



PowerCube[™]
ISOLATED ONBOARD ENERGY SYSTEMS

PARTS AND SERVICE MANUAL

These recommended service procedures are intended to support PowerCube dealers and other trained service personnel in the maintenance and service of PowerCube APU units. Engine related information comes from Caterpillar's "Operation and Maintenance Manual".

Modifications to the truck or unit can affect its serviceability and are outside the scope of this document.

TECHNICAL ASSISTANCE

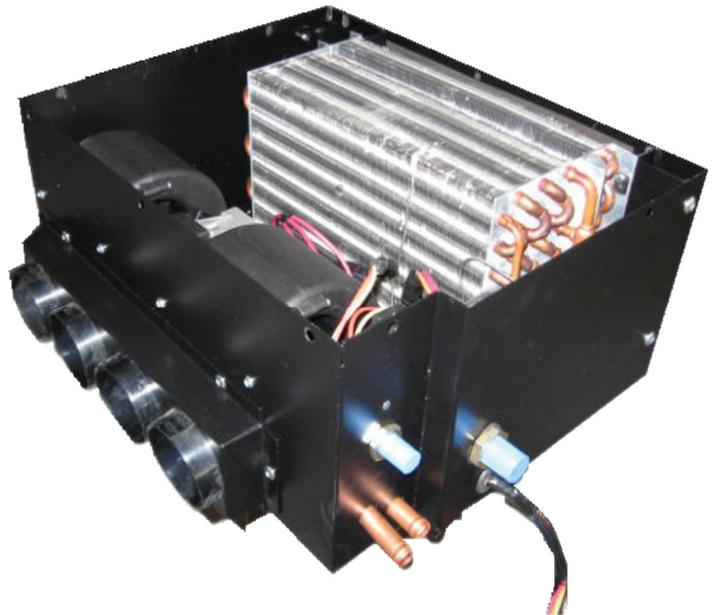
Before calling technical assistance please have the following ready:

- PowerCube Serial Number
- APU Hours
- In-Service Date

Technical Support is available Mon.-Fri. 8AM-5PM
Call 1-308-762-2975

ADDITIONAL DOCUMENTATION

PowerCube APU Installation Guide
PowerCube APU Limited Warranty
Caterpillar C0.7 Maintenance Intervals
Caterpillar C0.7 Industrial Engine Serial Number Prefix
C5M Parts Manual



Maintenance Interval Schedule

Daily

Cooling System Coolant, Check Level Engine Air Cleaner Service Indicator, Inspect Engine Air Pre-cleaner, Check/Clean
 Engine Oil Level, Check
 Fuel System Primary Filter/Water Separator, Drain
 Walk-Around Inspection

Every 50 Service Hours or Weekly

Fuel Tank Water and Sediment, Drain

Every 250 Service Hours or 6 Months

Cooling System Coolant Sample (Level 1), Obtain Cooling System Supplemental Coolant Additive, Test/Add Alternator and Fan Belts, Inspect/Adjust
 Engine Oil, Obtain Sample

Initial 500 Hours (for New Systems, Refilled Systems, and Converted Systems)

Cooling System Coolant Obtain Sample (Level 2)

Every 500 Service Hours or 1 Year

Battery Electrolyte Check Level
 Cooling System Supplemental Coolant Additive, Test/Add Engine Air Cleaner Element, Replace filter
 Engine Oil and Filter, Change
 Fuel System Secondary, Replace Filter (spin-on and inline)
 Engine Protective Devices – Check
 Hoses and Clamps - Inspect/Replace
 Radiator, Clean

Every 1000 Service Hours Alternator and Fan Belts - Replace Engine Valve Lash - Inspect/Adjust Turbocharger - Inspect

Every 2000 Service Hours

Alternator - Inspect
 Engine Crankcase Breather - Replace
 Engine Mounts - Inspect
 Starting Motor - Inspect

Every Year

Cooling System Coolant Obtain Sample (Level 2)

