

This flow chart is applicable to all types of lead acid batteries. This includes flooded, AGM / VRLA, Gel, etc. There are multiple battery chargers available that are capable of charging 12 and 24 VDC batteries. Use the TM and TB for a listing of approved diagnostic testers, and charging equipment.

**Always make every attempt to test and charge on equipment BEFORE pulling batteries or even disconnecting 1 battery cable! A Proactive approach to battery maintenance ALWAYS saves time and money.**

This SOP Appendix does NOT take the place of the applicable TM, TB or other safety / maintenance messages. Proper precautions such as proper PPE, adequate pre-inspection of batteries, and the multiple different charging approaches cannot all be addressed in this flow chart.

Refer to your specific vehicle TM, Automotive Lead-Acid Storage Batteries TM 9-6140-200-13, or Recharging Procedures for Automotive Valve Regulated Lead-Acid Batteries TB 9-6140-252-13. **Pre-charge inspection of batteries must occur. Never attempt to charge any lead-acid batteries that are swollen, cracked, damaged or suspected frozen. Terminals and cables should be clean, tight, and serviceable. Refer to the specific vehicle TM and battery TM or TB for specific information.**

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**Table of Contents: Again...Always conduct battery pre-charge inspection IAW this SOP and applicable TMs prior to attempting to charge any lead-acid batteries that are still mounted on the platform or dismantled. Swollen, cracked, damaged or frozen batteries should never be charged.**

Page 2: [Batteries still mounted on equipment – Testing and Charging with \\*ProHD Charger.](#) \*[Best charger for on equipment charging.](#)

Page 8: [Batteries still mounted on equipment – Testing and Charging using the Pallet or Pro-PC Chargers.](#)

Page 12. [Testing Batteries dismantled from platform.](#)

Page 15. [Charging dismantled batteries with the ProHD Charger.](#)

Page 18. [Charging dismantled 12 V batteries with the Pallet Charger.](#)

Page 21. [Charging dismantled 12 V batteries with the World Charger.](#)

Page 24. [Charging 24V batteries using the Dual 24V charger.](#)

Page 25. [Pro12 Battery Maintainer.](#)

The steps outlined in this appendix addresses chargers and diagnostic testers included in TM 9-6140-200-13 (MAY 2011) and TB 9-6140-252-13 (Jan 2012).

**For additional questions contact your supporting PulseTech FSR or your TACOM LAR.**

# Batteries still mounted on equipment: Testing and Charging using the Pro HD charger.

**1. Batteries require service.**  
**Batteries still mounted on vehicle**

- Equipment won't start.
- Equipment starts slowly.
- Vehicle in for Scheduled services
- Battery Test IAW TM.
- If batteries are removed go to page 12

**2. Test the Batteries.**  
**Batteries still mounted on vehicle**

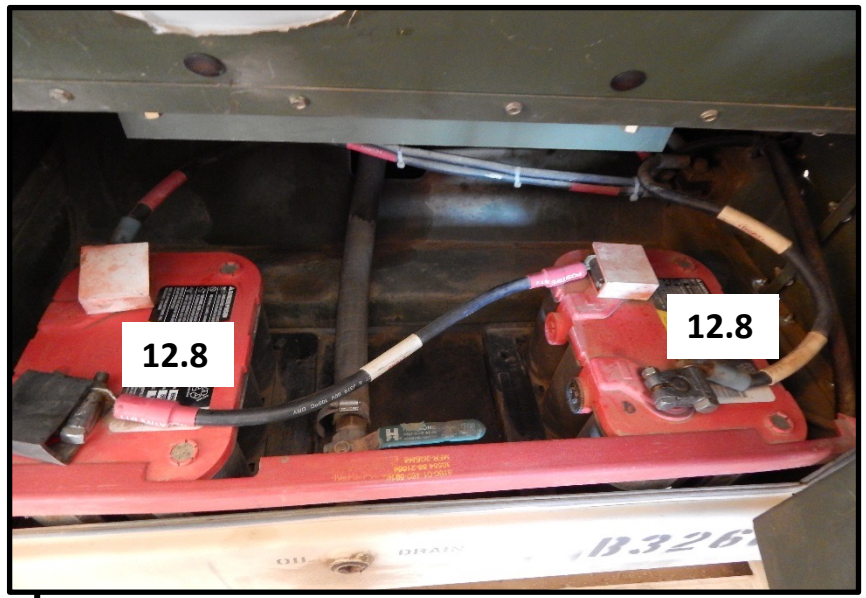
- Use Multimeter or Conductance tester to check the **open circuit voltage (OCV)**
- **When testing OCV only there is no need to disconnect any cables.**

**3. Test the Batteries.**  
**Batteries still mounted on vehicle**

- **Are batteries all within **.5 VDC** of one another, and a minimum of **8Vdc** each?**
- **See examples below**

