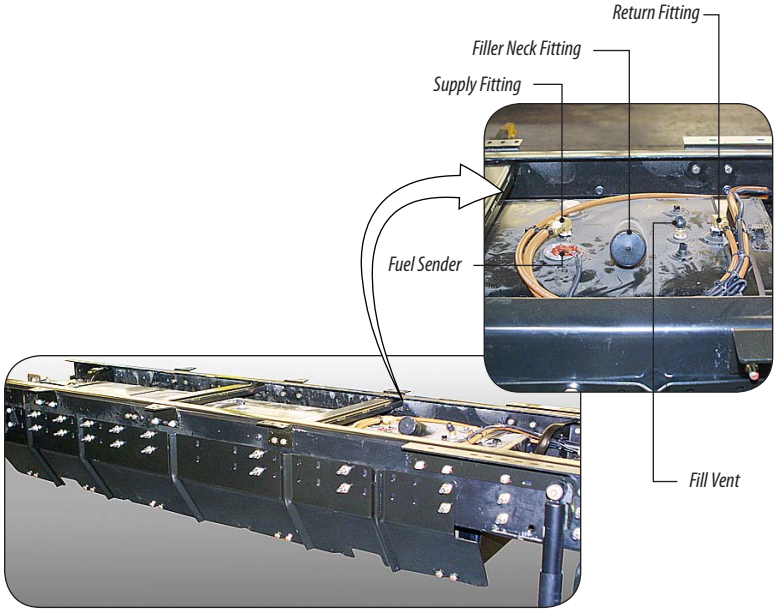
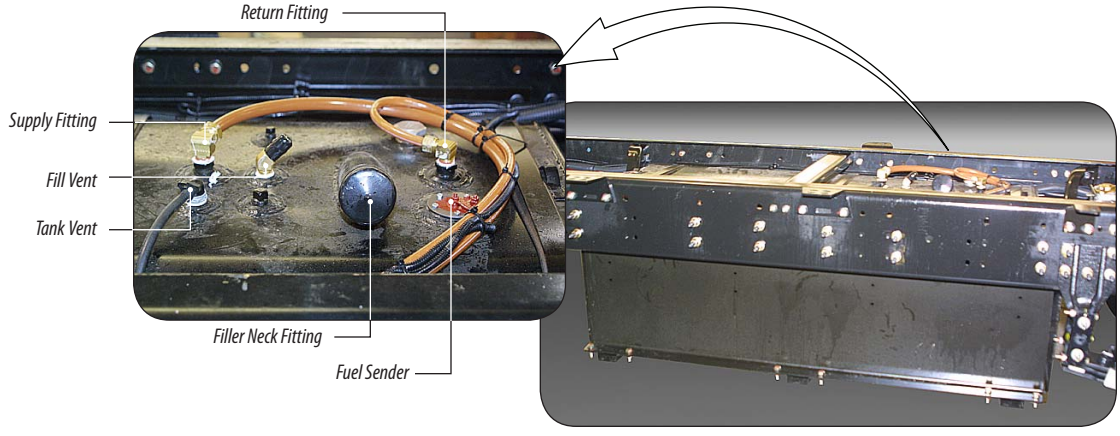
Fuel System

Fuel Storage

On most All American buses, the fuel tank is mounted between the frame rails and is surrounded for impact protection by a barrier system of steel panels and structural beams. On All American Rear Engine, the between-rails fuel tank is located rearward of the front axle. On All American Forward Engine, the between-rails fuel tank is located in the rear overhang, aft of the rear axle. Some All American Forward Engine buses have fuel tanks mounted outboard of the frame rails on the right side of the bus.

Fuel tanks of several capacities are available. All are rectangular tanks secured by a set of steel straps which surround the tank and mount to the barrier and support members. All tube fittings, filler necks, and sending units are mounted on the top of the fuel tank. An inspection port on the floor of the passenger compartment provides access to the fuel sending unit.





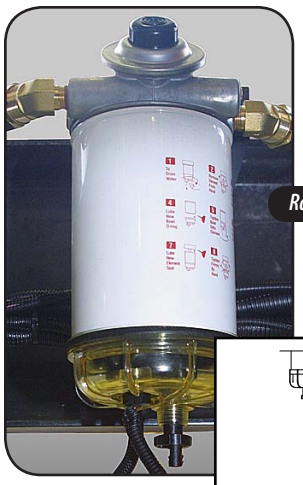
WARNING ***Blue Bird Product Engineering does not approve or disapprove additions to or modifications of Blue Bird fuel systems. Blue Bird fuel systems are designed and installed to meet federal standards and engine manufacturer's guidelines. The upfitter or modifier assumes all responsibility for vehicle engine and fuel system if the fuel system is modified.***

CAUTION ***In 2007 diesel engines, use only diesel fuel labeled Ultra Low Sulfer, per the engine manufacturer's specifications.***
In Caterpillar, use oils meeting API CJ-4 or Caterpillar ECF-3 compliant. See Caterpillar Operation and Maintenance Manual SEBU8083-08 for details.
In Cummins, use oils meeting API CJ-4/SL and Cummins Engine Standard CES-20081. See Cummins Owners Manual ISB 6.7L CM2150 for details.