Every 3000 Service Hours

Fuel Injection Nozzles - Test/Exchange Water Pump - Inspect

Every 3000 Service Hours or 2 Years

Cooling System Coolant (DEAC) - Change
 Cooling System Water Temperature Regulator, Replace

Every 6000 Service Hours or 3 Years

Cooling System Coolant Extender (ELC) - Add

Every 12 000 Service Hours or 6 Years

Cooling System Coolant (ELC) - Change

PowerCube APU Service Part Numbers

The following table contains part numbers for common service parts used on the PowerCube APU and its Caterpillar C0.7 engine.

ENGINE AND APU SERVICE PART LIST	
CAT 0.7 ENGINE	Part Number
Oil Filter	CAT 150-4140 Wix 51348
Fuel Filter	Raycor – R12T Fram – PS11281 Baldwin – BF1380 Luberfiner – LFF8678 Wix - 33583
Primary Air Filter (Engine)	Donaldson - P822686-016-140 Wix - 46449
V- Belt and Stretch Belt	Stretch Belt Our # - 2354 Gates – 81625575 V- Belt Gates - 7312
25 Amp Fuse	CAT 113-8493
APU SYSTEM	
Relay	PC 11511
Cabin Air Cleaner filter (HVAC)	PC 13744
ADDITIONAL COMPONENTS	
Receiver Dryer	PC 928
Isolator Engine Mount	PC 2291
CAT Replacement Alternator	CAT AND 0433

Lubricant Viscosity Recommendations

The minimum ambient temperature during cold engine start-up, and the maximum ambient temperature during engine operation determine the proper SAE viscosity grade of oil.

Use the following table to for selection of oil viscosity under the minimum and maximum ambient temperature anticipated.

Note: Generally, use the highest oil viscosity available to meet the start-up temperature requirements.

If ambient temperature conditions at engine start-up require the use of multigrade SAE 0W oil, SAE 0W-40 viscosity grade is preferred over SAE 0W-20 or SAE 0W-30

Engine Oil Viscosities for Ambient Temperatures		
Viscosity Grade	Ambient Temperature	
	Minimum	Maximum
SAE 0W-20	-40 °C (-40 °F)	10 °C (50 °F)
SAE 0W-30	-40 °C (-40 °F)	30 °C (86 °F)
SAE 0W-40	-40 °C (-40 °F)	40 °C (104 °F)
SAE 5W-30	-30 °C (-22 °F)	30 °C (86 °F)
SAE 5W-40	-30 °C (-22 °F)	50 °C (122 °F)
SAE 10W-30*	-18 °C (0 °F)	40 °C (104 °F)
SAE 10W-40*	-18 °C (0 °F)	50 °C (122 °F)
SAE 15W-40	-9.5 °C (15 °F)	50 °C (122 °F)

*Recommended motor oil weight for the PowerCube APU.

Refill Capacities for the Lubrication System

The refill capacities for the engine crankcase reflect the approximate capacity of the crankcase or sump plus standard oil filters.

Engine Oil Approximate Refill Capacity C0.7		
Compartment or System	Liters	Quarts
Crankcase Oil Sump (Standard) •	2.01	2.1
External System	.85	.9
Total Lubrication System	2.86	3.0

- This value is the approximate capacity for the crankcase oil sump, which includes the standard oil filter that was installed at the factory.

“ASTM D975” generally meet the specifications. Diesel fuels from other sources could exhibit detrimental properties that are not defined or controlled by this specification.

