Overview

The cooling system on the Blue Bird Vision is designed to maintain the temperature of the engine within the optimum operating range, throughout the conditions for which the vehicle is intended to function.

The down-flow radiator and transmission fluid cooler are fabricated together. The engine coolant and transmission fluid radiator is assembled to the Charge Air cooler prior to installation in the chassis. The radiator is mounted at the front of the vehicle, behind the first cross-member and between the frame rails.

A 9-blade, 24 inch diameter nylon fan assists by pulling ambient air over the radiator. The operation of the fan is controlled by signals from the engine Electronic Control Module (ECM), through the Multiplex System. Control of the fan is limited to "Fully-On" or "Fully-Off" by an electromagnetic clutch arrangement.

Power to drive the fan is supplied by a polly vee fan belt, driven directly by the engine. An automatic belt tensioner helps to keep the drive belt at the proper tension for maximum drive function and service life.

The water pump provides coolant flow within the cooling system, at a level sufficient to maintain pressure of less than 10 psi. Circulation of the coolant liquid is critical to maintaining proper operating temperature. Coolant absorbs heat generated by the combustion action of the engine and by friction generated by the moving parts. The heated coolant circulates through a system of pipes and hoses to the radiator, where heat is transferred to the atmosphere by the ambient air flowing over fins in the radiator.

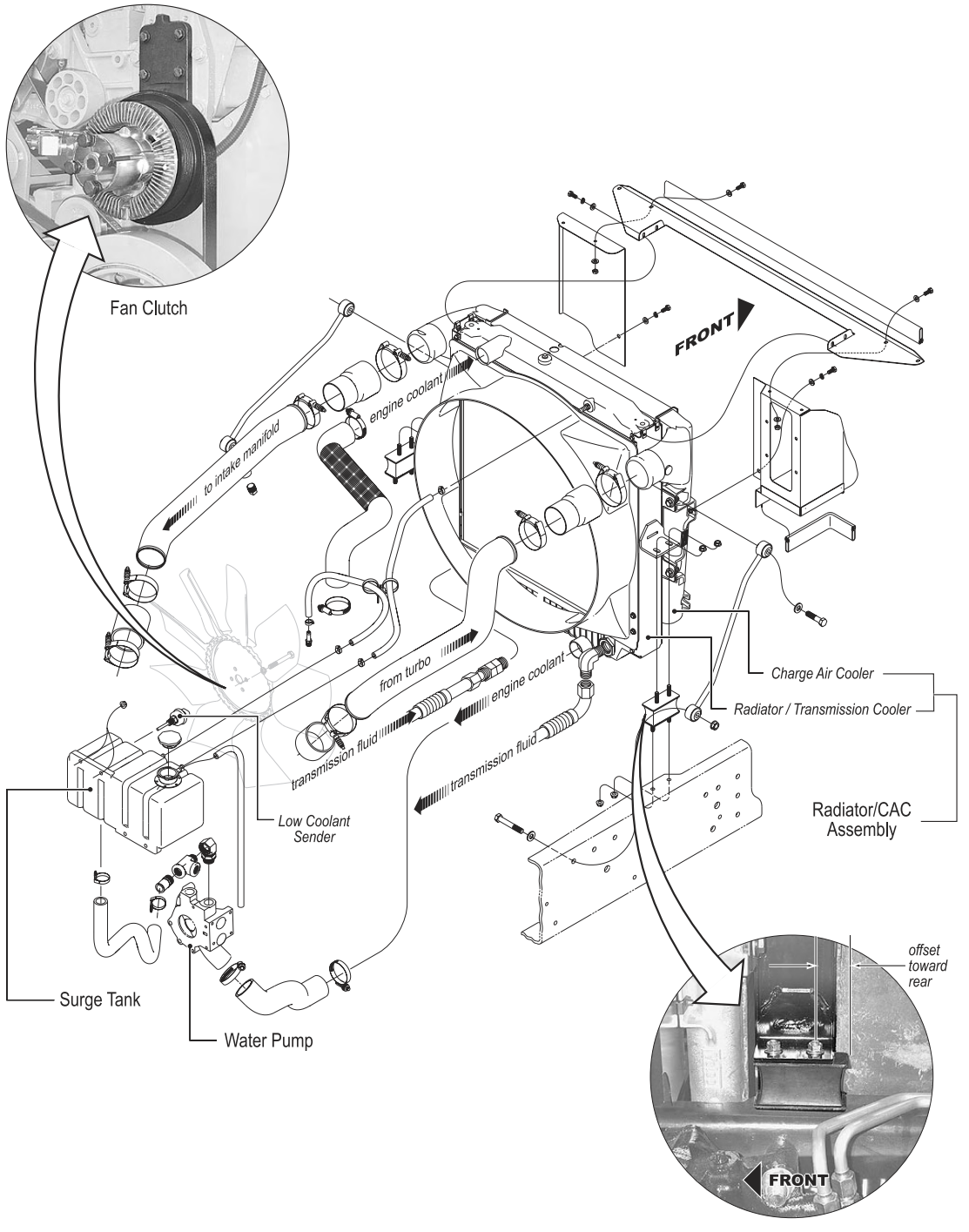
When excessively high operating temperature is observed, first check for proper fluid level in the coolant reservoir or "surge tank". If the fluid level is low and cannot be maintained without constant refill, inspect for leaks at pipe and hose connections. Also look for damaged hoses due to heat or chaffing from incorrect routing. During cold weather, the coach heater system may also be an area of leaks.