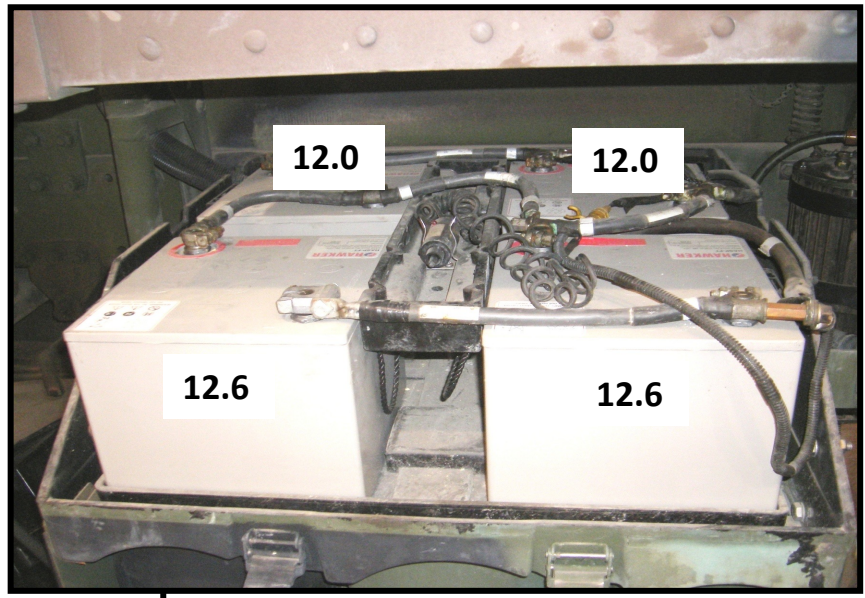
YES

NO



Example: Balanced Batteries, less than .5VDC difference.

Go to step 11. Charge all Batteries.



Example: Batteries out of balance, more than .5VDC difference.

Go to Step 4. Charge lowest VDC batteries. Batteries below 4VDC will need extra effort. Go to step 13 on page 6 for these.

# Batteries still mounted on equipment: Testing and Charging using the Pro HD charger.

**4. Charge lowest VDC batteries.**  
First, starting charging lowest VDC battery or batteries. These will be the battery with the lowest VDC identified in previous steps.

- Pro HD charger, Hook up clamps to lowest battery, ensure good connection, and turn on charger.
- See examples below. **\*See Note for flooded lead acid batteries.**

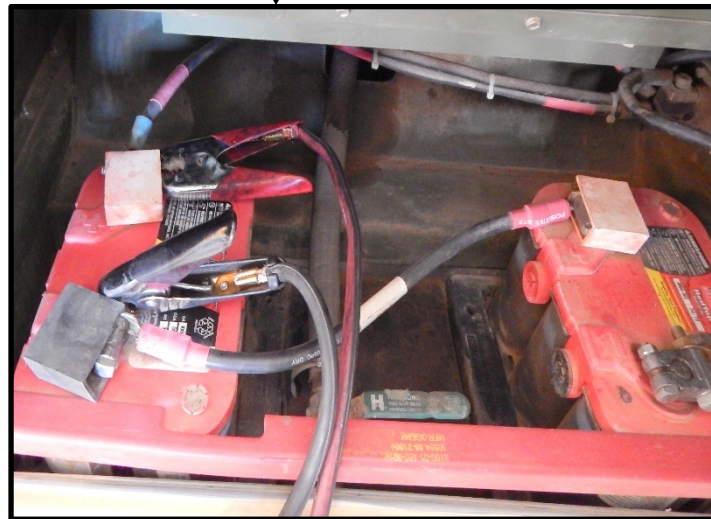
**\*Note: Refer to TM for proper inspection.** If equipment has flooded lead acid batteries, the electrolyte levels must be checked prior to charging. If required, use distilled water to fill to appropriate level.

Slightly loosen each battery cap approximately 1/2 turn counterclockwise (flooded type only) IAW TM.

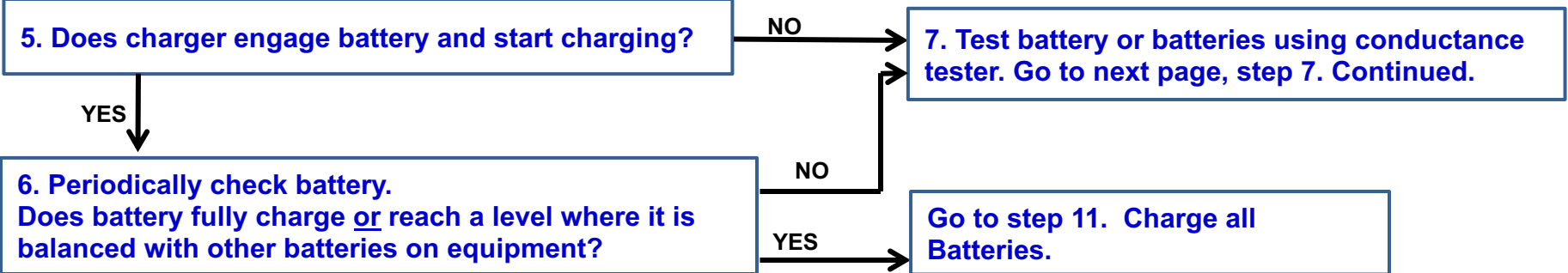
Use proper PPE (gloves and eye protection required).



Example: Attempting charge the front 2 batteries on a 4 battery, series / parallel system.



Example: Attempting charge on lowest battery on a 2 battery, series system.



# Batteries still mounted on equipment: Testing.

**7. Continued; Test battery or batteries using conductance tester.**

- Secure a conductance tester.
- Tester examples to the right. NSNs are listed in appendix 3.



**8. Test battery or batteries using conductance tester.**

- Set up the Conductance tester for the type battery you are testing. See Battery listing appendix of this SOP for example battery types, and CCA ratings.