Note: Operating fuels that do not meet these recommendations can cause the following effects: starting difficulty, poor combustion, deposits in the fuel injectors, reduced service life to the fuel system, deposits in the combustion chamber and reduced service life of the engine

Territory	Fuel Requirements from 2007		
EPA	Low Sulfur (500 ppm) maximum		
EC	Sulfur/Power	Low sulfur (300 ppm) maximum for less than or equal to 19 kW	Sulphur (1000 ppm) maximum for greater than 19 kW
	Model	C0.7	C1.1 C1.5NA C1.5T C1.6 C2.2NA C2.2T C2.2TA
Non-Regulated Territories	Sulfur limit of less than 4000 ppm		

NA is Naturally Aspirated. T is Turbocharged. TA is Turbocharged Aftercooled

Territory	Fuel Requirements from 2010		
EPA	Ultra Low Sulfur (15 ppm) maximum		
EC	Sulfur/Power	Ultra Low sulfur (10 ppm) maximum for less than or equal to 37 kW	Low Sulphur (300 ppm) maximum for greater than 37 kW
	Model	C0.7	C2.2NA C2.2T C2.2TA
Non-Regulated Territories	Sulfur limit of less than 4000 ppm		

GENERAL COOLANT INFORMATION

NOTICE

These recommendations are subject to change without notice. Contact your local Caterpillar dealer or PowerCube dealer for the most up to date fluids recommendations.

NOTICE

Never add coolant to an overheated engine. Engine damage could result. Allow the engine to cool first.

NOTICE

If the Engine is to be stored in or shipped to an area with below freezing temperatures, the cooling system must be either protected to the lowest outside temperature or drained completely to prevent damage.

NOTICE

Frequently check the specific gravity of the coolant for proper freeze protection or for anti-boil protection.

Clean the cooling system for the following reasons:

- Contamination of the cooling system
- Overheating of the engine
- Foaming of the coolant

Note: Air pockets can form in the cooling system if the cooling system is filled at a rate that is greater than 5 L (1.3 US gal) per minute.

After you drain the cooling system and after you refill the cooling system, operate the engine. Operate the engine without the filler cap until the coolant reaches normal operating temperature and the coolant level stabilizes. Ensure that the coolant is maintained to the proper level.

NOTICE

Never operate an engine without water temperature regulators in the cooling system. Water temperature regulators help to maintain the engine coolant at the proper operating temperature. Cooling system problems can develop without water temperature regulators.

Refer to Special Instruction, SEBD0518, “Know Your Cooling System” and Special Instruction, SEBD0970, “Coolant and Your Engine” for more detailed information.

Many engine failures are related to the cooling system. The following problems are related to cooling system failures: overheating, leakage of the water pump, plugged radiators or heat exchangers, and pitting of the cylinder liners.

These failures can be avoided with proper cooling systems maintenance. Cooling system maintenance is as important as maintenance of the fuel system and the lubrication system. Quality of the coolant is as important as the quality of the fuel and the lubricating oil.

Coolant is normally composed of three elements: water, additives, and glycol.

Coolant Recommendations

NOTICE

Do not use a commercial coolant/antifreeze that only meets the ASTM D3306 specification. This type of coolant/antifreeze is made for light duty automotive applications.

The following two coolants are used in Caterpillar diesel engines:

Preferred - Caterpillar Extended Life Coolant (ELC) or a commercial extended life coolant that meets the Caterpillar EC-1 specification.

Acceptable – Caterpillar Diesel Engine Antifreeze (DEAC) or a commercial heavy-duty coolant that meets “ASTM D4985” or “ASTM D6210” specifications.

Caterpillar recommends a 1:1 mixture of water and glycol. This mixture of water and glycol will provide optimum heavy-duty performance as a coolant.

Note: Caterpillar DEAC does not require a treatment with an SCA at the initial fill. A commercial heavy-duty coolant that meets “ASTM D4985” or “ASTM D6210” specifications MAY require a treatment with an SCA at the initial fill. These coolants will require a treatment with an SCA on a maintenance basis.

Refer to Special Publication, SEBU6251 “Caterpillar Commercial Diesel Engine Fluids Recommendations” for additional information that relates to coolant.

Refill Capacity of the Cooling system

To maintain the cooling system, the Total Cooling System capacity must be known. The approximate capacity for the “Engine Only” cooling system and the external system is listed.

