



Living on 12 Volts A GMC Guide

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Introduction

- What do YOU Want from your GMC living area?
- Batteries
- Charging
- Loads
- Wiring
- Troubleshooting



A Little Technical Stuff

- PIE for power: power in watts = current in amps times voltage in volts
- Wires have resistance
- Small wires have more resistance
- Corroded connections have high resistance
- Resistance is bad



A little More Technical

- Batteries are measured by Cold Cranking Amps (starting batteries)
- and Amp-hours (deep cycle)
- Amp-hour measures are determined by completely discharging a fully charged battery at a specific rate (20 amps or 75A)
- You can safely use 50% of the amp-hours (more on this later)



What Do You Want?

- How do you use your coach?
- Full Hookups
- Drive a day, stay a day
- Drive a day, stay a few days
- Hardcore Boondocking
- Total electrical load is key for battery life



Batteries

- Engine starting battery
- House battery
- Hybrid start/deep cycle
- Wet Lead-acid deep cycle
- Absorbed Glass Mat
- Gel cell
- Advanced technologies



Engine Starting Battery

- Engine starting battery – good for high peak loads of very short duration
- Poor life cycle for deep discharges (<50 cycles)
- Easy to buy
- Poor energy density



House Batteries

- Primary energy source when not hooked up to shore power and NOT running genset
- Deep cycle are best
- Golf cart batteries are the best tradeoff for cost and performance – barring excellent local deals on other types



House Batteries

- Often neglected due to difficult access
- Consider installing a battery tray with slides to make it easier to check all the cells.
- Renew/Replace/Inspect battery cables – possible fire hazard



Hybrid Starting/Deep Cycle

- Good compromise of starting capability and deep cycle
- More expensive per amp-hour than golf cart batteries
- Better starting capacity than golf cart batteries
- Work fine for dive a day, stay a day dry camping



Wet Cell Golf Cart Batteries

- Highest energy capacity of batteries except for advanced construction (expensive gel cells and others)
- 6V battery, so two required in series to make 12V
- Low cost because of high demand



Golf Cart Batteries

- Shipping is the big expense
- Buy locally if possible
- Contact a golf course – they buy in bulk and ship in bulk
- 2 – T105 style batteries will fit in the rear battery compartment with a little room to spare



Golf Cart Batteries

- In general, the heavier the battery the better
- Most weight comes from the lead used in the construction of the plates
- Extra room at the bottom to allow sulfates to slough off without shorting the cells



Golf Cart Batteries

- Good for 500-1000 charge-discharge cycles each using 50% of the battery capacity
- This is 5,000+ hours of electricity
- Built to withstand road vibration
- How long will it take you to use 5,000 hours?



Checking Battery Life

- Fully charge your battery with a good quality charger
- TrueCharge, automotive multi-stage, Precision Dynamics
- Measure battery voltage at the terminals after allowing the battery to sit for at least 1 hour using DVM
- Measure electrolyte specific gravity



Checking Battery Life

- Turn on 10 amps of appliances
- Run the appliances for 50% of the expected battery life in hours
- Calculate battery life hours at 10 amps by dividing amp-hour rating by 10. This tells you how long in hours the battery should last if it's in perfect shape.



Checking Battery Life

- Operate the appliances for one half of the ideal life
- Allow the battery to sit for one hour after turning off all loads
- Measure the battery voltage at the terminals.
- The voltage should be approximately 0.4V lower than the starting point.



Battery Charge State

- Open Circuit Volt
- >12.6
- 12.45-12.6
- 12.24-12.45
- 12.06-12.24
- 11.7-12.06
- <11.7
- Percent Charge
- 100%
- 75-100%
- 50-75%
- 25-50%
- 0-25%
- 0%



Battery Fails to Hold Charge

- Fully charge battery
- Disconnect cables from the battery
- Wait one hour
- Measure open circuit voltage
- Measure specific gravity of all cells
- Leave it for three days
- Re-measure voltage and specific gravity