**9. Test battery or batteries using conductance tester.**

- First. Technicians MUST identify if a battery is paralleled with another battery. If so, the CCAs reading will be for all paralleled batteries. These batteries can still be tested BUT the CCA readings will be for ALL paralleled batteries (less terminal, cable resistance, etc.).
- Examples below and at right
- Go to 9. continued on next page.

Example: Conductance testers.



Example: Batteries are in series with another Battery. There will be no CCA nor Voltage from another battery.



Example: Single Battery isolated, Tester Results: Charge and retest. 12.6VDC, 533CCAs



Example: Same Battery NOT isolated. Battery is paralleled with a bad battery and causes MUCH different reading. Tester Results: Bad & Replace. 12.9 VDC, 958 CCAs



Example: Batteries are series and paralleled with other batteries. There WILL BE CCA and Voltage from paralleled batteries.

# Batteries still mounted on equipment: Testing and Charging using the Pro HD charger.

## 9. Continued; Test battery or batteries using conductance tester. The tester reads:

- **Charge and Retest:** If the Pro HD would not engage this battery, it is probably highly sulfated. Attempt to Jump start the charge (see step 12). If jump starting the charge doesn't work, you will need to remove the battery from the equipment and use steps listed in dismantled battery charging techniques later in these instructions.
- **Bad and Replace, or Bad Battery.** This reading can sometimes be the result of highly sulfated batteries that are still recoverable. **If battery is less than 4 years old we highly recommend attempting to jump start the charge BEFORE battery removal.** If jump starting does not work remove battery from equipment. Use dismantled battery charging techniques later in these instructions and attempt to engage the battery into a charge cycle.
- **Good and Pass.** You may occasionally see this even if the charger will not engage the batteries. Test all batteries on the platform. There is likely one or more that are causing the issue, and once isolated from the depleted battery retest all.



**10. Did low battery start to charge?**  
• Are Batteries now balanced with .5VDC across the system?



**11. Charge all batteries on platform.**  
• Use Pro HD NATO plug or Clamps and connect to the main POS and NEG lugs across the batteries.  
• Example below.

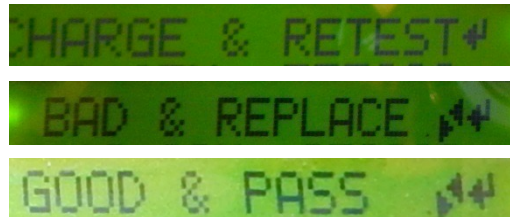


**12. Did the Pro HD start charging at the appropriate VDC level?**



**Charge batteries and test after charge complete. Repeat as required.**

**Go to step 13 on next page.**



Remove discharged batteries. Replace some or all as needed with recovered batteries. You can attempt charge the remaining batteries without removal if they are accepting a charge.

**Note: The system MUST be above 15VDC for the ProHD charge to engage at 24V.**

Example: 24VDC system charging via Clamps on main POS and NEG lugs.



# Batteries still mounted on equipment: Testing and Charging using the Pro HD charger.

## 13. Charger will not charge all batteries on platform.

Vehicle must have minimum VDC: Test VDC across batteries or at slave receptacle.

- 12VDC systems must have a minimum of 4VDC across system or at slave receptacle.
- 24VDC system must have a minimum of 15VDC across system or at slave receptacle.
- Verify VDC, charger connections, and reattempt to charge.
- Did system engage at correct level, or is VDC at required level?

YES  
↓

Charge batteries and test after charge complete. Repeat as required.

NO  
↓

14. Jump start charging using another vehicle or jump starter. See examples below.

15. Take the ProHD clamps and hook them onto the main POS and NEG lugs of the equipment with low VDC or highly sulfated batteries. See example below.

Next, hook a functioning jump starter **or** slave to another vehicle without starting it. See example, below left.

Go to step 16 on next page.



Example: Getting a low VDC or highly sulfated 24VDC system to start charging via a jump start.



Example: Pro HD clamps hooked up to main POS and NEG clamps on an FMTV.

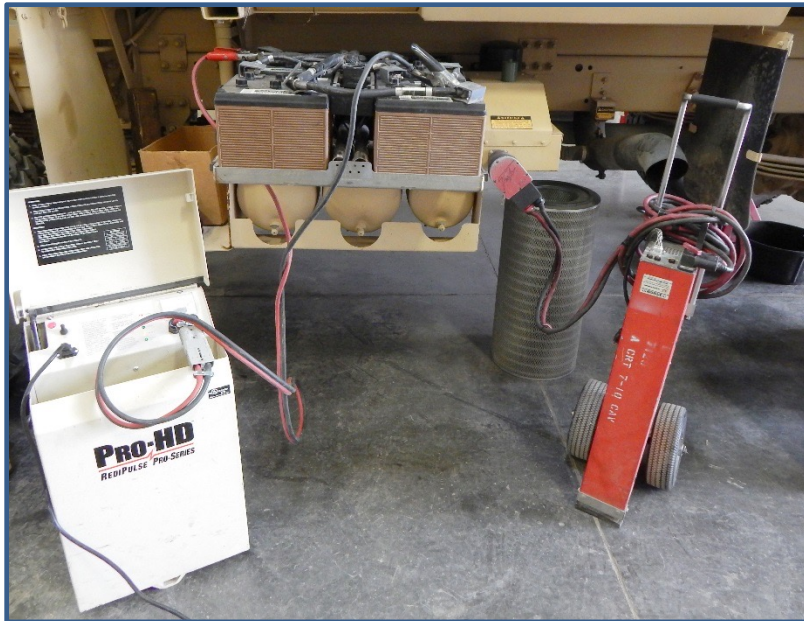
## Batteries still mounted on equipment: Testing and Charging using the Pro HD charger.