Fuel Filtration

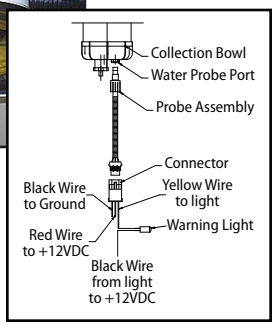
It is critical to the high pressure fuel injection systems of modern diesel engines that fuel is free of contaminates and moisture. Diesel fuel serves to lubricate the injector pumps; any water in the fuel inhibits that lubrication and can lead to injector/pump failure. Therefore, dilligent inspection and maintenance of the fuel system filters is essential to engine longevity and performance.

Diesel-fueled All Americans are equipped with two stages of fuel filtration; a primary filter and a secondary filter, each with its own replaceable element. The primary filter is mounted by Blue Bird between the tank and the engine along the inside of the left frame rail, and provides the first stage of filtration at a scale of approximately 30 microns. The second stage of filtration is provided by a much finer filter (2-5 microns, depending upon specific engine) mounted on the engine by the engine manufacturer. Water separation occurs at either or both filters, depending upon which engine is installed. A manually-operated drain is provided to allow collected moisture to be expelled. The moisture collection trap(s) are equipped with electric heater elements to prevent accumulated water from freezing. The moisture trap may also be equipped with an electric water sensor, which causes a yellow warning light in the Driver's instrument panel to illuminate when water in the trap rises to a level sufficient to complete the circuit between the sensor's contacts. This indicates it is time to drain the contaminant collection bowl. After the water has been drained from the bowl, the yellow warning light resets.



Raycor Primary Fuel Filter

Cummins ISB
CAT C7



Optional Water Level Sensor

On All Americans equipped with Cummins ISB engines the primary filter is a Raycor filter/water separator unit with a replaceable spin-on element. The Raycor filter incorporates a see-through trap bowl which is equipped with a manually operated drain and electric heater.

The secondary filter is a Fleetguard unit mounted to the engine and equipped with water separation feature, a manual-operated water drain, electric heater, and electric moisture sensor.

Raycor Primary Fuel Filter

Cummins ISC

On All Americans equipped with Cummins ISC engines the primary filter is a Fleetguard unit with a spin-on element, a manually operated drain, an electric heater element and a moisture sensor.

The secondary filter is a Fleetguard unit mounted to the engine and does not have its own water-separation feature.

On All Americans equipped with Caterpillar C7 engines the primary filter is a Raycor filter/water separator unit with a replaceable spin-on element. The Raycor filter incorporates a see-through trap bowl which is equipped with a manually operated drain and electric heater. The trap bowl may also be equipped with an optional electric moisture sensor.

The secondary filter is a Caterpillar unit mounted to the engine and does not have its own water-separation feature.

Consult the engine manufacturer's Operators Manual, supplied with the bus, regarding maintenance schedules and replacement cartridges for the secondary filter. Blue Bird recommends using only OEM replacement filter elements.

Secondary Fuel Filters

Caterpillar C7

Cummins ISB

Cummins ISC

Fuel Delivery

The fuel delivery systems are somewhat different between Caterpillar and Cummins engines, in that Caterpillar employs one pump, while Cummins employs two.

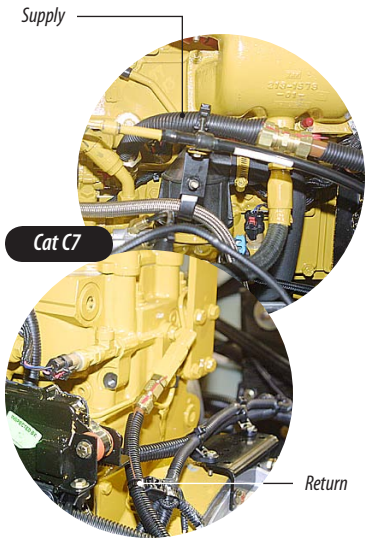
On Caterpillar equipped All Americans, the engine's "lift pump" provides the relatively low pressure to draw fuel from the tank's 3/4" OD fuel supply line and through the primary Raycor fuel filter. The fuel then enters the engine's supply port and proceeds through the engine-mounted secondary fuel filter. The HEUI hydraulic fuel injectors are controlled by the engine ECU and provide the high-pressure pulses to force the filtered fuel into the engine's combustion chambers on an individual per-cylinder basis. The portion of the fuel flow not used by the injectors continues on its way back to the engine's fuel return port, where a 1/2" OD fuel line conveys it back toward and into the top of the fuel tank.

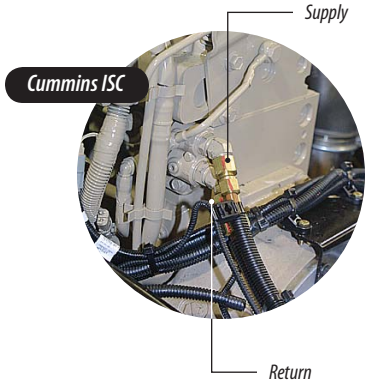
On Cummins engines, two pumps are employed: The "transfer pump" draws fuel from the tank, through the frame-mounted Raycor filter, and into the engine supply port. The fuel then passes through a cooling coil mounted between the engine ECM and the engine. Thus, fuel is used as a cooling agent to reduce the temperature of the Electronic Control Unit. Leaving the ECM cooler, the fuel passes through the engine-mounted secondary filter and then enters a second, high pressure pump. The high pressure pump delivers the fuel under increased pressure to the Cummins Common Rail fuel delivery system. The portion of the fuel flow not used by the injectors continues on its way back to the engine's fuel return port, where a 1/2" OD fuel line conveys it back toward and into the top of the fuel tank.