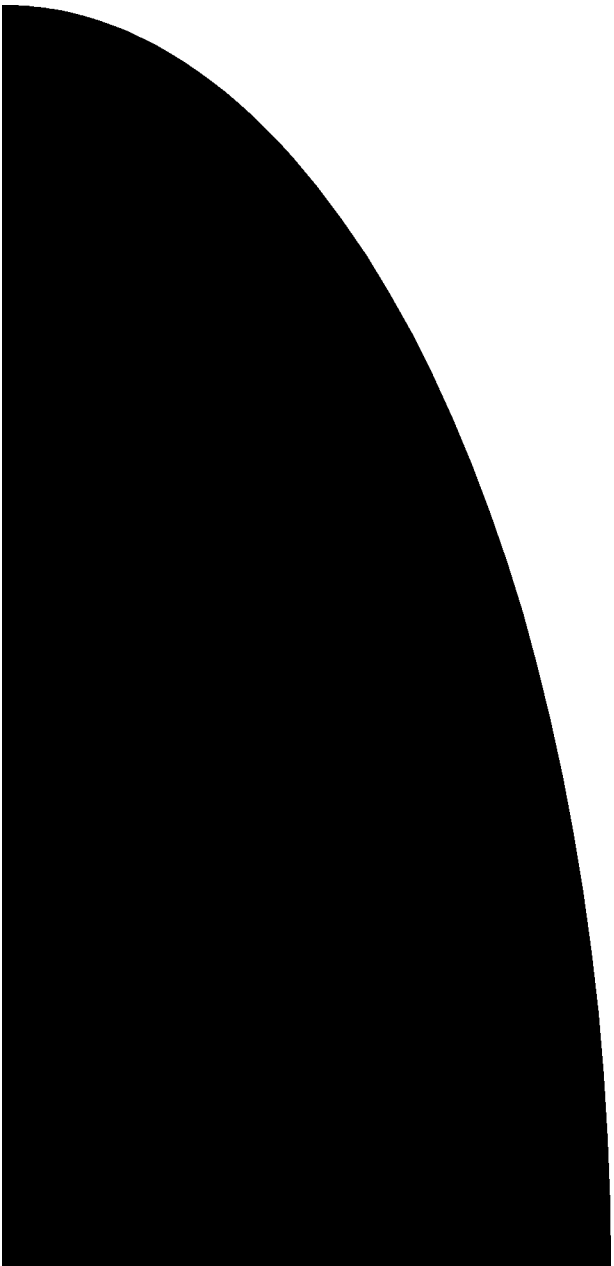
Battery Fails to Hold Charge

- Internal short exists if any single cell specific gravity drops by .035
- Internal short exists if voltage drops by 0.2V
- If battery passes test, there is a load draining the battery.