**16. Turn on charger.** The Pro HD should now run at the appropriate voltage level and begin charging.

- Run Charger like this for 15 minutes. Check periodically during this process to ensure batteries are not releasing excessive gas (strong rotten egg smell, steam, etc.), overheating (sides of battery are very warm to the touch), \*swelling, etc. If any of these are observed immediately stop charging and let the battery cool. Excessive swelling on a battery is an indicator of internal damage and these batteries should be discarded.
- Check to see if the charger now stays engaged at the appropriate VDC level with the vehicle being charged.
- **If it does stay engaged** let the charger run through a charge cycle.
- **If it does NOT stay engaged**, turn off charger, reattach the jump start or slave and run another 15 minutes. It may take several tries to get it going. Again, watch for any signs of issues. If it will not start charging after several attempts remove batteries and move to dismantled battery charging.



**END.** On equipment Charging with ProHD.



Example: Getting a low VDC or highly sulfated 24Vdc system to start charging via a jump start.



Example: Pro HD charging all batteries via clamps, and jump start or slave cables to other vehicle removed.

# Batteries still mounted on equipment: Testing and Charging using the Pallet Charger.

## 1. Batteries require service. Batteries still mounted on vehicle

- Equipment won't start.
- Equipment starts slowly.
- Vehicle in for Scheduled services
- Battery Test IAW TM.
- If batteries are removed go back to page 1 and pick appropriate dismantled charging instructions.

## 2. Test the Batteries. Batteries still mounted on vehicle

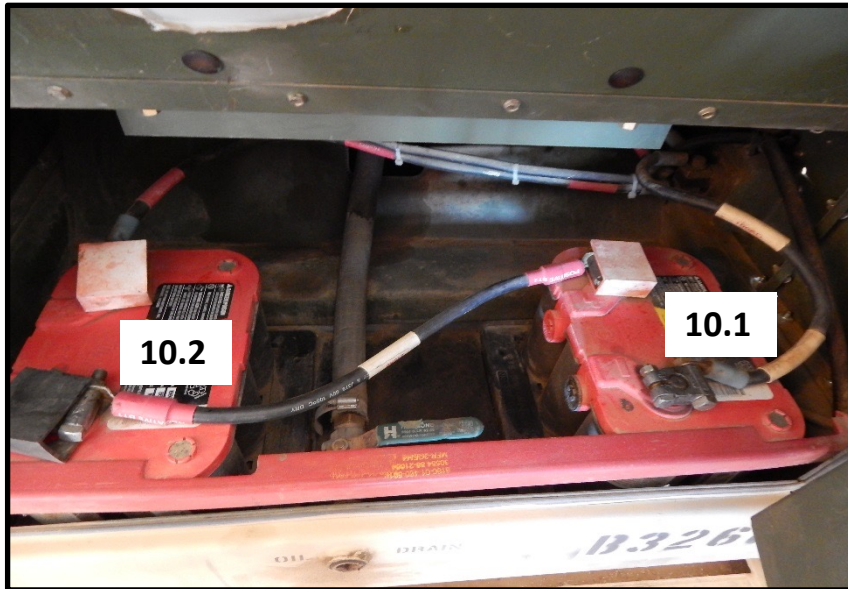
- Use Multimeter or Conductance tester to check the **open circuit voltage (OCV)**
- **When testing OCV only there is no need to disconnect any cables.**

## 3. Test the Batteries. Batteries still mounted on vehicle

- Are batteries all above 4VDC?
- **See examples below**

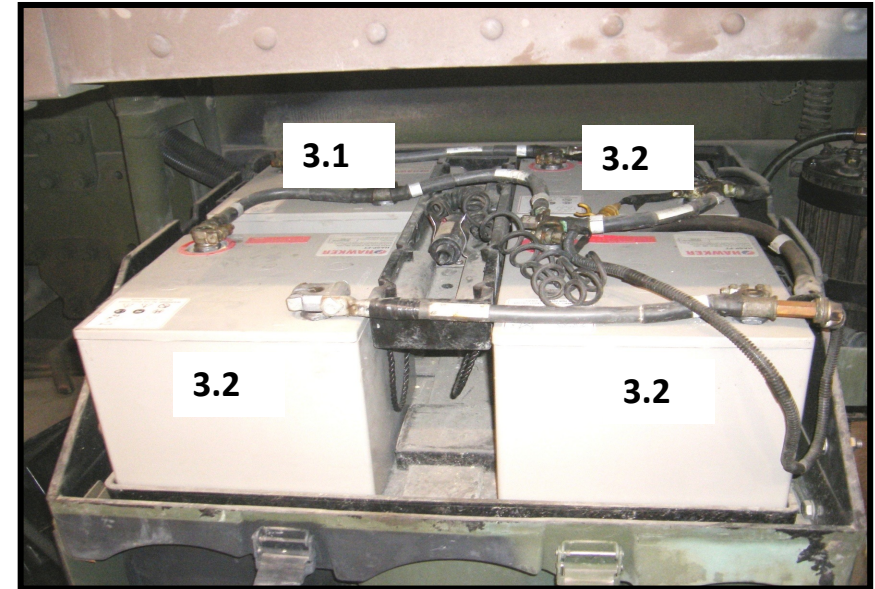
YES

NO



Example: Batteries well above 4VDC, ok to charge with Pallet Charger.

