

**AMBULANCE
PREVENTIVE
MAINTENANCE
MANUAL**



FOREWORD

As emergency response vehicles, ambulances must be maintained in safe and reliable operating condition at all times. While occasional mechanical failures are inevitable, much can be done to prevent them.

The provincial Safety Inspection Audit Program, which started in 1999, serves two purposes: the safety inspections done by the operator's mechanics are audited and the operator's preventive maintenance (PM) program is evaluated. These evaluations have revealed a wide range of PM programs. Some operators had very comprehensive PM programs with regular, detailed inspection of all components. Other programs were limited to "change oil every 5,000 km and fix it if it breaks". This has led, in more than one instance, to poor vehicle performance and premature component failure.

Through discussions with operators and mechanics during and after the audits, we have found that a new level of awareness often leads to a safer, more reliable fleet. Several operators asked where they could get more information. We saw this as an opportunity to provide a framework for developing solid PM programs. This manual was compiled in consultation with a number of operators who have shared their PM programs with us. Preventive maintenance should be an important part of every ambulance operator's written maintenance policy, which is a required component of the ambulance licensing process. However, use of this manual is not mandatory. It is not a legislated part of the Alberta ambulance program.

Operators are encouraged to choose which parts of the manual will be implemented. Please feel free to adopt or adapt the manual to meet local needs. The following recommended service intervals will work well for most fleets but can be adjusted to meet local operations:

Schedule A	every 5,000 km or	6 months or	250 hours
Schedule B	every 25,000 km or	12 months or	1,250 hours
Schedule C	every 50,000 km or	24 months or	2,500 hours
Schedule D	every 6 to 12 months		

(Operator and service tech should decide frequency of Schedule D based on vehicle usage)

For additional copies of this manual, write to Emergency Health Services, Alberta Health and Wellness, 10025 Jasper Ave., Edmonton, AB T5J 1S6.

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DEDICATION

This manual is dedicated to Mr. Vern Burton (1953-2001).

As a part-time ambulance attendant who worked with St. Paul and District Ambulance, Vern understood the need for fleet safety and reliability. As an emergency vehicle technician, Vern was a highly trained mechanic who specialized in maintenance and repair of ambulances and fire apparatus in northeastern Alberta.

His vision, and his passion for the safety of his patients and coworkers, led to the creation of this manual.

SECTION A – ENGINE COMPARTMENT

A.1 Change Engine Oil

Refer to owner's manual for recommended oil viscosity. Use of proper viscosity is especially important due to the severe duty application of ambulances. On the inspection form, record the number of litres used.

A.2 Change Oil Filter

Refer to owner's manual for recommended oil filter. Lubricate the filter seal before installing. On the inspection form, record filter number. (Refer to Ford Ambulance Package; filter part #FL1995 should be used on 7.3-litre diesel.)

A.3 Service Air Cleaner

Check air filter element for restriction. Remove any debris from the air cleaner housing. Do not use compressed air to clean air filters. Compressed air may tear the filter material and allow dirt and debris to enter the engine.

A.4 Air Intake Ducts

Inspect intake ducts for debris or blockage.

A.5 Belts

Check for worn, cracked or glazed belts. Check that belt tension is set to manufacturer's specifications. Check for worn bearings on idlers. It is common for belts to glaze and slip due to the high load that is demanded from the alternator and accessories. Suggested belt lifetime is 50,000 km.

A.6 Hoses

Inspect for cracked, deteriorated or brittle hoses. Check for proper and secure routing. Check for loose or deteriorated clamps. It is important to check for loose hose clamps regularly as they may loosen due to expanding and contracting of the hoses.

A.7 Brake Fluid Level and Condition

Inspect brake fluid level and top up as necessary. Check fluid in brake reservoir for contamination and condition. If any contamination is found in the brake fluid, it should be flushed and refilled. The brake lines must be bled as per manufacturer's specifications.

A.8 Engine Leaks

Run the engine and check oil filter and drain plug for any leaks. Check the engine for any other leaks. This is important after an oil change as occasionally the filter o-ring or drain plug gasket may leak. Replace as required.

A.9 Transmission Fluid Level and Condition

Check transmission oil. This should be done with transmission at operating temperature to ensure an accurate reading. It is important not to overfill the transmission. Check the oil for discoloration, burnt smell or metal filings built up on dipstick. This could prevent premature transmission failure. IF IN DOUBT, SEND AN OIL SAMPLE FOR ANALYSIS.

A.10 Washer Fluid Level

Check and add washer fluid as needed. Check washer operation.

A.11 Coolant Level and Condition

Check coolant level; if equipped with an overflow reservoir, ensure that it is full. Check for any leaks in the cooling system. Check coolant condition to ensure there is proper lubrication for moving parts. If there is any discoloration, the coolant should be flushed and replaced.

A.12 Coolant Strength

Test the coolant strength. If necessary, adjust to meet manufacturer's specifications. This will help prevent freezing and overheating conditions. Record the coolant strength on the inspection form.

A.13 Battery, Water Levels and Terminals

Check the battery water levels and add distilled water as required. Remove battery ends and clean terminals. Check for cracked or corroded cables. Tighten cables onto battery posts and grease lightly.

A.14 Starter Draw

Check starter draw with an automatic voltage regulator (AVR) to ensure it is within manufacturer's specifications. Listen for abnormal noise during cranking. On the inspection form record the number of amps drawn. It is important to use an AVR to test the starter, as excessive draw may not be readily noticeable. This test could prevent a sudden failure.