Debris accumulation in the radiator fins or bent fins restricting airflowmay also cause overheating.

The three main symptoms of trouble in the cooling system are overheating, overcooling, and loss of coolant. A cooling system should first be diagnosed by a thorough visual inspection. If this reveals no useful information, tools and test equipment will be needed to proceed.

In the case of overheating, the next step is to verify the proper operation of the thermostats. Refer to the appropriate Caterpillar publication for instructions regarding the removal and testing of the thermostats.

The engine, coolant, and transmission fluid may be very hot (possibly above the boiling point at atmospheric pressure). Use caution when working with these components. Allow the system to cool to the point where you can comfortably lay your hand on the engine block and radiator before working on it. Refer to the Introduction section of this manual for advice on the environmental considerations required when working with these materials.



Cooling System *Major Components*

Maintenance

Caterpillar Level 1 Preventive Maintenance schedule recommends that the coolant in the system be analyzed every 11,000 miles (17700 km) or 1,100 gallons (4150 L) of fuel consumption, or 250 hours of engine operation or 6 months; whichever is the first to occur.

Caterpillar Level 2 Preventive Maintenance schedule recommends thermostat replacement every 100,000 miles (161000 km), or 15,000 US gallons (56850 L) of fuel consumption, or 2,000 service hours, or 2 years; whichever is the first to occur. Refer to the appropriate Caterpillar publication for details.

Cooling System Maintenance Schedule

It is very important that the coolant be tested at regular intervals. Refer to the appropriate Caterpillar service manual for instructions on the procedures necessary to perform the maintenance schedules.

Cooling System

OPERATION	WHICHEVER OCCURS FIRST: Daily	1 month / 250 hours	3 months / 1,000 miles	6 months / 1,000 hours	24 months / 500 hours	36 months / 300,000 miles	72 months / 600,000 miles	NOTES
Coolant								
Check fluid level in reservoir	•							*Also check coolant level whenever engine runs hotter than normal. Repair any leaks immediately. Use only Caterpillar ELC. See your Caterpillar® Operations and Maintenance Manual for details.*
Clean debris from radiator fins.	•							
Inspect for leaks.	•							
Add coolant	as required							
Add extender						•		*Use Caterpillar ELC Extender.*
Change coolant							•	*Use Caterpillar ELC.*
Belts								
Inspect tension & condition		•						
Hoses & Clamps								
Inspect for leaks or deterioration		•						
Tighten clamps					•			*Torque radiator hoses to 90 in. lbs (10 Nm) and heater hose clamps to 45 in. lbs. (5 Nm).*

Coolant Mixture

The coolant mixture in the Blue Bird Vision is 55% Extended Life Coolant (ELC) and 45% distilled or ionized water. This formula will protect the engine against freezing down to -40° F (-40° C) and protects against boiling to 232° F (111° C).

Extended Life Coolant is red in color and must not be mixed with other kinds of antifreeze, or with standard Supplemental Cooling Additives (SCAs). Do not use water filter elements which introduce SCA into the system.