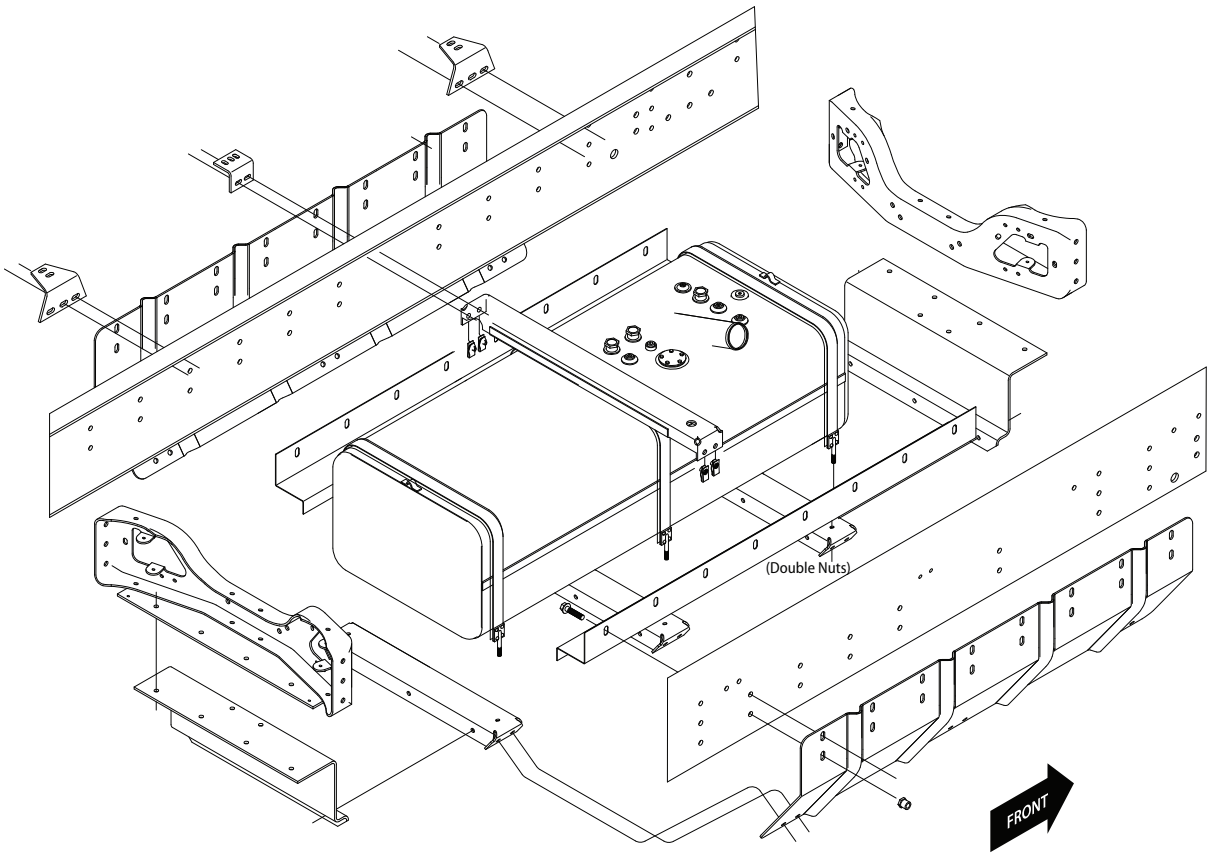
Fuel system delivery problems typically manifest themselves as symptoms such as failure to start, rough idling, rough running, etc. When a fuel-related problem is suspected, first check the Driver's dash panel warning lights for any light which would be generated by the ECM (Check Engine, Stop Engine, etc.) If any such lights are displayed, use the engine manufacturer's recommended electronic diagnostic tool(s) to obtain more detailed information about any stored error codes.

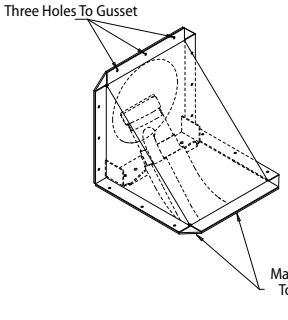
If no dash light errors are indicated, check the fuel delivery system components between the fuel tank and the engine's supply and return ports for possible causes such as clogged filters, water presence in the water separator bowl, leaking or otherwise damaged lines, etc.

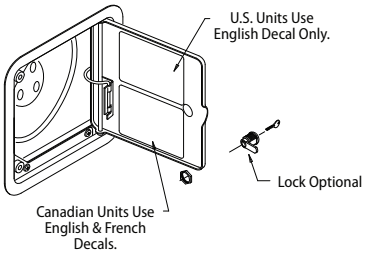
If both filters and fuel system components external to the engine package have been eliminated as causes, but a fuel-related problem is still suspected, consult the engine manufacturer's service documentation for troubleshooting procedures.