A.15 Alternator and Starter Wiring

Ensure alternator and starter wiring is routed correctly. Check terminals for corrosion and damage. Check for cracked or loose wiring. Loose or corroded connections may cause improper charging or hard starting. They may also cause excessive heat within a wire harness, which may lead to extensive damage.

A.16 Alternator Output

Check alternator output with an AVR to ensure that it is capable of sufficient output to power the ambulance. Record the amperes output on the inspection form. The minimum output required by provincial regulations is 60% of cold temp rating or 97 amps, whichever is greater.

It is very important to test the alternator with an AVR so that you have an accurate reading. Due to the high electrical load caused by the ambulance conversion, a failing alternator will cause the system to start feeding off the batteries. This will result in a lower voltage and some components will fail to operate correctly.

A.17 Load Test Batteries

Load test batteries to determine their condition. Record the beginning and ending voltages on the inspection form.

Replace weak or marginal batteries in sets. This is recommended because a new battery will likely not operate at its full voltage if it is mated with an older one. The system will cause the new battery to operate at the same voltage as the older battery. This can cause insufficient power for the starting system.

A.18 Fan, End Play and Operation

Ensure there is not excessive endplay in the fan. Due to severe duty application, it is important to check fan endplay regularly. Check that blades are not damaged and check fan operation by testing the airflow. This is important to ensure that the engine does not overheat. The fan shroud must be fully intact to prevent water pump failure. When part of the fan shroud is damaged or missing, changes in airflow may create an imbalance in the fan's operating plane, causing premature fan or water pump failure.

A.19 Radiator Condition

Check condition of radiator core. Check tanks for cracks, leaks and overall condition. Radiators are susceptible to corrosion and may spring leaks at any time. Regular inspections can locate these leaks before a major failure of the cooling system results.

A.20 Pressure Test Radiator and Cap

Install a pressure tester and pressure test the radiator to the manufacturer's specifications. Check for any drop in pressure. If pressure drop is seen, check cooling system, including patient compartment heaters, for leaks. Check cap for leaks and opening pressure as per manufacturer's specifications. Record pressures on inspection form. It is important to check the radiator and its cap, as the pressure that they are both holding is necessary to prevent overheating of the engine.

A.21 Air Conditioner Condenser

Check AC condenser for bent fins or obstructions. Check mounting brackets to ensure the condenser is not loose. It is very common for the condenser to become loose from the vibrations of the vehicle. A loose condenser may rub on something, causing a leak, which will result in failure of the air conditioning. Bent fins or obstruction may not allow enough air to pass through the condenser, which will result in poor cooling.

A.22 Airflow Through Radiator

Inspect the space between the condenser and radiator for debris that could restrict airflow. Clean as necessary. Debris in this area is very common even with bug screens. If not removed, it may cause both poor operation of the air conditioner and engine overheating.

A.23 Coolant Additive Level

Check coolant additive level as per manufacturer's specifications. Lack of additive (lubricant) can cause failure to cooling system components. Coolant additive in diesel engines is important, as it will lubricate the water pump bearings, thereby increasing the life of the pump.

A.24 Glow Plug Operation

Check wires for cracks and loose connections. Check for proper and secure routing. Test glow plugs as per manufacturer's specifications. Cracks in glow plug wiring are common as the wires run close to exhaust components. The resulting corrosion can cause shorts in the wiring. To prevent hard starting, it is very important to test each glow plug separately to ensure that they are all working.

A.25 Fuel Filters and Water Separator

Replace fuel filters. Lubricate seal on new filter before installing. Drain water separator until only fuel runs out.

A.26 Block Heater Operation

Check block heater cord for cracks, corrosion, damage and plug condition. Test block heater operation.

A.27 Belts

All belts should be replaced at 50,000 km due to the severe duty application. Inspect condition of all pulleys. Tighten new belts to manufacturer's specification. Recheck the belt tension following the test drive as they may stretch after engine has been run. The heavy load demand on the alternator causes high load to the belt. Change them before they break!

A.28 Accessory Brackets (alternator, power steering pump)

Inspect all accessory brackets for cracks, tightness and correct mounting as brackets may loosen or crack due to the vibrations of the vehicle.

A.29 Cooling System

Flush the cooling system including radiator and heater core. Remove drain plugs in engine block to ensure engine is thoroughly flushed. Contaminants, which can remain in the engine block if it is not flushed correctly, may cause premature failure. Refill the radiator with the correct coolant/water mixture. Ensure all water is removed from cooling system so that the proper strength is maintained. After running engine to normal operating temperature, recheck coolant level and strength.

A.30 Thermostat

Replace thermostat. Run vehicle to ensure proper operation and temperature. The thermostat is replaced at this time, due to the severe duty application, in order to maintain vehicle efficiency and passenger comfort.

A.31 Power Steering Fluid

Flush the power steering system until fluid comes out clean. Ensure all air is purged from the system. Use oil meeting the manufacturer's specifications. Flushing the fluid is important as contaminants collect in the reservoir and fluid viscosity will break down over time. This may cause power steering system failure.

A.32 Turbocharger

Check for loose or broken connecting bolts and leaking gaskets on the turbocharger. Inspect for damaged turbo vanes and loose bushings. High heat within the turbo can cause gaskets to leak or bushings to wear. These can cause immediate failure.

A.33 Water Pump Endplay

Check water pump front hub for endplay. Check that bearings operate smoothly. Belt must be removed to check water pump end play to ensure accurate reading.