Go to step 4. Charge all Batteries.



Example: Batteries less than 4VDC. Batteries this low will take many hours (or even days) to charge. If time is an issue, use Pro HD or remove batteries for off platform charging.

If any batteries are below 2VDC, the pallet charger may not engage them. Suggest use Pro HD to engage these batteries with a jump. See page #6.



## Batteries still mounted on equipment: Testing and Charging using the Pallet Charger.

- Hook up Pallet Charger clamps to each battery. There is **NO** need to disconnect any cables, as the pallet charger can functionally charge batteries in a series, parallel, or series/parallel configuration with cables attached.
  - See examples below. **\*See Note for flooded lead acid batteries at right.**



Example: Pallet Charger engaging a 4 battery, series / parallel system.

**\*Note: Refer to TM for proper inspection.** If equipment has flooded lead acid batteries, the electrolyte levels must be checked prior to charging. If required, use distilled water to fill to appropriate level.

Slightly loosen each battery cap approximately 1/2 turn counterclockwise (flooded type only) IAW TM.

Use proper PPE (gloves and eye protection required).

5. Does charger engage battery and start charging?

YES

6. Periodically check batteries.  
Do all batteries fully charge?

NO

7. Test batteries using conductance tester. Go to next page; Step 7 continued.

NO

YES

END

# Batteries still mounted on equipment: Testing and Charging using the Pallet Charger.

## 7. Continued; Test battery or batteries using conductance tester.

- Secure a conductance tester.
- Tester examples to the right. NSNs are listed in appendix 3.



## 8. Test battery or batteries using conductance tester.

- Set up the Conductance tester for the type battery you are testing. See Battery listing appendix of this SOP for example battery types, and CCA ratings.



## 9. Test battery or batteries using conductance tester.

- First. Technicians MUST identify if a battery is paralleled with another battery. If so, the CCAs reading will be for all paralleled batteries. These batteries can still be tested BUT the CCA readings will be for ALL paralleled batteries (less terminal, cable resistance, etc.).
- Examples below and at right
- Goto Step 9 continued on next page.

Example: Conductance testers.



Example: Batteries are in series with another Battery. There will be no CCA nor Voltage from another battery.



Example: Battery in series / isolated. Tester Results: Charge and retest. 12.6Vdc, 533CCAs



Example: Same Battery NOT isolated. Battery is paralleled with a bad battery and causes MUCH different reading. Tester Results: Bad & Replace. 12.9 VDC, 958 CCAs



Example: Batteries are series and paralleled with other batteries. There WILL BE CCA and Voltage from paralleled batteries.

## Batteries still mounted on equipment: Testing and Charging using the Pallet Charger.

### 9. Continued; Test battery or batteries using conductance tester.

- **Charge and Retest:** If the Pallet Charger will not charge this battery on the platform it is probably highly sulfated. You may need to remove the battery from the platform and use steps listed in dismantled battery charging techniques later in this annex.
- **Bad and Replace, or Bad Battery.** This reading can sometimes be the result of highly sulfated batteries that are still recoverable. **If battery is less than 4 years old we highly recommend making every attempt to recover the battery before disposal.** Use dismantled battery charging techniques later in these instructions and attempt to engage the battery into a charge cycle.
- **Good and Pass.** You may occasionally see this even if the charger will not engage the batteries. Test all batteries on the equipment. There is likely one or more that are causing the issue, and once isolated from the depleted battery we suggest retesting all.

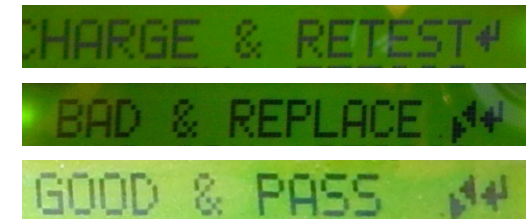


### 10. Remove or attempt another charge cycle

- See dismantled battery charging if removed. Go back to page 1 to select the appropriate dismantled charging steps.
- If re-attempting charge, go back to page 9, step 4.



**End: Batteries still mounted on platform – Testing and Charging using the Pallet Charger.**



## Begin Batteries Dismounted – Testing.

Batteries dismounted from vehicle. Testing, charging, maintaining batteries in Unit battery service area.

1. Organize the batteries for charging. **Start charging the newest batteries in the best shape (CCAs and health) first.** These batteries will recover the quickest. **Less than 3 years old should see a 90%+ recovery rate! 3 to 4 years should see a 70%+ recovery rate!**

2. How do you tell the manufacture date on batteries? Many are labeled, although manufacturers use different ways to mark their “born on dates” for their batteries. (some examples below)

**READ This!**

**ATTENTION:** Testing NEW and used batteries! **From TB 9-6140-252-13, Jan 2012, Page 0011**

**New 12 V batteries;** OCV should be above 12.65Vdc. If below, charge prior to installation.

**Recovered 12V used batteries** will recharge to voltages > 12.85 VDC but after an eight hour rest period may stabilize to > 12.65 VDC. They should also have a CCA rating > than 90% of CCA rating shown on battery when tested.



Some batteries will come with a shipped date. This label will be on top or on the side. These are usually very close to the manufacture date.



Hawker 6TAGM batteries have the date on the label directly on top. All newer ones use a month / year designation. The above 6TAGM Hawker was manufactured in Aug 2011.