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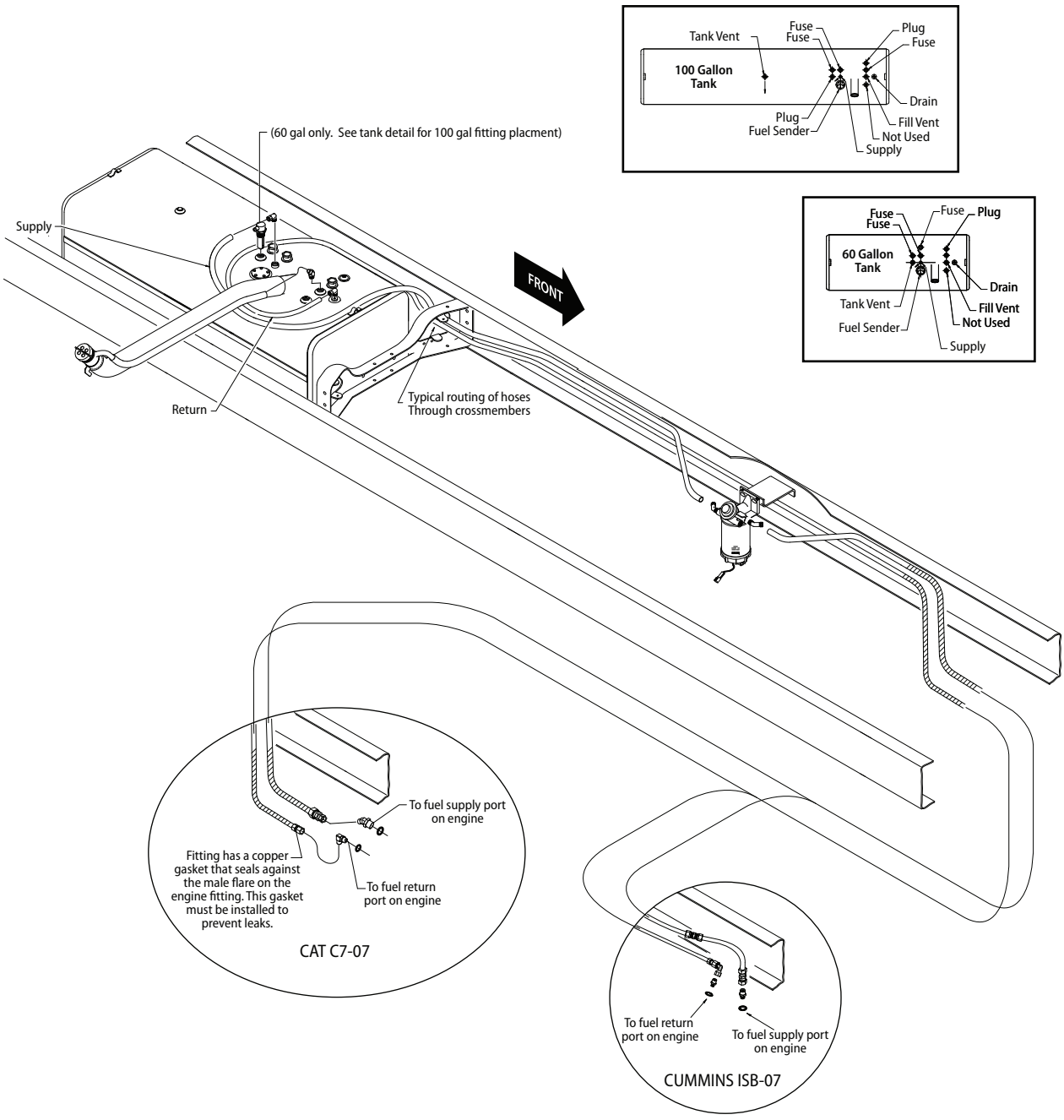
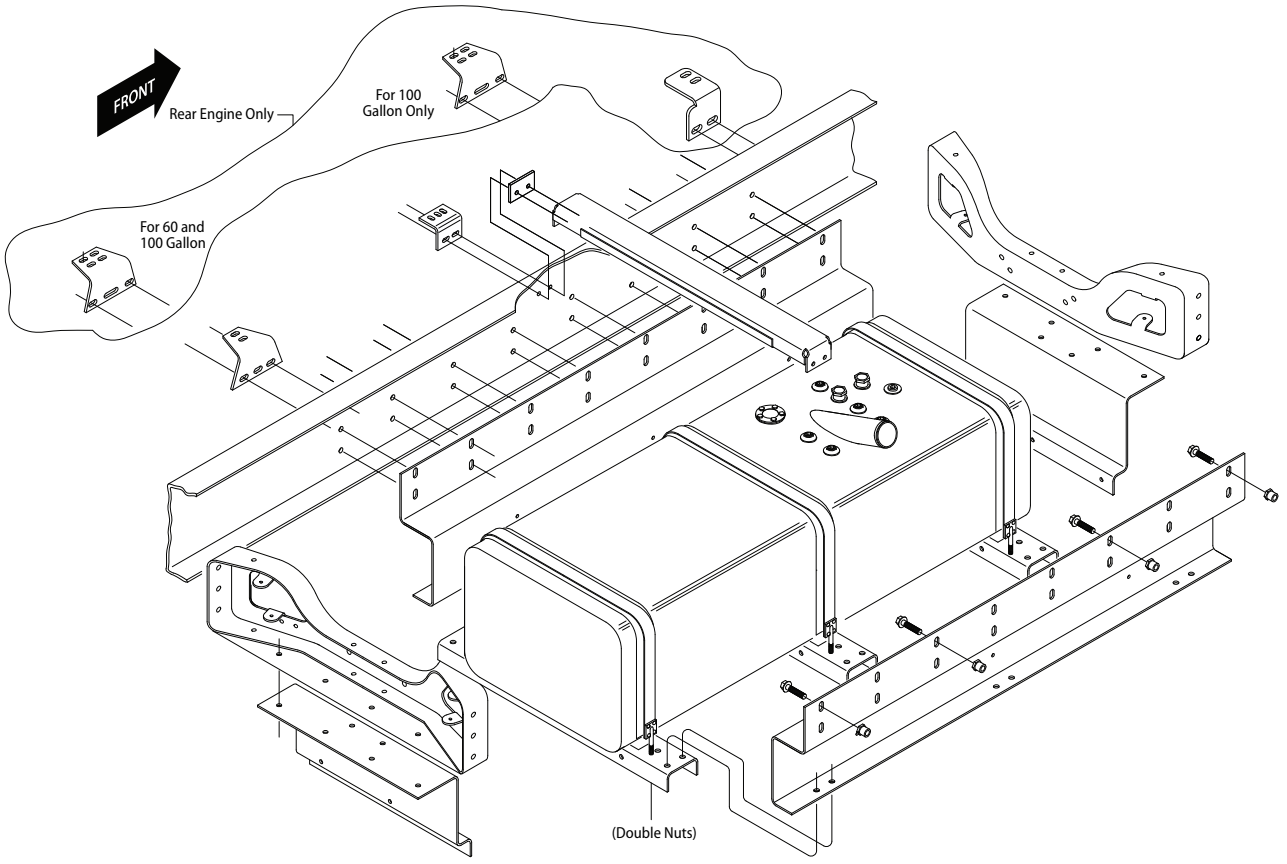
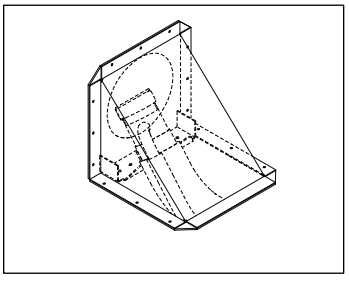
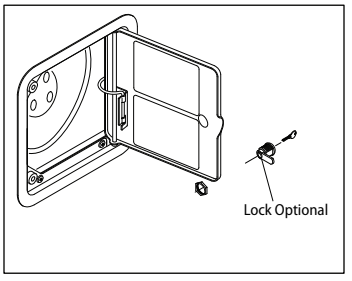
Fuel Tank & Barrier A3FE