SECTION B – UNDER VEHICLE

B.1 Lube Chassis

Grease ball joints, tie rod ends, idler arm, pitman arm, u-joints and other grease zerks. Use grease as per manufacturer's specifications. Inspect all boots for cracks and ensure all grease zerks take grease.

B.2 Driveshaft and U-joints

On units with a one-piece driveshaft, remove the rear u-joint from the differential. Rotate the rear joint in both directions. Inspect for loose, worn or seized joints. Move the shaft so as to check the front u-joint for the same faults.

On units with a two-piece driveshaft, remove the rear u-joint from the differential and remove the steady bearing bolts. Lower the shaft and steady bearing. Check for seized u-joints as described above.

It is important to be able to move the u-joints freely because a seized joint might not be readily noticeable and will fail if not repaired.

B.3 Exhaust

Check for corroded, cracked or leaking exhaust components. Inspect all exhaust hangers. This is critical to prevent exhaust gases from entering the interior of the vehicle.

B.4 Heat Shield Condition

Check that all heat shields are in place. Inspect for damaged or loose shields. This can prevent excessive heat from damaging the floor or causing a fire.

B.5 Shock Absorbers

Inspect for damaged, leaking or loose shock absorbers. Ensure shocks stabilize the vehicle when each corner is bounced. Checking shocks is important, as they are required to stabilize the vehicle when cornering or travelling over rough roads. Worn shocks can cause vehicle handling to become erratic and hard to control.

B.6 Suspension Components

Visually inspect all suspension components for loose parts, cracks in springs and damaged parts. Any of these conditions may compromise handling of the vehicle.

B.7 Differential Oil Level and Condition

Check level and condition of differential oil. If oil needs to be added, refer to manufacturer's specifications for correct type. Check for contamination caused by dirt or water, which can lead to failure of differential. Check that the vent is open so that any pressure build-up will be released. Check that vent cap is in place to prevent water from entering the differential. Due to severe duty application, differential oil can become very hot. This may cause breakdown of bearings or other differential components.

B.8 Differential Leaks

Check rear pinion seal and differential cover for leaks. Check backing plates on differential. Look for oil leak at axle seals. Axle seals and pinion seals are a common place for oil to leak as seals become brittle or wear on axle shafts and pinion yoke. Also, the differential vent could be plugged, leading to increased pressure within the housing, which can cause leaks.

B.9 Crown and Pinion

Check for any abnormal clearance in pinion and crown gears by testing play on driveshaft. This can help determine if there is any potential for failure. If there is excessive clearance, the cause should be determined immediately.

B.10 Tire Pressure

Check all tire pressures and adjust to manufacturer's recommended pressures. If any tire has excessive air pressure loss, check that tire for leaks. Record tire pressures on the inspection form. Checking tire pressure regularly will help ensure vehicle stability and maximize fuel efficiency.

B.11 Tire Condition

Check tires for cracks, belt separation, cupping and other abnormal wear. Measure the tread depth of each tire and record on the inspection form.

B.12 Rotate Tires and Balance Wheels, if Required

Rotate tires to even out wear and extend the tire life. Balance tires if vehicle has any vibration on road test. Use this interval or see your operator's manual for suggested rotation intervals.

B.13 Brake Cylinder Seals, Wheel Bearings and Axle Seals

Remove the wheels. Inspect for worn, cracked, leaking or brittle brake cylinder seals and axle seals. Inspect for pitted, worn or discolored bearings.

B.14 Front Brakes

Check front brake pads for condition and thickness. Refer to the Alberta Ambulance Safety Inspection Manual for minimum thickness. Inspect caliper slides and calipers to ensure they move freely and are not seized. Due to moisture and dirt, caliper slides may seize, or partially seize, resulting in premature failure of brakes. Record measurements on inspection form.

B.15 Rear Brakes

Check the rear brake pads/shoes for condition and thickness. Refer to the Alberta Ambulance Safety Inspection Manual for minimum thickness. Ensure all hardware moves freely and springs are not stretched. Check axle seals for leaks. Check wheel cylinders for leaks and free movement. Wheel cylinders can seize causing poor braking and could cause brakes to remain partially applied. It is also important to check self-adjusters, as they can become inoperative or seized, resulting in poor braking.

B.16 Rotor Thickness, Front and Rear, if Equipped

Check that rotor thickness is within manufacturer's specifications. Record measurements on inspection form. Rotor thickness is very important due to the severe duty application. As the rotor becomes thinner, the brakes may not cool correctly causing brake fade. Check radial run out and ensure wheel bearing does not have excessive play. Radial run out may cause vehicle instability while braking, as vehicle will shake when the brakes are applied. Check rotors for excessive grooves on wear surface.

B.17 Brake Drum Thickness and Condition, if Equipped

Check that brake drum thickness is within manufacturer's specifications. This is important due to the severe duty application. As the drum becomes thinner the brakes may not cool correctly, causing brake fade. Record measurements on inspection form. Check for roundness. Drum roundness is important to check, as warpage may cause vehicle instability while brakes are being applied. Check for excessive grooves on shoe surface.

B.18 Brake Lines and Hoses

Check for kinked, damaged, leaking or corroded brake lines. Check for cracked or leaking hoses. Check for proper and secure routing.

B.19 Parking Brake Operation

Check that parking brake cables move freely and return correctly. Apply parking brake and check that it holds firmly. As the rear brakes wear, parking brake operation becomes diminished and should be adjusted as needed.

Due to severe duty application, especially when cornering quickly, a lot of stress is put on front suspension and steering components. This results in more wear, so the following components need to be checked frequently:

B.20 Ball Joints/King Pins

Lift vehicle and support as per manufacturer's specifications. Check ball joints or king pins for excessive play and seizing.