**NOTE:** **dismounted batteries that are in a high voltage and low amperage state.** Recovery rates can be increased by discharging the battery before attempting a charge cycle. This can be done by hooking it to any DC 12V load such as lights, fans, or even a dead battery in parallel.

See next page for more info.



Optima batteries use a Julian date. The first 4 numbers, reading left to right, First digit - 3: This is the year, 2013. Next 3 digits - 209: The day of the year using a Julian calendar. Manufacture date is 28 July 2013.

Go to step 3 on next page.

# Batteries Dismounted – Testing.

Example: Conductance testers.

## 3. Test the Batteries.

- Multimeter can be used to check **open circuit voltage (OCV)**
- **However**, **Conductance tester** should be used to check the **OCV, health and CCAs of the battery.**



MDX490



490PT+



390PT

**NOTE: Dismounted batteries that are in a high voltage and low amperage have a surface charge. Recovery rates can be increased dramatically by discharging these batteries and removing the surface charge before attempting a charge cycle. This can be done by hooking it to any DC 12V load. I.e. load tester, lights, fans, or even a dead battery in parallel. See below**

## Test battery or batteries using conductance tester.

- Set up the Conductance tester for the type battery you are testing. See Battery listing appendix of this SOP for example battery types, and CCA ratings.

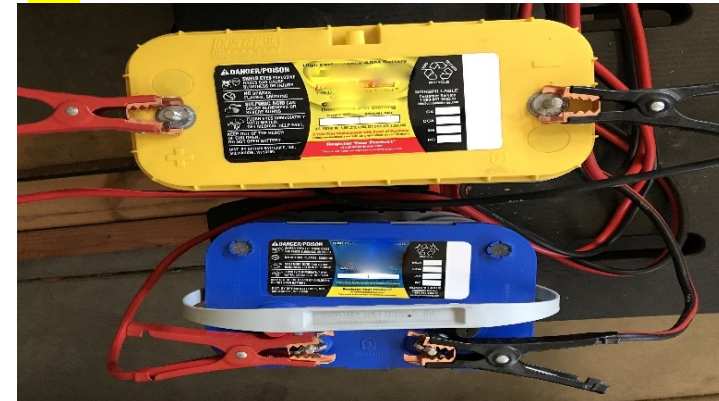
## Example. 490PT+ screen shots.

**First Screen. Battery VDC. Ensure it is on Battery Test. Left and right arrow can change test type.**

**Next. Choose correct battery type. Very important. Battery listing has examples listed by type, CCAs, etc.**

**Next. Set the battery CCA rating. Very important. Battery listing has examples listed by type, CCAs, etc.**

Go to step 4 on next page.



Example: Using a dead battery connected in parallel with battery to be charged in an Attempt to remove surface charge. Leave the batteries like this for at least an hour. In many cases this will remove the surface charge. Once Vdc has been lowered (below 10V or less) attempt to charge again.

# Batteries Dismounted – Testing.

## 4. Test battery using conductance tester.

- If the battery is less than 2.5VDC it is hard for any conductance tester to lock in very accurate findings.
- Test battery using conductance tester.

### Findings:

Battery has less than 2.5VDC. See note at right.

**Bad battery reading next page.** See note at right.

**Charge and Retest:** Attempt to start charge on the battery with approved systems.

**CHARGE & RETEST**



Example: Pallet charger engaging batteries.

Pick the system you are going to use to charge your dismantled batteries. These instructions will cover all systems. There are differences and will be pointed out in the instructions. Choose which charger you are using and go to the appropriate page for instructions.

As with dead batteries on equipment, batteries less than 2.5 VDC and in some cases higher, may need to be jump started to get them engaged into a charge cycle. This will be addressed with each charger.

**Bad Battery Reading.** Many times, especially on the newer AGM batteries, high sulfation can cause micro sulfate crystal connections between plates. This will cause the conductance tester to read the battery as bad. However, many of these batteries may still be recoverable. Sometimes simply paralleling these with a charged battery, or charging them can break these crystals. Again, this will be addressed with each charger.



**Pro HD charger:**  
Go to Next Page, 15.

**Pro HD.**  
Standard on SATS.  
Can charge 12 or 24  
batteries / systems.



**Pallet charger:**  
Go to Page 18.

**Pallet Charger.**  
Can charge any type  
12V batteries. Any  
configuration can be  
mixed and matched.



**12V Multi station Chargers**  
Go to Page 18.

**Bench Top 6 or 12 Station  
and Dual 12V charger.**  
Can charge any type 12V  
batteries. Any  
configuration can be mixed  
and matched.



**World charger:**  
Go to Page 21.

**World Charger.**  
Can charge any type  
12V batteries.

# Batteries Dismounted – Charging with the Pro HD

1. Take Pro HD clamps and hook to depleted battery.

Turn on Charger.

Note: The Pro HD can be used to charge multiple dismantled batteries at once. See examples on page 16.

Did the charger engage the battery?

YES

2. Allow charger to run thru charge cycle. After charge cycle is complete the charge complete light will illuminate.

Note: Charge complete light illuminated **does not** always mean charge cycle has completed successfully. It is rather an indicator that you should now check the condition of the battery.

3. Initial test; Test battery with conductance tester. What does the conductance tester read?

GOOD & PASS #4

CHARGE & RETEST #4

Bad Battery  
Go to Next Page

4. Tester reads good, or good and pass. Has battery reached rated VDC and CCAs?

YES

5. Allow battery to sit a minimum of 4 hours (preferably 24hrs) and retest. Does battery still read good VDC and at or near rated CCAs?