C0.5 Engine and APU Approximate Refill Capacity		
System	Liters	Quarts
Engine	1.1	1.2
APU / radiator	2.6	2.8
Pre-loaded total (1)	3.8	4.0
Additional for Hoses and HVAC (2)	2.5	2.6
Total System Capacity	6.2	6.6

- The PowerCube APU is shipped with pre-loaded total.
- The PowerCube APU installation kit includes an optional 30 feet of heater hose. Individual installation uses a variable amount of this hose for desired placement of the HVAC system.

WATER

NOTICE

Never use water alone without Supplemental Coolant Additives (SCA) or without inhibited coolant. Water alone is corrosive at engine operating temperatures. Water alone does not provide adequate protection against boiling or freezing.

Water is used in the cooling system in order to transfer heat.

Distilled water or deionized water is recommended for use in engine cooling systems.

DO NOT use the following types of water in cooling systems: hard water, softened water that has been conditioned with salt and sea water.

If distilled water or deionized water is not available, use water with the properties that are listed in the following table.

Caterpillar Minimum Acceptable Water Requirements		
Property	Maximum Limit	ASTM Test
Chloride (Cl)	40 mg./L (2.4 grains/US gal)	D512 D4327
Sulfate (SO ₄)	100 mg./L (5.9 grains/US gal)	D516
Total Hardness	170 mg./L (10 grains/US gal)	D1126
Total Solids	340 mg./L (20 grains/US gal)	D1888
Acidity	pH of 5.5 to 9.0	D1293

For water analysis consult one of the following sources: Caterpillar Dealer
Local water utility
company Agricultural
agent Independent
laboratory

Additives

Additives help to protect the metal surfaces of the cooling system. A lack of coolant additives or insufficient amounts of additives enable the following conditions to occur:

- Corrosion
- Formation of mineral deposits
- Rust
- Scale
- Pitting and erosion from cavitation of the cylinder liner
- Foaming of the coolant

Many additives are depleted during engine operation. These

additives must be replaced periodically. This can be done by adding Supplemental Coolant Additives (SCA) to Diesel Engine Antifreeze/Coolant (DEAC) or by adding ELC Extender to Extended Life Coolant (ELC).

Additives must be added at the proper concentration. Over concentration of additives can cause the inhibitors to drop out-of-solution. The deposits can enable the following problems to occur:

- Formation of gel compounds
- Reduction of Heat Transfer
- Leakage of the water pump seal
- Plugging of radiators, coolers and small passages.

Glycol

Glycol is the coolant that helps to provide protection against the following conditions:

1. Boiling
2. Freezing
3. Cavitation of the water pump and the cylinder liner.

Note: Use a mixture that will provide protection against the lowest ambient temperature.

Note: 100 percent pure glycol will freeze at a temperature of -23 °C (-9 °F).

Most conventional heavy-duty Coolants use ethylene glycol. Propylene glycol may also be used. In a 1:1 mixture with water, ethylene and propylene glycol provide similar protection against freezing and boiling.

Ethylene Glycol		
Concentration	Freeze Protection	Boil Protection
50 Percent	-36 °C (- 33 °F)	106 °C (223 °F)
60 Percent	-51 °C (- 60 °F)	111 °C (232 °F)

NOTICE

Do not use propylene glycol in concentrations that exceed 50 percent glycol because of propylene glycol's reduced heat transfer capability. Use ethylene glycol in conditions that require additional protection against boiling or freezing.

Propylene Glycol		
Concentration	Freeze Protection	Boil Protection
50 Percent	-29 °C (- 20 °F)	106 °C (223 °F)

To check the concentration of glycol, use the 1U-7298 Coolant/ Battery Tester (°C) or the 1U-7297 Coolant/Battery tester (°F).

The testers give readings that are immediate and accurate. The testers can be used with ethylene or propylene glycol.