Fuel System: A3FE







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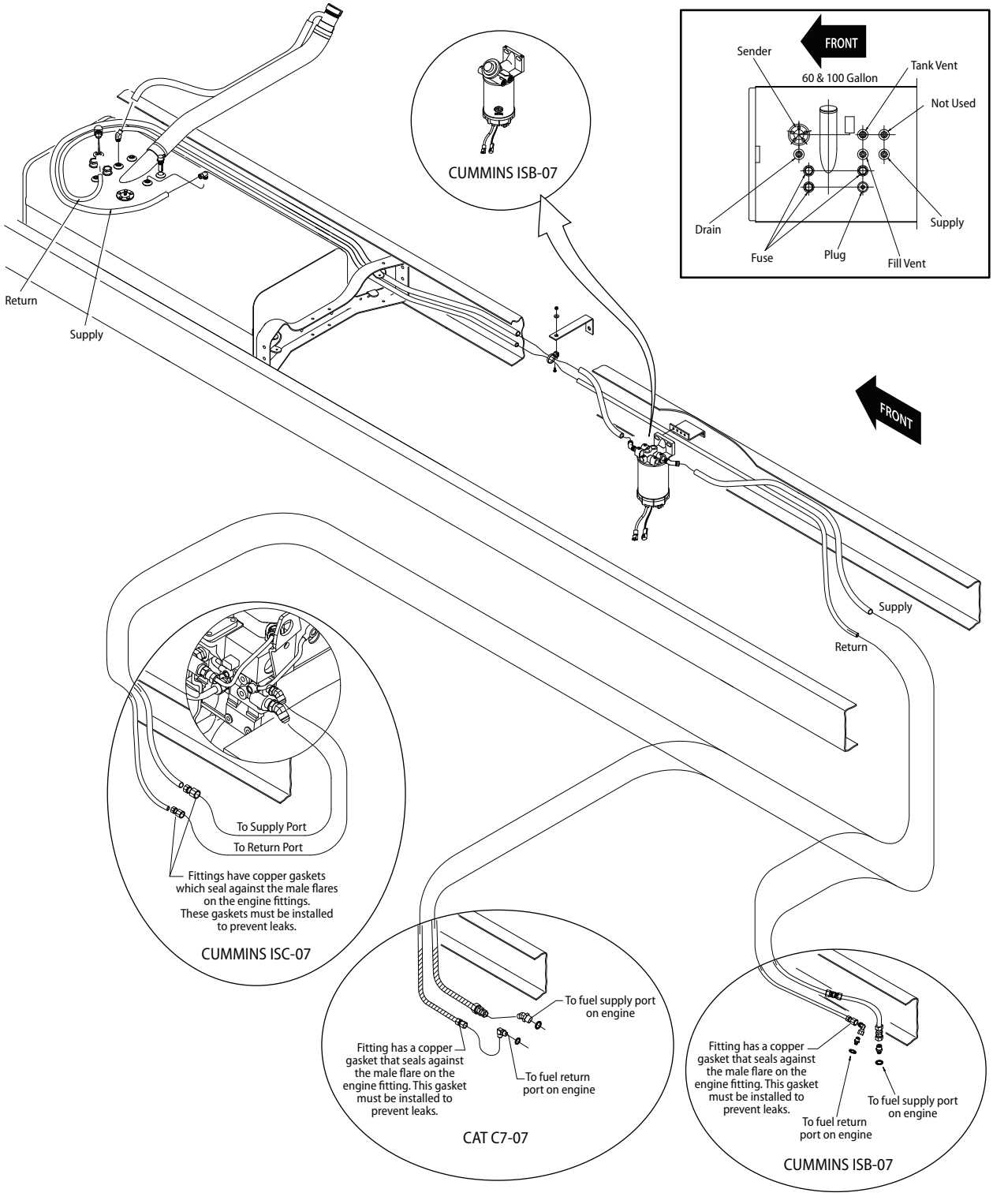
Fuel Tank & Barrier: A3RE