B.21 Tie Rod Ends

Check tie rods for damage or play. Ensure tie rods move freely. Refer to manufacturer's specifications.

B.22 Idler Arm

Check idler arm for excessive play. Ensure idler moves freely. Refer to manufacturer's specifications.

B.23 Pitman Arm

Check pitman arm for excessive clearance or damage. Ensure arm moves freely. Refer to manufacturer's specifications.

B.24 Steering Gear Box

Check for loose, cracked or damaged mounts on the steering gear box. Check the gear box for any leaks.

B.25 Control Arms and Bushings

Check for damaged or loose control arms and bushings. Check control arms for proper travel. Refer to B.20.

B.26 Springs, Bushings and Shackles

Check for cracked or damaged springs. Check the bushings for excessive clearance. Check shackles for damage. Ensure spring mounts are secure. Excessive wear can cause vehicle instability and poor handling.

B.27 U–Bolts and Mounting

Check for damaged, cracked or loose u-bolts and mounts. Due to vehicle vibrations u-bolts may loosen or crack. Torque u-bolts to manufacturer's specifications.

B.28 Frame and Rivets

Check the frame rails for cracks, bends or damage. Ensure that rivets are secure and fully intact. Frame rivets may loosen and frames rails may crack or bend under the high stress of ambulance operation. Inspecting these components could prevent major damage to the vehicle.

B.29 Differential Stops

Check that the differential stops are present and that they are not damaged, worn or loose. Differential stops help ensure vehicle stability and prevent damage to springs, shackles, etc., while travelling over rough terrain.

B.30 Fuel Lines

Check that routing is proper and lines are secure. Check for leaking, kinked, corroded or damaged steel fuel lines. Check for leaking, cracked, swollen or brittle rubber fuel lines. When lines become brittle, normal vehicle vibration can cause cracks, which may lead to leaks.

B.31 Fire Extinguisher (charge, date)

Check that the fire extinguisher is fully charged and is up to date.

B.32 Flares, Triangle Reflectors

Check the traffic warning triangles. Ensure that triangles are clean and functional (base supports the device so as to provide proper warning).

B.33 Torque All Wheel Nuts and Record

Torque all wheel nuts to manufacturer's specifications. Record the torque setting on inspection form. Proper torque will ensure nuts are not overtightened and they will be able to be removed in the field if necessary. It will also prevent stud or nut damage.

B.34 Road Test

Road test the vehicle for 5 km or more to ensure vehicle gets to operating temperature. This will determine that the repairs made are working properly. Vehicle may need to be road tested again if more repairs are required after initial road test.

B.35 Retorque Wheels After Road Test

Retorque all the wheels to ensure they did not loosen up while being driven.

B.36 Wheel Alignment, if Required

Do a wheel alignment if there is any abnormal tire wear or if the vehicle pulls to left or right. (Rule out faulty steering and suspension components.) Wheel alignment should be done whenever any front-end components are replaced as this can cause the alignment to be out of specifications.

B.37 Lug Nuts and Rim Condition

Check for damaged, bent or cracked rims. Ensure lug nuts thread onto studs freely.

B.38 Transmission Service and Adjustment

Remove transmission pan. Replace filter and adjust the bands if applicable. Transmission pan should be thoroughly cleaned and dried before installation. Use a new gasket meeting manufacturer's specifications. Some vehicles have a drain plug in the torque converter and will require more oil. Transmission should be filled with oil meeting manufacturer's specifications. Do not overfill. Vehicle should be road tested to bring transmission to operating temperature to ensure accurate reading on the dipstick. In severe duty applications, it is important to service transmission at regular intervals to prevent premature failure.

B.39 Transmission Oil Cooler Lines and Fittings

Inspect transmission oil cooler lines and fittings for leaks, secure routing or damage. Due to vehicle vibrations, fittings may loosen and lines could rub on other components causing leaks or damage.

B.40 Transmission Internal Wiring

Inspect the transmission internal wiring while servicing to ensure wiring is not broken, brittle or cracked and that terminals are in good condition. Heat from the transmission can cause wiring to become very brittle. This may cause broken wires or internal shorts, which will affect the transmission's performance.

B.41 Transmission Linkage

Check for damaged or loose transmission linkage. Lubricate the linkage.

B.42 Service Rear Differential

Remove the differential cover, drain oil and inspect teeth on pinion and crown gear for wear, damage and adjustment. Check for filings from bearings and other internal parts. Clean differential components with approved cleaner and reassemble. Refill with oil meeting manufacturer's specifications.

In severe duty applications, it is very important to inspect and service the differential at regular intervals to prevent premature failure. Failures can be caused by worn or loose bearings, which may not be noticeable while driving.

B.43 Differential Backlash

Measure backlash on differential with a dial indicator as per manufacturer's specifications. Checking the backlash can help determine worn, loose or improperly fitted parts and prevent premature failure.

B.44 Shock Absorbers

Disconnect one end of each shock absorber. Inspect for weak, damaged or seized shocks. This is done to ensure proper operation of vehicle for stability. You may not be able to determine if a shock is working correctly without removing one end and checking operation.

B.45 Cables (heater, throttle and brake)

Check heater cables for proper routing and operation. Check for stiff or seized cables. Lubricate with appropriate lubricants. Ensure cable movement is not restricted. This will ensure proper operation and can prolong the life of the cables.

SECTION C - BODY

C.1 Clearance Lights

Check lights for proper operation and secure mounting. Check for cracked, damaged or missing lenses.