NO

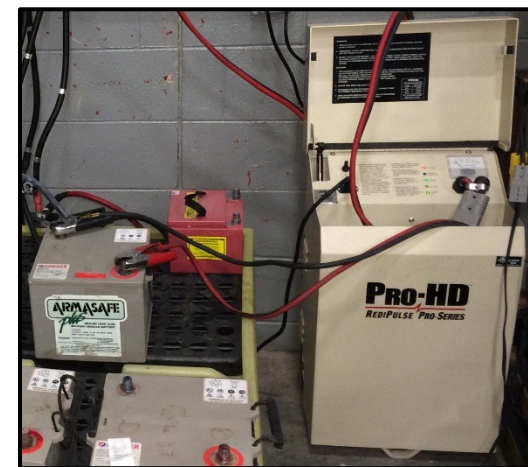
YES

6. **Good battery.**  
Place on shop stock or reissue.

NO

Jump battery to get charge started. Note: PulseTech chargers are extremely safe systems. However, precautions should be taken when jumping one battery to the next. Follow the steps on page 16 and 17.

Run battery through another charge cycle. This may take multiple times for a highly sulfated, severely discharged battery. Some batteries may take quite some time to recover, even several days for a severely discharged 6TAGM. If after charge you receive a bad battery reading on the conductance tester, or the battery reaches a level of charge below it's rated capacity and stops gaining charge turn in as unserviceable.



Example: ProHD charging a single 6TAGM battery.

Note: The ProHD or the World Chargers are the best bet for initial engagement on highly discharged or sulfated batteries. Once the batteries start to accept a charge then a lower amperage Pallet, Pro-PC or dual 12V can be used.

## Batteries Dismounted – Charging with the Pro HD

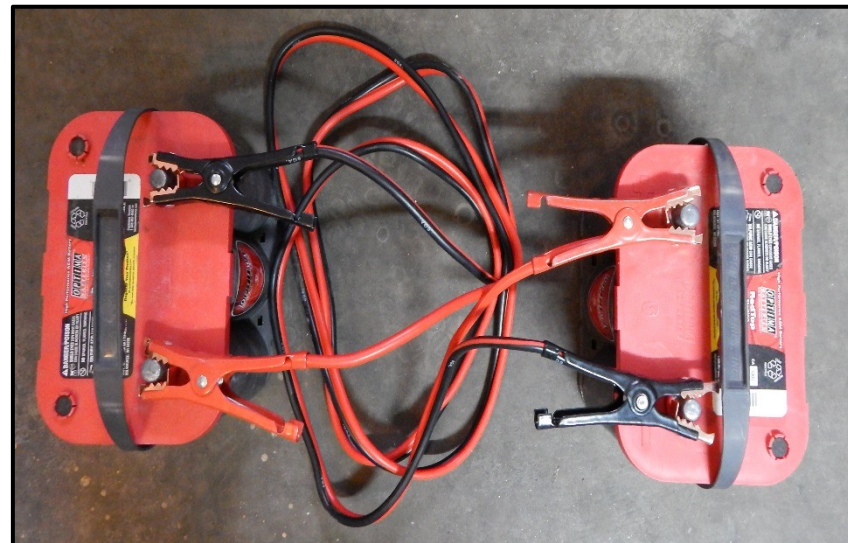
7. The ProHD or World Charger can push higher amperage and in some cases, these are more suited to initially engage extremely discharged batteries. This high amperage push combined with the high frequency voltage pulsation can be very effective on discharged batteries.

8. Find a battery that the charger starts to charge. When using the Pro HD it is suggested that you find a battery that is absorbing 30+ amps if possible.



Example:  
ProHD  
engaging a  
battery at  
50 Amps.

Note: The Optima family, the 6TAGM (Hawker, Exide and Batcore), and the Gil / Teledyne 24Vdc VRLA batteries have proven to be very recoverable, and rechargeable multiple times from extreme discharge.



9. Parallel the discharged battery to the good battery. See example at right. Note hook up sequence under pic. Ensure this is done in a well ventilated area. Some small sparking can or may normally occur. If you have significant sparking when hooking up the last neg lead on the discharged battery abort attempt.

Example: Paralleled batteries. This can be used to try and break sulfation crystal connections and get low VDC batteries to start charging. Hook up sequence.

1. Pos lead on good battery
2. Pos lead on Bad or depleted Battery
3. Neg lead on good battery
4. Last: Neg lead on bad or depleted battery. If you observe significant sparking immediately stop and tag battery as bad / unserviceable.

Goto next page.



# Batteries Dismounted – Charging with the Pro HD

10. Hook the Pro HD to the discharged battery that is paralleled with the good battery. See examples below.

11. Turn on Charger. Does charger engage battery and start charging?

NO

1<sup>st</sup> Attempt. Check connections and cables. Wiggle connections to ensure good contact, then try again. Does charger engage now?

NO

Connect charger to good jump battery and turn on. If the system engages the jump battery the charger is working correctly. Next check the jumper cables to ensure they are serviceable. If these are good, the battery is bad and should be turned in as unserviceable.

YES

12. Let charger run for 5 minutes with the batteries paralleled. After 5 minutes disconnect the negative jumper cable lead on the good battery. Did the charger stay engaged with the low VDC or discharged battery when the jump battery is disconnected?