Fuel System: A3RE

Accelerator Control, Electronic

The All American's throttle control regulates engine speed not by direct mechanical linkage, but by electronically communicating the position of the pedal to the engine's Electronic Control Module (ECM). The ECM in turn controls the engine's fuel system to adjust engine speed.

When the pedal is pressed, its lever arm rotates a spring-loaded mechanism inside the throttle assembly's housing. Attached to the side of the housing is an electronic position sensor which varies a signal it sends to the engine ECM. The signal modulates according to the position of the rotating part of the pedal assembly.

The accelerator pedal assembly is mounted entirely inside the bus, with no part of it extending through the firewall. The assembly is not rebuildable; therefore, it must be replaced as a unit if damaged or faulty. The Accelerator Pedal Position Sensor (APPS) requires no adjustment, and is not rebuildable. However it is replaceable as a separate unit from the pedal assembly (Blue Bird kit # 0064032).

Throttle Position Sensor

The APPS receives an +8 volt DC supply voltage from the engine ECM, drawing less than 40mA of current. It's electonic circuitry senses the accelerator pedal position, and generates an output signal which communicates the throttle position back to the ECM.

The output signal conveys its data by means of *pulse width modulation (PMW)*, a method by which the wave form of a pulsating DC current signal may be altered in order to convey a signal. Because of its fundamentally on/off nature (square wave form) PWM is particularly well-suited for communication between digital control devices and microprocessors.

Pulse Width Modulation

Pulse width modulation varies the width of the positive crest of each wave of current. Thus, in pulse width modulation, both the voltage (amplitude) and wave length (frequency) remain constant, while the duration of the positive pulse (pulse width) varies. The longer the duration of the pulse, the higher the percentage of the total wave length it occupies. For this reason, pulse width is measured as a percentage of the wavelength. The percentage is refered to as the *duty cycle*.

In typical applications, the signal frequency is quite higher than the response rate of the load device. The on/off pulses therefore tend to be "smoothed out" or averaged over time while the load operates. The net result is the appearance and behavior of varying output voltage, even though the voltage of the pulses is constant.

Pulse Width Modulation

Several components on the Blue Bird All Americam employs pulse width modulation rather than mechanical rheostats or resistors. These include the acellerator pedal, and instrument lighting. This illustration explains the basic principle of Pulse Width Modulation.

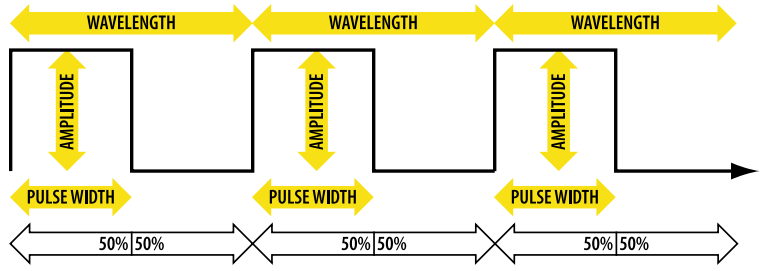
Uniform Square Waveform

In this unmodulated wave:

Wavelength (and therefore Frequency) is constant.

Amplitude (wave height) is constant.

Pulse Width (the positive portion of the wave) is constant. Note that in this example, the Pulse Width occupies 50% of the total wavelength.



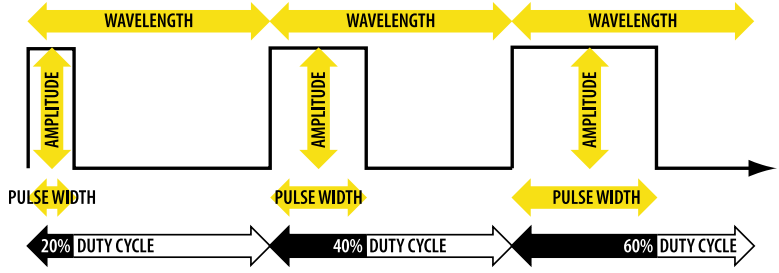
Pulse Width Modulation (PWM)

In a PWM circuit, information is conveyed by varying the percentage of total wavelength which is occupied by the Pulse Width.