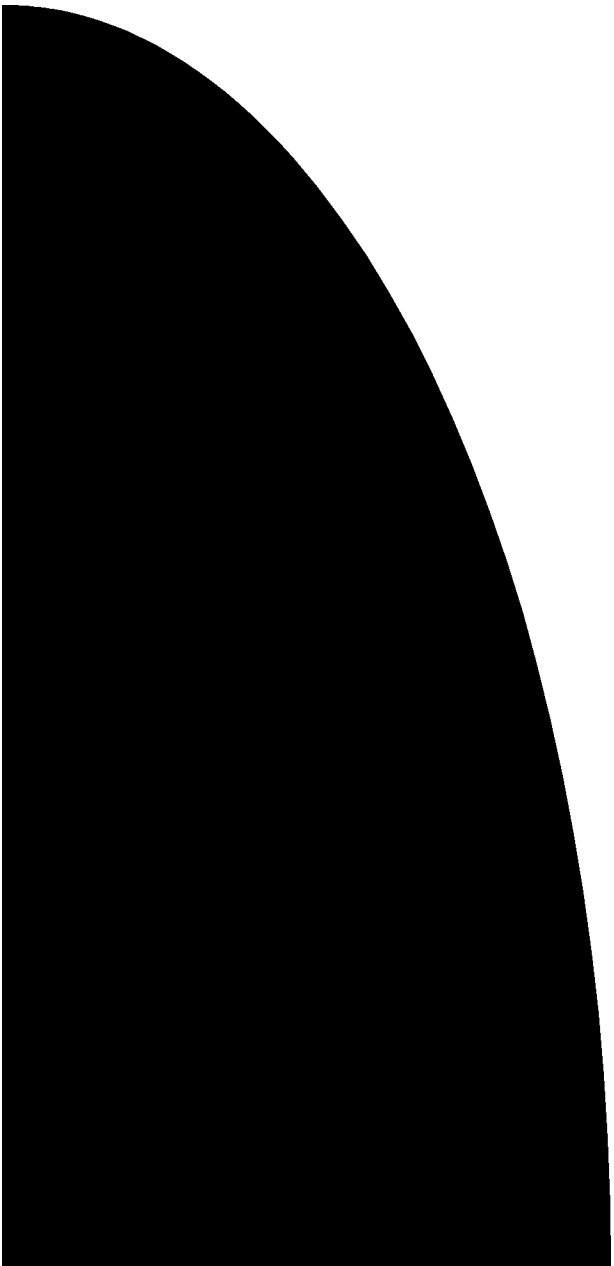
Battery Killers

- Leaving battery fully discharged for any amount of time
- Letting it run dry
- Failing to fully charge the battery for an extended period of time
- Mechanical failure (warped or broken plates)
- Overcharging



Drive a Day, Stay a Day

- GMC alternator is 80 amp (early models), 100 amp and 145 amp RPO
- Daylight driving permits battery charging, night driving charges at a possibly lower rate.
- 4 hours highway will put at least 50 AH into the battery



Drive a Day, Stay a Day

- 50 AH will service at least 4 hours of heavy usage, and 8 hours of medium usage
- DC fridge will run all but golf cart batteries completely down overnight



Drive a Day, Stay a Few

- Dry camping for 2 days requires conservation of electricity AND good batteries (golf cart)
- Highway driving for 5 hours will adequately recharge batteries for most people
- OEM DC fridge isn't practical for this scenario



Hardcore Boondocking

- Replace incandescent ceiling lights with florescent – reduces energy consumption by 50%
- Substitute 3-way (or propane + 120V) fridge.
- Replace bathroom fixtures with safety halogens
- Use a multi-stage charger
- Monitor battery state



Battery Charging

- Automotive – constant voltage, assume that batteries will NOT be discharged below 75% of capacity
- Multi-stage –bulk (constant current), absorption (constant voltage), float (below battery gassing voltage)



Battery Charging

- Equalizing
- Used to force desulfation
- Employs high voltage (15V+)
- Extends deep cycle battery life
- CAN NOT be used with AGM, sealed, or gel cells



Loads

- Lights - florescent (1.3 amps) vs incandescent (3+ amps)
- Fans (furnace and vents)
- Fridge
- Furnace starter
- Water pump
- Radio
- TV/VCR/Computer