Caterpillar ELC is available in both concentrate and premix forms. When using concentrate for routine top-off, always pre-mix to the 55:45 ratio. *Do not add plain water or pure antifreeze to the system.*

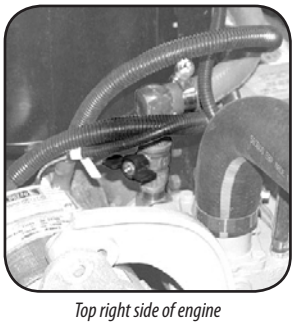
The ELC coolant has a flush & replace service life of 6 years or 600,000 miles (956606 km); whichever occurs first. However, it must be supplemented by the addition of ELC Extender at 3 years or 300,000 miles, whichever occurs first.

Coolant Capacity

The Blue Bird Vision is manufactured with a 7.5-gallon coolant capacity, not including the heater system. To calculate the capacity of the coolant in the heater system, multiply 5.33 ounces (0.16 L) by the number of feet of heater hose in the system. This calculation is critical to the computation of the proper amount of Extender to be added at the 3 year, 300,000 mile requirement.

Heater Cut Offs

Lower right side of engine



Top right side of engine

Coolant Extender

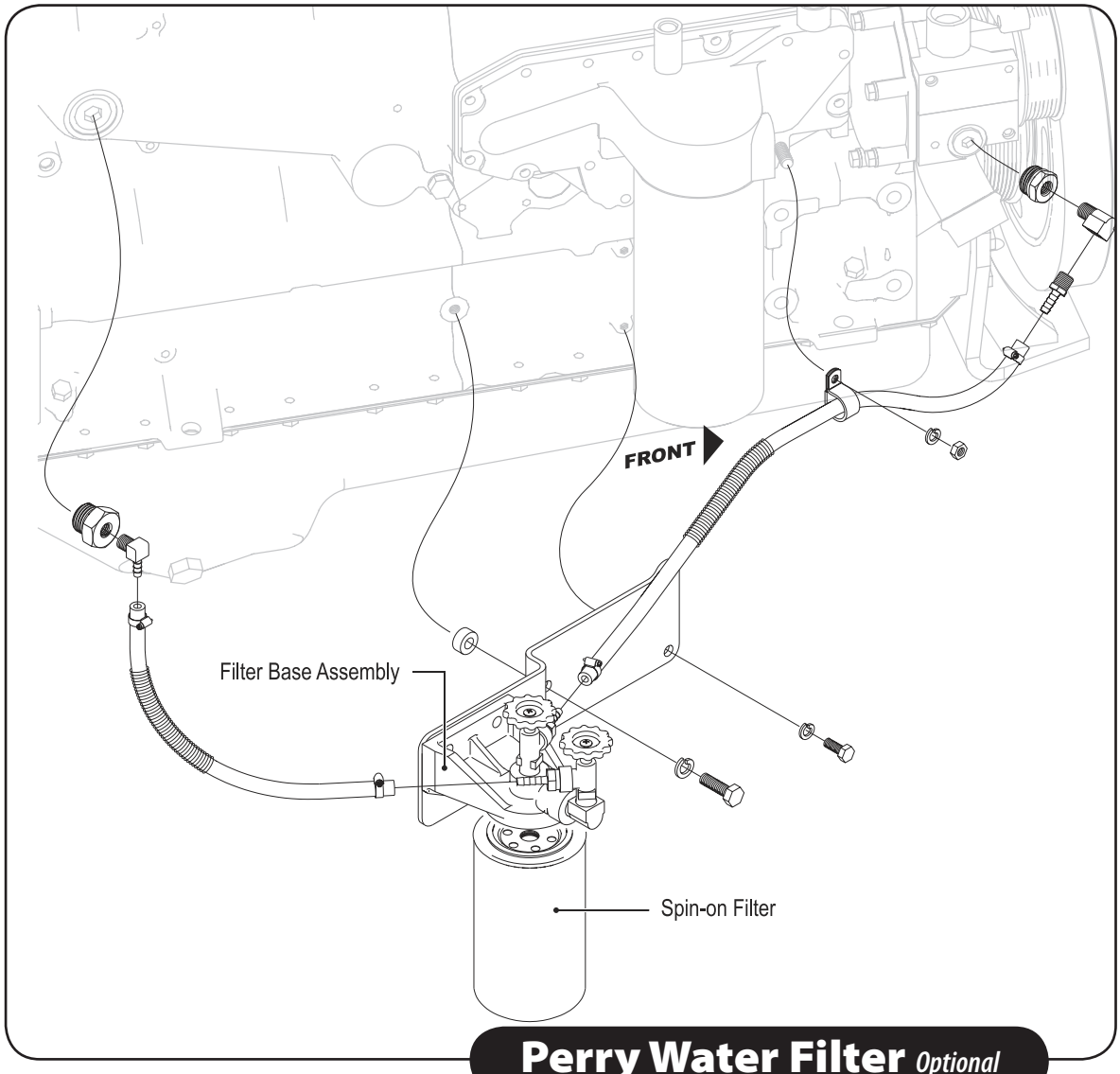
Add Caterpillar ELC Extender after the first 3 years or 300,000 miles (482803 km) and 3 years or 300,000 after each coolant replacement. The heater/defroster cut–off valves must be open during this procedure. The coach heater supply and return hoses each have a ball valve cut-off located on the engine to prevent circulation of hot engine coolant into the passenger area. These valves must be in the "OPEN" position when heat is desired in the coach, and they must be open during any maintenance procedure that requires an accurate coolant chemical analysis (e.g. during the addition or change of coolant, or while adding ELC Extender).