C.2 Headlamps

Check the headlamps for proper operation and proper aim. Check for cracked or damaged lenses. Vehicle vibrations can cause headlamps to loosen, thereby causing improper aim and poor visibility. If headlamps are replaced, it is good practice to re-aim them.

C.3 Signal Lights

Check the signal lights for proper operation or damage.

C.4 Backup Lamps

Check operation of backup lamps.

C.5 Brake Lamps

Check operation of brake lamps.

C.6 Hazard Warning Lights

Check operation of hazard warning lights.

C.7 Horn Operation

Check the horn operation for proper tone and volume. Check horn pad for ease of operation.

C.8 Siren Operation

Ensure all siren modes are fully functional and speakers are clear of any obstructions. If two siren amplifiers are installed, check each separately. See D.19 for preventive maintenance of the siren amplifier.

C.9 Hinges, Pins and Bushings

Lube all door hinges and latches. Check for loose pins and bushings. Compartment latches may have to be adjusted for proper operation of doors. Ensure all doors work with ease.

C.10 Air Conditioner Operation – Record Temperature

With a thermometer, check temperature of cool air at duct outlets for front and rear air conditioners. Ensure that they are within the manufacturer's specifications. Record temperatures on inspection form.

C.11 Heater Operation – Record Temperature

With a thermometer, check temperature of hot air at duct outlets for defroster, and front and rear heaters. Ensure that the temperatures are within the manufacturer's specifications. Record temperatures on inspection form. Check that there is adequate airflow from defrost vents to keep windows defrosted. Check that there is proper airflow from heater vents.

C.12 Armrests and Inner Door Panels

Check for loose, deteriorated or damaged armrests and inner panels. Repair, replace and/or tighten as necessary. Due to the vibrations of the vehicle, inner door panels and armrests may loosen frequently.

C.13 Running Boards, Steps and Attachments

Check for loose or damaged running boards, steps and attachments. Ensure all bolts are tight on these components and their support braces.

C.14 Mud Flaps

Check mud flaps for missing bolts, cracks and damage.

C.15 Attach Oil Change Sticker; Record Date and Odometer Reading

Attach a sticker with date and odometer reading as a reminder of the last and next scheduled service.

SECTION D – AMBULANCE CONVERSION

FRONT SWITCH CONSOLE

D.1 Voltmeter and Ammeter Accuracy

When checking the voltmeter and ammeter, use AVR test equipment to compare operation of the meters. The ambulance meters should be within 1% of the AVR meters. Check several ways to make sure the meters work at both the top and bottom end of the scale. Also check draws to confirm they work on the discharge side.

D.2 Switches and Indicator Lights

Check the function of each switch, ensuring that it works in all positions. Ensure that the indicator light circuit on each switch is working. With an ohmmeter, check the continuity of the circuit through every switch, to confirm a good contact.

D.3 Main Power or Battery Switch, if Equipped

The function of the battery switch is to disconnect all power draws in vehicle. On many ambulances, power for the on-board computers, including the transmission controller, may be hooked up to bypass the battery switch. This is to keep the computer chips programmed and in a constant state of readiness. When testing, identify whether it is hooked up this way or not. Check to see that the switch is mounted securely. Check continuity on both sides of the switch to be sure it is making full contact and complete disconnection. Check operation of isolator module for battery, making sure each circuit is connecting correctly.

D.4 Master Power Switch (a.k.a. AMB connect or MODULE connect)

Check operation of master power switch. Test both sides of the switch to be sure full contact is being made within the switch. The meter should read the same on both sides of the connection.

D.5 Emergency Boost (Sure Start), if equipped

Check operation of the emergency boost system. Also check connections at solenoid and batteries. Checking the draw on the circuit through the solenoid can also tell you if solenoid is breaking down. Some older units had a separate battery, dedicated to the emergency boost circuit. This battery tends to not last as long, due to limited amount of use. On newer units, emergency boost power is taken from the coach batteries, which may be RV deep cycle batteries.

D.6 Light Bar

Check operation of light bar. Make sure all bulbs are illuminated and rotators are turning freely. Listen for noisy rotators. Check the amount of power draw with test meter to determine if it is within the manufacturer's specifications.

Remove lenses and check wiring, making sure that the wires are not damaged and insulation is intact. Check ground in the body of light bar and to each light and rotator. Clean rotators and lubricate with light grease (lubra plate graphite). Make sure lens seals are good. Clean lenses before installing. Draw test again to compare difference to before and after servicing.

Ensure mounting brackets and main wire cable to the ambulance are secure. Ensure that the grommet through the body of ambulance is good and does not leak.

D.7 Emergency Warning Flashers, Primary and Secondary

Check operation of all primary and secondary warning flashers. Remove all lenses and check bulbs for deterioration due to moisture and dirt. Remove bulbs and apply a small amount of dielectric grease on the contacting area and reinstall. Rusted bulb sockets and connectors should be replaced. Check lens gaskets for proper seal. Consider replacing bulbs and seals on an annual basis as part of your preventive maintenance program.

D.8 Intersection Lights

Check operation of intersection lights. Remove lenses and check for moisture, dirt, etc. Check bulb contacts. Clean and apply a small amount of dielectric grease to contacting surface. Check lens seals; clean and replace if required.

D.9 Wig-wag Headlamps

Check operation of wig-wag headlamps. Wig-wags are intended to only work on low beam headlamps. When high beams are activated, the wig-wag control module should not flash.

