B-)

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

Test Points	Spec.	Comments
1 to Grd.	< 5 ohms	Resistance to grd. (B-) check w/key off, > than 5 ohms harness is open. -AP sig. Grd.
2 to Grd.	> 1000 ohms	Resistance less than 1000 ohms indicates a short to ground. -AP signal.
3 to Grd.	> 1000 ohms	Resistance less than 1000 ohms indicates a short to ground. - AP VRef
A to Grd.	> 1000 ohms	Resistance less than 1000 ohms indicates a short to ground. -IVS signal

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

Test Points	Spec.	Comments
1 to Grd.	0 - .25 volts	Signal ground no voltage expected.
2 to Grd.	0 - .25 volts	If greater than .25 volts signal circuit is shorted to V Ref or battery. -AP signal.
3 to Grd.	5 ± .5 volts	VRef check key on, if VRef not present check open/short to grd #91 to B, see VRef circuit.
A to Grd.	0 - .25 volts	If greater than .25 volts signal ground wire is shorted to V Ref or battery.
B 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
#91 to 1	< 5 ohms	Resistance from 104 pin connector to harness connector - Signal Ground
#89 to 2	< 5 ohms	Resistance from 104 pin connector to harness connector - AP Signal
#90 to 3	< 5 ohms	Resistance from 104 pin connector to harness connector - V Ref
#5 to A	< 5 ohms	Resistance from 104 pin connector to harness connector - IVS Signal
V IGN. to B	< 5 ohms	Resistance from V IGN. power to harness connector

Position	AP Test Points (+) #89 to (-) #91	IVS Test Points (+) #5 to (-) #91	Operational Voltage Checks (Check with breakout box installed key "ON")
	Voltage	Voltage	Comments
Low Idle	.37 to 1.4 V	< .25 volts	Minimum IVS transition point .2 volts above base idle voltage.
High Idle	3 to 4.5 V	12 ± 1.5 volts	Maximum IVS transition point @ 1.6v of AP signal

### Diagnostic Trouble Code Descriptions

0122 AP signal was less than 0.37 volts for more than 0.5 seconds \*

0123 AP signal was greater than 4.56 volts for more than 0.5 second \*

0221 AP and IVS disagree \*

0220 PCM did not receive IVS transition

\* - IF FAULT CODE IS SET, ENGINE OPERATION WILL DEFAULT TO RUN AT LOW IDLE SPEED ONLY.