To calculate the amount of ELC Extender needed, refer to the figures below. Also review the Caterpillar Operator's Manual that came with the bus (Caterpillar publication number SEBU7766 for the C–7 engine).

Cooling System Capacity	Amount of Extender
6–8 Gal. (22–30 L)	20 Fl oz (0.57 L)
9–10 Gal. (31–38 L)	24 Fl oz (0.71 L)
11–13 Gal (39–49 L)	32 Fl oz (0.95 L)
14–17 Gal (50–64 L)	40 Fl oz (1.18 L)
18–22 Gal (65–83 L)	54 Fl oz (1.60 L)
23–30 Gal (84–114 L)	72 Fl oz (2.15 L)
31–43 Gal (115–163 L)	100 Fl oz (3.00 L)
44–64 Gal (164–242 L)	148 Fl oz (4.40 L)

Coolant Filter

If the unit under repair is equipped with a water filter, the paper cartridge must be replaced at 1,000 hour/6 month intervals. Use Wix p/n 24070 or equivalent. Do not use filter cartridges with Supplemental Cooling Additives (SCAs).

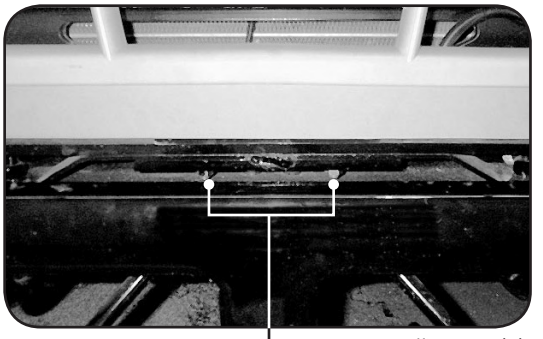


Perry Water Filter *Optional*

Radiator

Removal

Disconnect front ends of gas springs.


Hinge mount bolts

1. Disconnect the headlight wiring harnesses.
2. Remove the gas springs from each side of the hood.
3. Remove 2 bolts at the center of the hood, just above the bumper. (Remove the holding bracket, hinges and hood as an assembly.)
4. Remove the drain plug from the transmission to drain the fluid into a suitable container.
5. Remove the transmission cooler hoses at the transmission to drain the fluid into a suitable container, observing all applicable local, state and federal laws concerning disposal of hazardous fluids. If the adapter fittings are removed from the bottom of the radiator, mark the orientation to aid at assembly.
6. Remove the transmission cooler hoses from the radiator.
7. Using the petcock at the lower left-hand (driver's) side of the radiator, drain the engine and radiator of coolant into a suitable container.
8. Remove the 4 nuts and bolts from the engine air intake grille.
9. Remove the air intake piping completely or ensure that it is secured out of the way.

Cover all openings in the engine, transmission, and radiator as they are opened. Plug all removed tubing, hoses and piping to prevent contamination.

10. After removing all the hoses and piping, remove 2 capscrews from each corner of the fan shroud assembly.
11. Pull the shroud as far rearward (over the fan) as possible. Allow the shroud to hang over the fan blades. If the vehicle is equipped with shutters, see the instructions for their removal below.
12. Remove the capscrew from each side of the radiator.