Check wiring and connections to headlamps from wig-wag control. If the control module is mounted where it is exposed to the outside atmosphere, check it for moisture, rusting or corrosion.

D.10 Strobe Flashers, if Equipped

Check operation and quality of light of strobe lamps. Remove lenses and check for moisture, dirt, etc. To prevent shock to the service person, strobe lights must be shut off for approximately 20 to 30 minutes before servicing. Replace bulbs or sockets if rusted or corroded. Clean and replace lens. Install new seals if required.

D.11 Auxiliary Lamps (fog, driving)

Check operation of fog and driving lamps. Check for dirt and moisture in lens. Check wiring and connections for corrosion. Set the aim for best coverage of the roadway ahead.

D.12 Scene Lamps

Check operation of scene lamps. Remove lenses and check for moisture and dirt. Remove and check bulbs; reinstall with dielectric grease on contacting surfaces. Check lens seals and replace if necessary. Check door switch operation. Some units have 2-way plunger switches on rear and side doors that will activate scene lamps. Check plunger operation. Clean and lubricate as necessary.

D.13 Dome Lamp Switch for Patient Compartment Lights

If the master console is equipped with a "dome lamp" or "cot lamp" switch, check that it operates the lamps in the patient compartment.

D.14 Rear Heater Control

If the master console is equipped with a "rear heater" switch, check that it operates the heater in the patient compartment. On some ambulances, the front console switch runs the heater on HIGH only. This overrides the multi-setting operation of the switch on the patient compartment switch console.

D.15 Map Light, if Equipped

Check the map light to ensure it is secure and operational.

D.16 Auto Throttle

Check operation of the auto throttle. Assess the control function when it is activated. Check that the linkage is free and the engine goes to the proper RPM. Check that the auto throttle releases and engine RPM drops immediately when stepping on the brake pedal or putting transmission in gear.

D.17 Electrical Overload / Poor Connections

Check all connections and components for signs of overload or poor contact. Ground contacts may corrode or become loose, which can cause intermittent functioning of components.

D.18 Back Lighting, Switch Labels

Check the function of back lighting on the front switch console. On newer units, the back lighting comes on with the park lamps. On some older units, turning on the master switch or "AMB Connect" switch activates it.

D.19 Siren Amplifier

Check siren operation in each mode. Check Public Address mode operation. If equipped with a Horn/Siren switch, check that the horn pad activates or changes the siren tones when the switch is in the "Siren" position. Check for loose, damaged or corroded wiring.

D.20 Siren Speaker Resistance

Disconnect wires at siren speakers. Use an ohmmeter to test the resistance through each speaker driver. Check manufacturer's specifications for proper readings.

MAIN ELECTRICAL CONTROL CENTRE

D.21 Voltage Drop, Main Power and Auxiliary Solenoids

Check solenoids by creating a draw and measuring the current on each side of the solenoid. If the voltage is not the same, check the manufacturer's specifications for variation.

D.22 Relays, Function and Connections

Check relays for function. Visually check for loose connections and discoloration. Check for loose or corroded ground strap.

D.23 Voltage Drop, Relay-Controlled Circuits

Relays may become weak in time and arcing on contacts may affect voltage output. Check voltage on output side of relays to ensure appliances are receiving proper voltage.

D.24 Check for Ground on All Circuits

Using a DC voltmeter, check for voltage drop on each circuit. Determine reason for drop, e.g. inadequate power feed, weak relay, poor ground.

D.25 Pin Connectors and Terminal Blocks

Check for loose or discolored pin connectors, indicating possible poor connection or overload. Re-grease pin connectors if insufficient signs of grease in connectors. Use dielectric grease.

D.26 Looms, Cables and Connectors

Check for broken, chaffed or damaged looms. Check damaged spots for any wire damage. Tie up loose or dangling cables with plastic ties. Check for loose connections and poor contact at each end terminal as well as any intermediate junctions. The best sign of a loose connection is arcing or discoloration.

D.27 Electronic Flasher Terminals and Wiring

Check for loose, corroded, or discolored connections. Check for damaged wires. Test for ground faults. Ensure that wires are protected in loom and looms are secured at regular intervals.

PATIENT COMPARTMENT SWITCH CONSOLE

D.28 Switch and Indicator Light Function

See procedures in D.2.

D.29 Dome (Cot) Lights

Check operation on high and low settings. Remove lenses and check bulbs for discoloration from heat and dust. Check lens seals; clean lenses if required. Check door switch operation. Some units have 2-way plunger switches on rear and side doors that will activate dome lamps. Check plunger operation. Clean and lubricate as necessary.

D.30 Fluorescent Lights, if Equipped

Check operation of fluorescent lights. Check for dim, flickering or burnt out bulbs. If the light is not working at all, verify power supply and check ballast.

D.31 Intake and Exhaust Vents

Check for airflow from intake and exhaust vents. Check intake screens to ensure that debris is not restricting airflow. Check motors for overheating. Check control, wiring and connectors for proper contact. Check that ground straps are secure and clean.

D.32 Electric Suction

Check the function of the electric suction switch. See D.53 for complete maintenance of the suction unit.

D.33 Air Conditioner, Patient Compartment

Check the fan functions on all settings. See D.39-D.44 for preventive maintenance of the climate control system.

D.34 Heater, Patient Compartment

Check the fan function on all settings. See D.39-D.44 for preventive maintenance of the climate control system.

D.35 Cabinet Lamps

Check cabinet lamps for operation. Remove lenses and check for dirt and moisture. Check bulbs for discoloration and lubrication on contacting surface. Check electrical contacts for proper connections.