Wavelength (therefore Frequency) is constant.

Amplitude is constant.

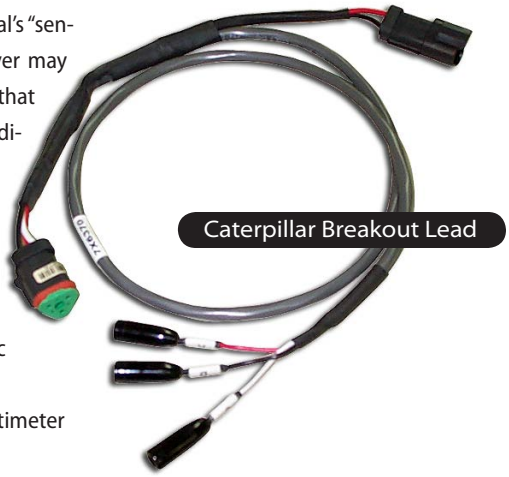
Pulse Width varies. Note that now, the Pulse Width varies independently of Wavelength. The Pulse Width-to-Wavelength ratio is expressed as a percentage and is referred to as ***Duty Cycle.***



Auto Calibration

The ECM is programmed to automatically re-calibrate its responses to the throttle position sensor signal each time the ignition is turned on. Initially, the ECM interprets a 22% pulse wave as a call for low idle, and a 75% pulse wave as full RPM. During the normal-use cycling of the accelerator pedal, the ECM adjusts its calibration, resulting in a broader duty cycle range in which 10-22% signals idle and 75-90% signals full RPM.

This process results in a slight, but noticable, change in the throttle pedal's "sensitivity" until the auto-calibration is completed. During this time, the Driver may notice that full RPM is achieved before the pedal is fully depressed, and/or that more pedal movement is required to raise engine RPM above idle. This condition is normal during the power-up and auto-calibration period.


Caterpillar Breakout Lead

Testing And Troubleshooting (CAT C7)

The acellerator installed on the Blue Bird All American produces a signal which meets Caterpillar's specs for PWM input throttle signal. Caterpillar provides diagnostic tests and codes in their ET and PocketTech diagnostic software.

The output of the throttle assembly may also be tested using a multimeter which is capable of measuring a PWM duty cycle, as follows:

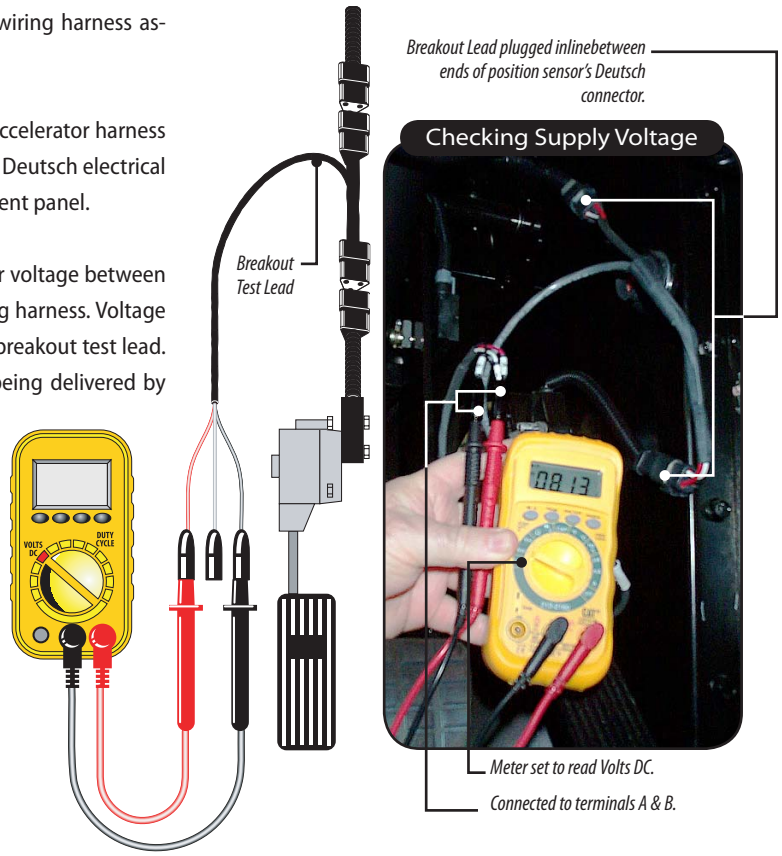
1. Inspect all electrical connectors and wiring harness associated with the accellerator.

2. With the ignition off, disconnect the accelerator harness from the vehicle wiring harness at the Deutsch electrical connector located behind the instrument panel.

3. Turn the ignition on and and check for voltage between terminals A and B of the vehicle wiring harness. Voltage can be checked by using Caterpillar's breakout test lead. This should indicate that +8 VDC is being delivered by the ECM to the harness connector.
   If the voltage is out of range:

   - Check the integrity of the vehicle wiring harness from the connector to the ECM. Repair as necessary.

   - If connections and harness test satisfactorally, the problem may be due to a damaged ECM. Refer to Caterpillar troubleshooting guidelines.



4. Turn ignition off. Connect the breakout test lead as follows:

   4.1 Connect the breakout test lead inline with the accelerator wiring harness.

   4.2 Connect the red lead of the meter to terminal C of the breakout test lead (accelerator pedal position ; white circuit).