13. Remove and discard the locknut at each support assembly, where it attaches to the frame rail. Store the support out of the way.

14. Remove and discard 2 locknuts from the isolator at each side of the radiator.

15. Carefully lift the radiator clear of the frame rails. Ensure the fins on the radiator and charge air are protected.

Reintallation

Both baffles must be in position and their respective seals in place for the cooling system to perform correctly.

When installing the radiator isolators, exercise care to orient the 20 mm edge distance toward the front of the bus. If the 35 mm edge is installed toward the front, there will not be space for the fan shroud and shutters.

When installing the fan, use 4 new split-ring lock washers. Torque the capscrews to 33–58 ft. lbs. (44.74–78.64 Nm). Ensure the fan blades are oriented to produce airflow through the radiator and toward the engine when rotated counter clockwise.

1. Position the fan shroud over the fan as far as possible.

2. Centering the assembly, carefully position the radiator onto the isolators at each frame rail. Torque new locknuts to 29–33 ft lb (39.32–44.74 Nm), at 4 places.

3. Position and install the radiator braces (14). Torque all 4 fasteners to 70–80 ft lb (94.91–108.47 Nm). Use new Grade 8 locknuts at the frame rail.

4. Position and install the transmission fluid cooler hoses to the bottom of the radiator. Ensure the hoses are in the proper position. The left (driver's) side transmission hose connects to the driver's side of the radiator. Ensure that the protective loom is installed on the transmission lines. The threads in the bottom of the radiator are National Pipe Threads (NPT). These threads require the application of Loctite 557™ pipe sealant with Teflon™. Follow the directions and warnings on the package. Start the fitting 1 thread into the proper location, and then apply the sealant. Torque to 70–77 ft lb (94.91–104.40 Nm).

5. Install the transmission drain plug. Torque to 22–30 ft lb (30–40 Nm).

6. If so equipped, position the shutter assembly onto the radiator.

7. Position the shroud onto the radiator and shutter assembly.

8. Loosely install 2 capscrews at each corner.

9. Turn the fan blades by hand. Ensure that the blades are centered in the shroud and do not touch at any point.

10. When the fan blades are centered in the shroud, torque the 8 fasteners to 30–38 ft lb (40.67–51.52 Nm).

11. Install the bottom coolant hose. Torque clamps to 5 ft lb (6.8 Nm).

12. Install the upper coolant hose; torque the clamp to 5 ft lb (6.78 Nm). Ensure the protective loom is installed on the top radiator hose.

13. Route the intake charge air tube over the radiator hose and install to charge air cooler. Torque clamp to 5 ft lb (6.78 Nm).

14. Install the charge air tube from the turbo outlet to the curb side charge air cooler fitting. Torque the clamps to 5 ft lb (6.8 Nm).

15. It is important that the baffles and their seals are properly positioned. Torque fasteners to 5–6 ft lb (6.78–8.13 Nm).

16. Install the hood in the reverse order of its removal. Torque the hinge fasteners to 25–37 ft lb (33.90–50.17 Nm).

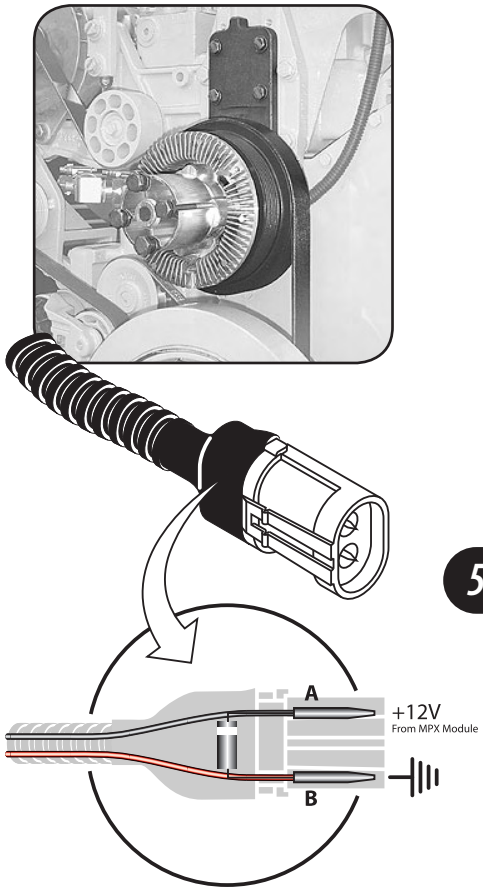
17. Torque the gas assist spring fasteners to 16–18 ft. lbs. (21.69–24.40 Nm).