D.36 Electric Oxygen, if Equipped

Check function of the electric oxygen switch. See D.48 for preventive maintenance of the electric oxygen system.

D.37 Options: Check as per Manufacturers' Specifications

Check any optional components not specifically noted in this manual. Assess them according to any specifications supplied with the component at the time of purchase.

D.38 Electrical Overload / Poor Connections

Check wire connections, wiring and ground straps for discoloration, corrosion and dirty terminals, which can all cause poor connections. Discoloration is also a sign of overloading causing too much heat. Ensure that the wires are the proper size for the loads they are carrying and that connectors are the proper size for the wire used. Check for dry bushings if a motor seems to drag. A draw test may indicate that it needs to be serviced or replaced.

CLIMATE CONTROL

D.39 Check Operation of Heaters and Air Conditioners

With vehicle in an ambient atmosphere of at least 10°C, run the engine. (Remember exhaust precautions.) Set the patient compartment air conditioning to maximum cooling. Check temperature with a thermometer. Turn the cab heater onto maximum heating and check for change in temperature of patient compartment air conditioner.

Set the patient compartment heater to maximum heat. Check temperature with a thermometer. If the ambulance has a combination heater/air conditioner, set the dash air conditioning to maximum cooling and the rear heater to maximum heat. Note any change in the heater's output temperature. Each unit is to be independent of each other. Changes in one unit should not affect the other.

Check shut off valves, if equipped. Some units have shut off valves on the hoses going to heater core. Some older units have a push-pull control at the rear panel or under the dash near the driver. Check cable operation; make sure it is freely moving on both ends. If not, disconnect cable and determine if the cable or shut off valve is defective. Repair or replace as necessary.

D.40 Air Exchange

Check for sufficient air exchange (in and out).

D.41 Worn or Dry Bushings; Fan Obstructions

Check fan for noises that may indicate dry or worn bushings. Check fan intakes for debris that may restrict airflow or hit against squirrel cage.

D.42 Thermostat Function

With a thermometer, verify the hot and cold readings of the wall-mount thermostat, if equipped.

D.43 Heater and Air Conditioner Hoses

Check all heater hoses. Some Type II (raised roof van) units have steel line partway to the back heater. Check the rubber hose that runs from the end of the steel line to the heater. This section of hose may be overlooked if you are not aware of its existence or are not looking in the proper places. Visually check the A/C hoses that run alongside the heater hoses. If a hose has any damage or is getting mushy, it should be replaced.

D.44 Condensation Drain, Air Conditioners

Check that condensation drains are not plugged. Sometimes dirt builds up and eventually plugs them.

OXYGEN SYSTEM

D.45 Pressure Drop Test

Turn on the tank valve to pressurize the system. Note the pressure shown on the gauge. Turn off the valve and monitor the gauge for 30 minutes to see if there is any loss of pressure.

In some systems the oxygen flow is controlled by a remotely switched electric solenoid. Be sure the solenoid is turned ON so that the whole system is pressurized.

D.46 Leak Test

If a pressure drop is noted in D.45 above, test for leaks by spraying connections with a mild soap solution. Repeat procedure at each connection until the leak is found, repaired and the system maintains pressure. Be sure to clean all fittings after spraying them. Never use oil on oxygen fittings.

D.47 Check for Correct Flow Rate at Each Outlet

Check oxygen flow through flow meters.

D.48 Check Electric Oxygen Solenoid / Valve Function, if Applicable

Check operation of the electric control to ensure that it stops and starts the flow of oxygen. Check wire connections for loose wires and dirty or corroded grounds.

D.49 Main Tank Retainers

Check main oxygen tank holder for proper fit. Check for misaligned or loose parts. These tanks are very heavy and can cause a lot of damage if they come loose during a collision.

D.50 Portable Oxygen Tank Retainers

Check portable oxygen tank holders for proper fit. Check for misaligned or loose parts. Portable tanks can hurt patients and attendants if they come loose during a collision.

D.51 Main Tank Regulator Function

Check main tank regulator function. If the regulator is adjustable, check that the pressure is set accurately. Adjust the pressure downwards and then back to specified pressure.

ON-BOARD SUCTION SYSTEM

D.52 Provincial Standard for On-Board Suction

The suction unit must develop a minimum vacuum of -300mm (-30 cm) Hg in 4 seconds or less. Clamp off the suction hose and turn on the switch. Monitor the gauge to ensure that the system meets the standard.

D.53 Suction Pump, Filter and Motor

Remove outlet filter from suction pump and check for dirt and contamination. Clean or replace as required. Regular servicing is important in order to get full capacity out of the suction unit.

Check motor and wiring for signs of overheating. Check for loose or corroded wire terminals and ground straps.

D.54 Suction Regulating Valve

Check the function of the regulating valve making sure it is operational. Some suction units use a threaded needle valve. It may be closed such that no vacuum will be created within the suction jar. As the valve is first turned open, it will allow maximum vacuum. Further rotation of the valve allows bypass air to enter, thereby limiting the amount of vacuum that can be built up.

Other suction units use a slide valve and/or a variable speed motor switch to regulate the amount of vacuum.

D.55 Leak Test, Suction System

Ensure that the regulating valve is set for maximum suction. With the unit running, pinch off the hose and build up vacuum. Turn the motor off and observe the gauge. If there is a drop in vacuum, check for leaks at all connections, seals and at the collection jar.