   4.3 Connect the black lead to terminal B of the breakout test lead (accelerator/switch sensor common; black circuit).

5. Set the meter to measure duty cycle percentage. Turn the ignition on.

6. Check the duty cycle readings with the accelerator at idle and at full RPM position. Compare the readings to the values shown here:

With the Position Sensor attached to the Accelerator Pedal Assembly, readings should be:

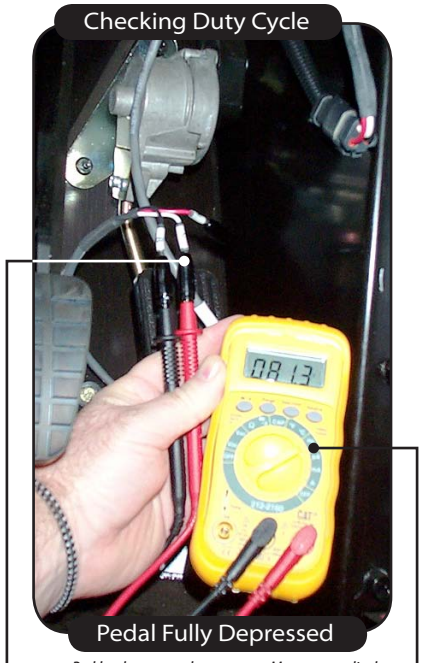
Idle:	**10–22 %**
Full Throttle:	**75–90%**

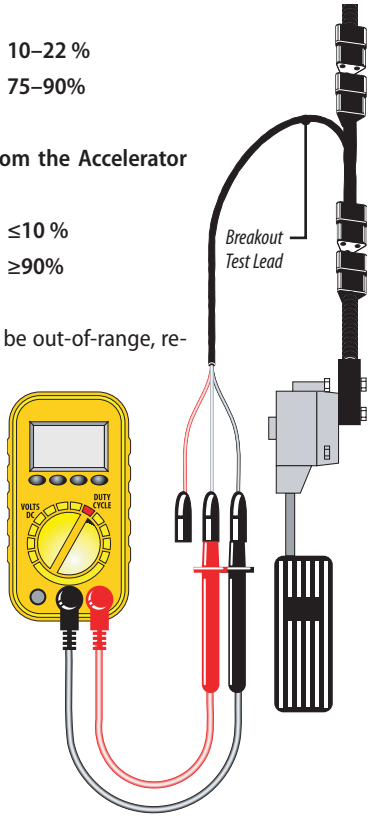
If the Position Sensor is removed from the Accelerator Pedal Assembly, readings should be:

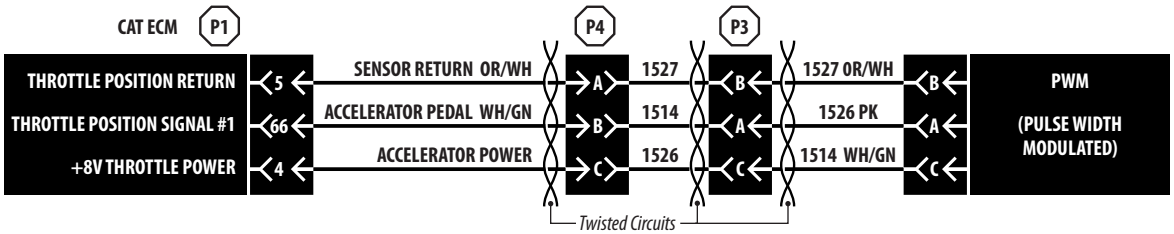
Idle:	**≤10 %**
Full Throttle:	**≥90%**

If duty cycle values are determined to be out-of-range, replace the APPS and/or the accelerator pedal assembly.

7. Slowly move the accelerator pedal from idle to full throttle position while observing the meter. Duty Cycle percentage should increase and decrease proportionally to the movement of the pedal. If it does not, replace the APPS and/or the accelerator pedal assembly.







Testing And Troubleshooting (Cummins)

The Cummins accelerator pedal incorporates two Throttle Position Sensors to provide the required input to the engine ECM. These components are non serviceable and should not be removed from the accelerator assembly or you could risk voiding the warranty. Each component has three wires going through a weather-pak connector and can be tested individually for proper operation.

Throttle Position Sensor Coil Resistance

The Throttle Position Sensor provides the engine an analog signal instructing it to increase or decrease RPM based on the position of the accelerator. This is done with a three wire potentiometer. The sensor is provided a continuous 5V DC (pin B27) and a ground (pin B28) by the engine ECU. As the accelerator pedal is depressed, the throttle position sensor will relay its position to the engine (pin B35). The throttle position sensor can be tested by the following:

Disconnect sensor plug and meassure resistance on accelerator side of connector between:

- Pins C and A. (Supply and Return) Value should be between 2000 and 3000 ohms.
- Pins C and B. (Supply and Return) Released pedal value should be between 1500 and 3000 ohms.
- Pins C and B. (Supply and Return) Depressed pedal value should be between 200 and 1500 ohms.

Resistance should decrease proportionally as pedal is depressed. Released pedal resistance minus depressed pedal resistancemust be greater than 1000 ohms.

CAUTION ***Do not attempt to adjust or repair throttle position sensor or idle validation sensor. Warranty will be voided.***

Should the accelerator fail to meet specifications the entire pedal must be replaced.