Fan Clutch

The cooling fan is not mounted to an engine shaft, but to a Horton magnetic fan clutch which engages only when the Vision's Multiplex system provides it 12 volt current. The outer housing of the clutch assembly is driven by the fan belt and therefore rotates whenever the engine is running. When the stator coil inside the fan clutch assembly becomes energized by 12 volt DC from the Multiplex system, the clutch engages the rotating outer housing with the inner hub to which the fan blade is mounted.

The engine ECM monitors engine temperature and provides a Cooling Fan Disable signal as an Active Input to the Multiplex system's central component, the MPX Module. When engine temperature is high enough to require additional cooling, the ECU stops the Input signal (the Input becomes Inactive). The absense of this signal is one of two conditions (the other being an Active Ignition Switch Input) which the logic of the MPX Module requires in order for it to provide an Active Fan Control Power Output (12 DC).

When the fan clutch is de-energized, the collapsing magnetic field momentarily induces a current with reversed polarity in the stator. The electrical connector of the fan clutch contains a diode which provides the induced current a low-resistance path to ground, to protect other circuits from being affected.



Troubleshooting

Because the fan cluch circuit is part of the Multiplex System, the first step in investigating an inoperative fan is to perform Multiplex diagonstics.

1. Refer to the Multiplex Output Table to find out which Port/Pin (B2-03) and which Output LED (B2-O02) pertain to the Fan Control Power Output. The chart also shows which Ladder Logic Line (#11) describes the logic of the circuit.

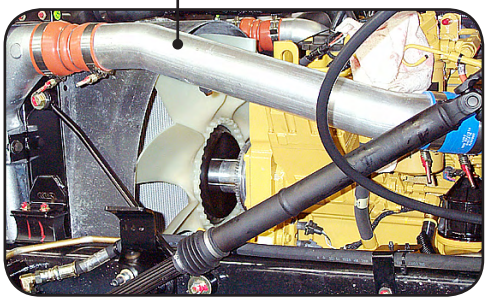
2. Use the Diagnostic Switch to cycle the MPX Module to the appropriate Diagnostic Mode (Showing B2 Outputs). Check the LED to see if it is Active. If the Output LED is Inactive, refer to the Ladder Logic line to systematically verify that each requirement for an Active Output is true. (See the Multiplex chapter for information on how to troubleshoot a Multiplex circuit.) If the Output is Active, but the fan clutch is not engaged, verify the 12 V Output at Pin B2-03 on the MPX Module, and/or at the fan clutch harness connector.

3. If, the fan clutch fails to engage after having determined it is receiving 12 volt power, replace the fan clutch.

Removal

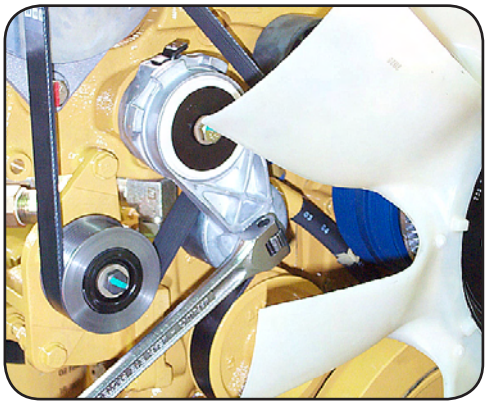
The fan clutch is assembled to a mounting bracket which bolts to the front of the engine. The fan clutch can usually be removed with the fan still attached, by removal of the Charged Air Intake tube on the left side of the engine compartment and unbolting the fan clutch mouting bracket from the engine. This avoids having to drain coolant and remove the radiator and/or remove the radiator shroud in order to service the fan clutch.

On most units, removing the Charge Air Intake Tube provides clearance for removal of the fan & fan clutch as a unit.



1. Loosen the clamps at each end of the Charge Air Intake Tube and remove the Charge AIr Intake Tube. Cover the open ends to prevent contamination.

Turning the tensioner to allow belt removal.