Maintenance Recommendations

System Pressure Release

Coolant System

WARNING: Pressurized system: Hot coolant can cause serious burns. To open cap, stop engine, wait until radiator is cool. Then loosen cap slowly to relieve the pressure.

To relieve the pressure from the coolant system Turn off the engine
Allow the cooling system pressure cap to cool.
Remove the cooling system pressure cap slowly in order to relieve pressure.

Fuel System

To relieve the pressure from the fuel system, turn off the engine. Engine Oil

To relieve pressure from the lubricating system, turn off the engine.

Overhaul Considerations

Increased fuel consumption and reduced power are two key indicators used when considering an engine overhaul. *

Type of Coolant	Level 1	Level 2
CAT DEAC (Diesel Engine Antifreeze/Coolant)	Every 250 Hours	Yearly
CAT ELC (extended life coolant)	Optional	Yearly

Level 1

Level 1 is a basic analysis of the coolant. The following items are tested:

- Glycol Concentration
- Concentration of SCA
- pH
- Conductivity

The results are reported, and recommendations are made according to the results. Consult your Caterpillar dealer for information on the benefits of managing your equipment with an S·O·S Coolant Analysis.

Level 2

This level coolant analysis is recommended when the engine is overhauled or sooner if a problem is suspected or identified. Refer to this Operations and Maintenance Manual, “Overhaul Considerations” for further information.

-  Battery indicator
-  Water Temperature Indicator
-  Oil Pressure indicator
-  Crank Error
-  Rabbit / Over Speed Error
-  Turtle / Under Speed Error



Battery Indicator: A voltage drop at or below 12 volts during cranking or normal operations.

- This could be an indication that the alternator has stopped functioning. Check the output during operations of APU.
- This could be an indication of low battery during startup. Check voltage on batteries before operation.



Water Temperature Light: Indicates that the APU is registering an overheat condition.

- Check fluids in the radiator and overflow bottle.
- Radiator should be completely full and water bottle should register at least to the ½ mark.
- Be sure that the radiator is free of debris and that the fan blades appear to be intact.
- Disconnect sensor, unit should stay running. If yes - sensor issue, If no – harness or controller issue.
- If problem persists, take to a qualified Powercubeapu.com service center or CAT dealer.



Oil Pressure Indicator: Indicates when the pressure has dropped below operating levels in the system.

- Could also indicate a failed start attempt. Often times when the engine does not fully start this will register an oil light fault.
- Check that the fuel pump is running; also check the fuel levels in the fuel filters and tank.
- Could indicate



Crank Error: symbol indicates an improper crank/glow/start cycle.

- Could indicate improper glow plug cycle. Measuring the voltage during the glow period will indicate whether voltage is getting to the glow plugs. If there is no voltage at the glow plugs, check the glow plug relay for operation. Replace as needed.
- There could be an issue with the fuel system on the engine; start by ensuring the fuel pump is engaging during cranking operations. Check that the fuel is freely flowing on the return fuel lines during the crank operations.
- This could indicate a starter issue. Check that the starter is cranking, if it is not, check for voltage at the solenoid on the starter.
 - If there is no voltage at the starter, check the solenoid in the service panel at the APU. The starter solenoid has yellow wires going to it.
 - If there is voltage at the starter and it does not crank this could indicate a bad starter.



Rabbit/Over Speed Error: would indicate that the engine/generator is running too fast. If problem persists, bring to qualified powercubeapu.com service center.



Turtle/Under Speed Error: would indicate that the engine/generator is running slow. This could be an indication that the generator is not producing any voltage.

- Check the breakers to make sure one hasn't tripped. Check the bunk outlet. Check the eternal plug for voltage.
 - If there isn't voltage at any of these locations, the generator could be bad.



If display read (?) in fan and hours, unplug and plug back in to reset.

Once your problem is diagnosed, clear the indicator lights. Go to: Menu > Display> Clear Faults>Enter> Exit> Exit