110-VOLT SYSTEM

D.56 Shoreline Connector on Exterior of Body

Check the shoreline plug connection for loose or corroded terminals. Remove mounting screws; remove plug from wall and check connection of cable to the plug. It is important that the connections are sound to prevent arcing and poor power flow. Components powered by a faulty shoreline may not function properly. Some components, usually motors, may leak power and burn out.

D.57 GFI Breaker Function, if Equipped

Push the Test button on the ground fault interrupt breaker to make sure it trips. Press the Reset button and ensure that it resets and holds.

D.58 On-board Inverter Function

Check on-board inverter operation. With the ambulance's engine running, turn the inverter on. Check the power output with an AC meter and compare the output to the specification sheet on the inverter.

D.59 Inverter-powered Outlets

With an AC voltmeter, check the function of each 110-volt outlet supplied by the inverter. If the voltage varies, check all connections before removing inverter for repairs. Sometimes loose or corroded connectors can cause voltage fluctuations.

D.60 Block Heater Connection and Operation

Check condition of underhood wiring and block heater operation. This can be done with an AC voltmeter. You should be able to hear the block heater “sizzling” when it is plugged in and the engine is cold. Check that it cuts out when it reaches the cutout temperature set out in the manufacturer’s specifications.

D.61 Cable Connections

Check to see that connections on cables to batteries, isolators and inverter are tight. With a DC voltmeter, check that the proper current goes to them.

12-VOLT SYSTEM

D.62 12-Volt Outlets and Plugs

Check that each outlet is functioning. Check that all appliance plugs are making and maintaining good contact.

D.63 Check for Ground in All Circuits

Using a DC voltmeter, check for voltage drop on each circuit. Determine reason for drop, e.g. inadequate power feed, poor connection, poor ground, etc.

MODULAR BODY

D.64 Exterior Doors

Open every door on the ambulance and check the function of the doors. Check the seals to make sure they are intact all the way around. This prevents dust and exhaust from entering the vehicle.

D.65 Door Latches and Pins

All latches should be cleaned and lubricated as necessary. Adjust latches and pins so doors close snugly on second latch. Check that the seals are making good contact and the latches are locking on both safety latch and second latch.

D.66 Door Hinges

Adjust and lubricate hinges on all doors. If piano hinges sound gritty when operated, they should be cleaned before being lubricated.

D.67 Latches and Locks, Entrance Doors

Check that both interior and exterior latches on all entrance doors operate properly. Using a key, check the function of all key locks on the doors. If any locks are equipped with interior knobs, check that they operate easily. If a lock is sticking, you may have to replace it. For safety reasons all entrance door latches must lock and unlock properly.

D.68 Check Door Seals – Replace As Necessary

D.69 Exterior Compartments

Check seals on all exterior compartment doors. Check floor and corners for rust or corrosion. Check for leaks in compartment. Replace seals if needed and repair any holes in the body of the compartment.

D.70 Door Closers, Hold Open Devices

Inspect all door closers and hold open devices. Lubricate as necessary with a light oil or grease. Replace worn parts as required.

INTERIOR OF MODULE

D.71 Sliding Cabinet Doors

Check sliding door tracks for worn liners to ensure doors stay shut and sealed properly. This will keep supplies contained within the cupboards and keep contamination out.

D.72 Latches and Locks, Interior Cabinetry

Check that latches and locks on interior cabinets work properly. This is to ensure that they remain closed on rough roads or in case of a collision. If the doors are not secured properly, the contents may be thrown about and cause injury to the patient or attendant.

D.73 Grab Rails and Door Pulls

Make sure all mounting screws, bolts, etc. are secured and tightened on grab rails and door pulls. Insecure hardware may break loose, causing a person to lose balance and fall.

D.74 Shelving

Check that the mounting strips for adjustable shelves are secure. Check all supports to ensure that they are attached to the mounts securely.

D.75 Tri- Or Edge Mouldings

Check for loose or damaged moulding at joints between wall panels and at corners of cabinets.

D.76 Squad Bench and CPR Seat, Lid Latch and Hold-Open Device(s)

Check lid latches to ensure that they lock properly. Check that hinges are securely attached to the lid and to the bench structure. These checks will ensure nothing can fall out, in case of a collision or upset. Check lid hold-open device(s) to be sure the mounts are secure. Check for proper function.

MEDICAL EQUIPMENT

D.77 Cot Anchor

Check the cot anchor to ensure that the mechanism latches completely. Lubricate all moving parts with lithium grease. Test the anchor by pulling sideways on the cot. If the anchor releases with a sharp sideways pull, it is not locking properly. Adjust according to manufacturer's specifications.

D.78 Main Cot, Clean and Lubricate

Clean the main cot as per manufacturer's specifications. Lubricate all moving parts using light (white) grease. Check and lubricate the wheel bearings and the pivots on the wheels.

D.79 Main Cot, Inspection

Check the cot very closely for damaged, worn or fatigued parts. If there are cracks in any of the cast aluminum fittings, take the cot out of service until the broken parts are replaced. A crack in cast aluminum may cause the fitting to fail at any time weight is put on the cot.

D.80 Cot Mattress and Straps

Check the mattress cover for holes, cuts, tears, etc. Check for abraded, cut or damaged restraint straps. Check for damaged or nonfunctioning buckles.

D.81 Secondary Cot / Portable Stretcher

Check secondary cot or portable stretcher for bent, broken or fatigued parts. Clean up and lubricate moving parts with light grease. Replace any parts showing signs of wear.

D.82 Scoop Stretcher

Check scoop stretcher for broken, bent or fatigued parts. Clean and lubricate moving parts with light grease. Check pins and latches for wear and replace if needed.

SAMPLE FORMS