2. Insert a 1/2-inch socket drive handle into the square socket of the idler pully arm. Lift upward to release tension from the fan belt. Slide the fan belt off of the fan clutch pully.

3. Remove the four bolts which mount the fan clutch bracket to the engine.

4. Carefully maneuver the fan, with clutch and bracket attached, out toward the driver's side of the engine compartment.

5. To remove the fan from the clutch assembly, acquire assistance in holding the fan at several places while removing the four bolts which fasten it to the inner hub. To avoid damage to the fan, do not rely upon pressure against only one fan blade.

6. To remove the fan clutch from its mounting bracket, secure the bracket in a bench vise. Insert a ½ inch socket drive extension into the square socket of the journal shaft in the center of the clutch hub and turn counter clockwise.

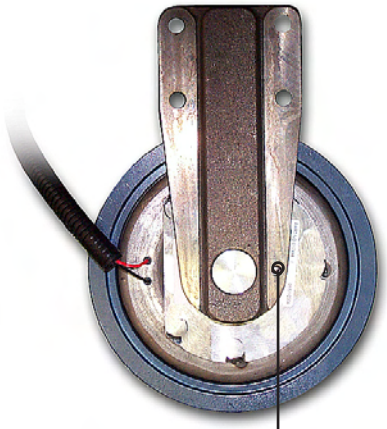
Reinstallation

Reinstall in reverse order of the removal procedure, observing these requirements:

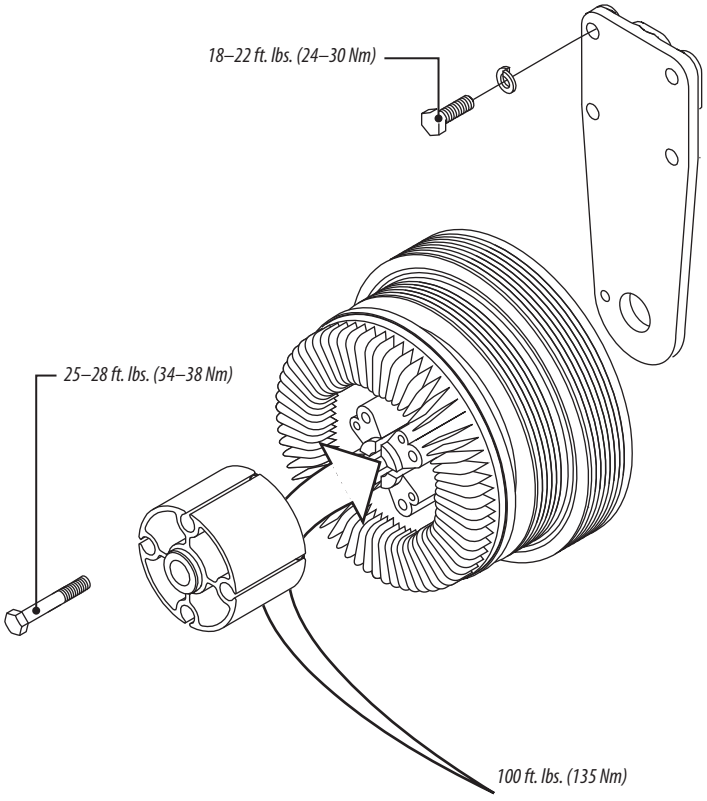
1. If the fan clutch assembly has been removed from the mounting bracket, be sure to align the anti-rotation boss on the mounting side of the fan clutch with the hole on the bracket:

2. Use these torque values when reassembling:

Journal Shaft to mounting bracket:	100 ft. lbs. (135 Nm.)
Fan mounting bolts to clutch hub:	25-28 ft. lbs. (34–38 Nm.)
Mounting bracket bolts to engine:	18-22 ft. lbs. (24–30 Nm.)



Be sure the anti-rotation boss aligns with the hole in the mounting bracket.