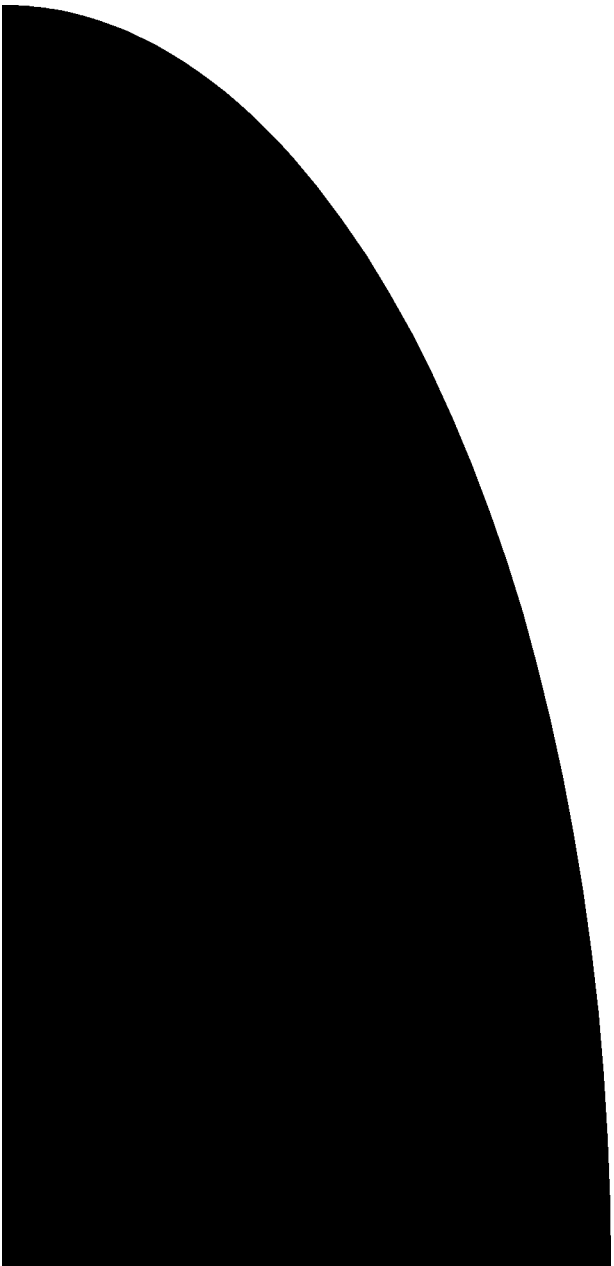
Loads

- Dimmers – use energy efficient pulse width modulated dimmers instead of resistance dimmers
- Replace OEM vents with Fantastic fans – better non-operation air movement, lower operating current
- Use Fantastic fan in bath – instant skylight!



Wiring

- Inspect ALL battery cables – rubs, abrasions, insulation degradation
- Clean all screw type connections
- Clean all plug together connections
- Clean grounds (behind electrical cabinet, at driver's side rear tail light assy inside, battery to frame etc)



Wiring - sizing

- Battery – to appliance – to battery distance in feet
- Recommended to get a copy of West Marine wiring table
- Use engine compartment table for genset and engine compartment wiring

Wire Size – 3% drop

Amps	10'	15'	20'	25'	40'
5	18	16	14	12	10
10	14	12	10	10	8
15	12	10	10	8	6
25	10	8	6	6	4
30	10	8	6	6	4

Wire Size – 3% drop

amps	10'	15'	20'	25'	40'
80	6	4	2	2	0
90	4	2	2	1	2/0
100	4	2	2	1	2/0



Troubleshooting

- Digital Volt Meter or Digital Multi Meter
- Alligator jumper wire
- Good flashlight
- Inspection mirror
- Common pins
- Test light (DVMs may not register some signals)



Troubleshooting

- Measure voltage at the appliance, if not voltage:
- Make sure that ALL switches are ON
- Check fuses to make sure that one hasn't blown
- Visually inspect connections



Troubleshooting

- Start at the battery
- Measure voltage (turn on DVM, put black probe on ground, red on 12V circuit)
- Move to the fuse block
- Then to the Appliance
- Look for opens (no voltage)



Troubleshooting

- You may need to disconnect the appliance to measure the 12V circuit
- If 12V is present at the connector, the problem is probably in the appliance (or connector)
- IF you get 12V but the appliance still doesn't work, the problem may still be in the voltage supply.



Troubleshooting

- High amperage appliances may cause 12V to “sag” under load causing the appliance to stop working.
- Grounds, 12V+ connections must be clean and tight
- You can make a test fixture using 2 or more headlights to simulate the load. Fridge + heater just shuts off



Troubleshooting

- To temporarily test for a bad ground, use a “jumper wire” from the load to the battery ground terminal. Long heavy gauge wire with alligator clips. If the appliance starts working you know that you have a bad ground.



Troubleshooting

- To temporarily test for a bad 12V circuit, run a “jumper wire” from the battery positive terminal to the 12V of the appliance.
- Use a fuse at the battery end of the jumper wire “just in case”



Troubleshooting

- If a previous owner hardwired loads
- Install connectors if you are able
- Use common pins pressed through the center of the wire to test voltages. **BE CAREFUL.**



Troubleshooting

- Light fixture problems
 1. Fuses
 2. Bulbs
 3. Corroded sockets
 4. Loose wires



Troubleshooting

- Furnace
 1. Bad ground
 2. Wrong propane pressure
 3. OEM furnace internals
 4. Bad fuse block



Troubleshooting

- Fuse block
 1. Corrosion
 2. Rust
 3. Leakage from one circuit to another (or ground)
 4. Breakage due to factory over-torque of fasteners



Temporary “Fixes”

- Fused jumper with alligator clips for fuse block (inline fuse with clips) Use the right fuse for the circuit
- Fused “jumper wire” with connectors on each end
- Surface mountable battery powered lights



Cautions

- 12V can be powerful stuff
- Use ring connectors instead of spades – they stay on better under vibration
- Avoid line taps – solder connections instead
- Use waterproof connectors where they can get wet



Cautions

- Inspect **EVERYTHING** if you have any sort of engine/genset compartment fire
- Tighten all connections at least once per year
- Replace any wiring that has cracked insulation