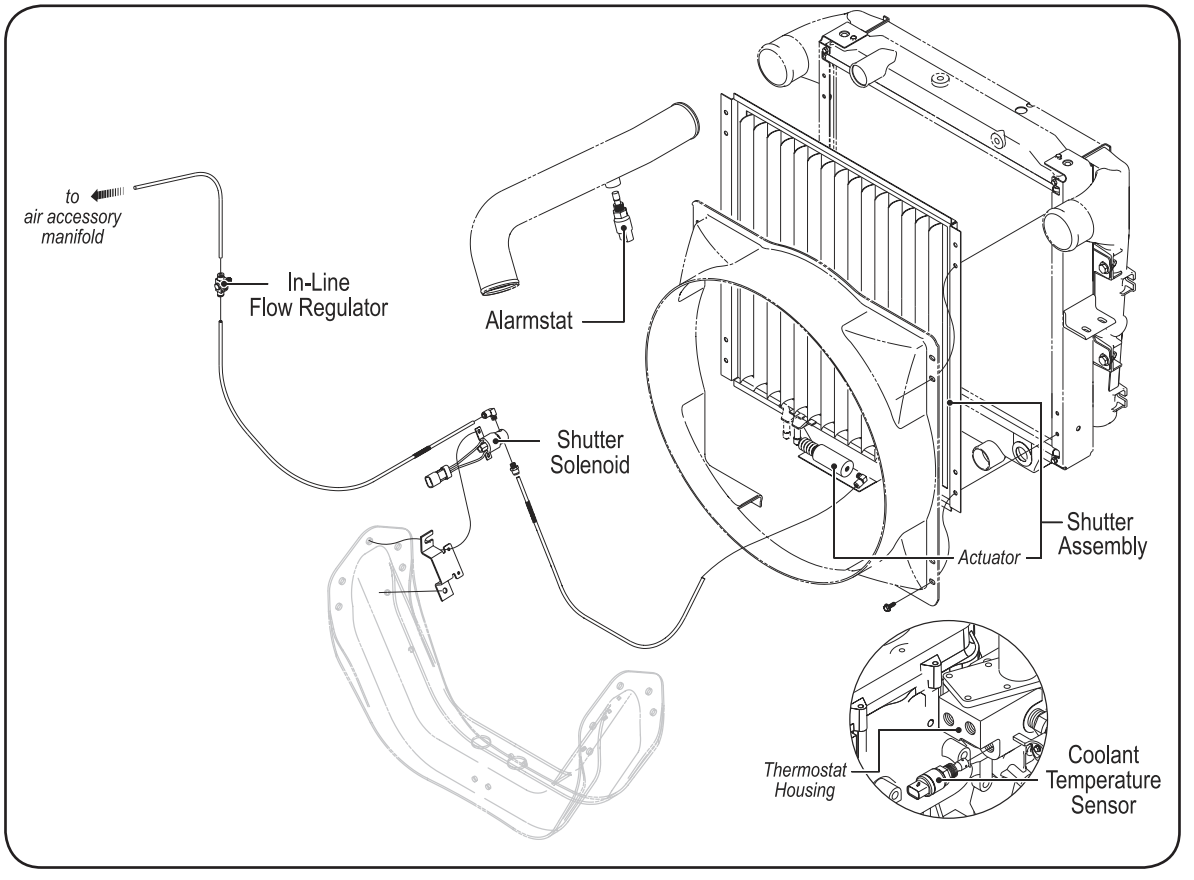


Shutters

Your Blue Bird Vision may be equipped with a shutter system to help with temperature control in colder climates. The shutters are spring-loaded and are normally open. When the operating temperature of the engine falls below the recommended range, the shutters close to prevent air flow through the fins of the radiator. Shutters may be hydraulically operated or pneumatically operated.

The shutter system requires little maintenance, beyond keeping the mechanism clean and free of debris that might bind or jam the shutters. See the illustrations for an overview of the shutter assembly.

The shutter assembly is installed between the radiator and the shroud and the 8 bolts that attach the shroud fasten it. The actuator assembly is located at the bottom center of the shutter assembly and is controlled by a valve located on the frame rail inside the front deep–U cross member. This valve is controlled by 185° Alarmstat controls located in the Charge Air (CA) pipe, between the CA cooler and the engine intake, and in the thermostat housing on the engine. There is no practical method to check the operation of the Alarmstats. If they are suspected of malfunctioning, substation is the method of testing.



Removal

1. Remove the actuator supply tube from the shutter actuator.
2. If necessary, remove the top radiator hose.
3. Remove the 2 capscrews from each corner of the shroud/shutters assembly.
4. Carefully lift the shutters assembly from the unit.

Shutter installation is accomplished in the reverse order of the removal instructions.