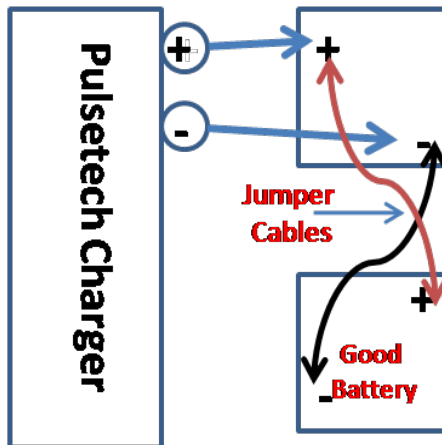
YES

YES

Go back to #2 Page 14

**END – Charging with Pro HD**

## Batteries in Parallel



The above diagram shows how the Pro HD would be hooked up to get low VDC or highly sulfated batteries to accept a charge via paralleled batteries. The picture on the right depicts the Pro HD charging 2 batteries at once. Notice they are paralleled but the charger is hooked up across them. This can be an effective way to charge multiple batteries at once using the Pro HD.

# Batteries Dismounted – Charging with the Pallet, Pro-PC, or Dual 12V Chargers

Note: The Pallet Charger, Bench top chargers, Dual 12 and SC-6 chargers have the same capabilities, so will be covered in the same section. The obvious difference is one is much more portable than the other.

1. Take the charger clamps and hook to the depleted battery.  
For batteries less than 9VDC, suggest using 2 leads per battery. See next page.  
Turn on charger; did the charger engage the battery?

YES

NO

2. Allow charger to run thru charge cycle.  
After charge cycle is complete the charge complete light will illuminate.  
Note: Charge complete light illuminated **does not** always mean charge cycle has completed successfully. It is rather an indicator that you should now check the condition of the battery.

Jump battery to get charge started.  
Note: PulseTech chargers are extremely safe systems. However, precautions should be taken when jumping one battery to the next. Follow the steps on page 19 and 20.



Pro-PC-12 Charger

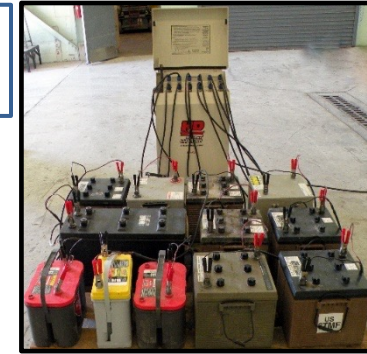


Pro-PC-6 Charger



Dual 12V Charger

Example: Pallet charging multiple batteries at once.



3. Initial test; After charge  
Test battery with conductance tester.  
What does the conductance tester read?

GOOD & PASS

CHARGE & RETEST

Bad Battery  
Go to Next Page

4. Tester reads good, or good and pass.  
Has battery reached rated Vdc and CCAs?

YES

NO

5. Allow battery to sit a **minimum of 4 hours (preferably 24hrs)** and retest.  
Does battery still read good VDC and at or near rated CCAs?

YES

Run battery through another charge cycle. This may take multiple times for a highly sulfated, severely discharged battery. Some batteries may take quite sometime to recover, even several days for a severely discharged 6TAGM.  
**If after charge you receive a bad battery reading on the conductance tester, or the battery reaches a level of charge below it's rated capacity and stops gaining charge turn in as unserviceable.**

6. **Good battery.**  
Place on shop stock or reissue.

# Batteries Dismounted – Charging with the Pallet, Pro-PC, or Dual 12V Chargers

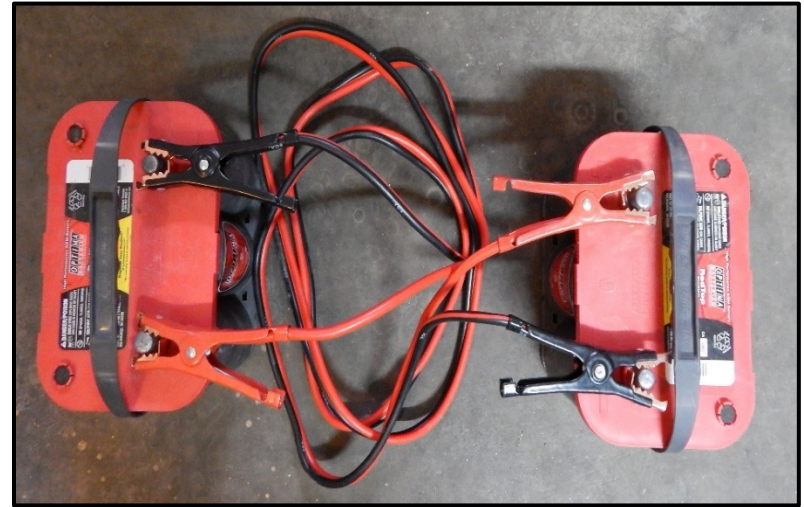
7. The Pallet, Pro-PC or Dual 12V chargers push 6Amps and may take a good amount of time to fully recover a battery. However, because it pushes less amperage, along with the high frequency voltage pulsation it can in many cases more completely charge a battery than higher amperage chargers.

8. Find a battery that the charger starts to charge. When using the Pallet or bench top chargers this is quite easy, as they will engage most 12V batteries that are above 2.5VDC. **Note: The charger can be running and charging other batteries while you are completing these steps for the low VDC or highly sulfated batteries.**

10. Parallel the discharged battery to the good battery or another battery being charged by the charger. See example at right. **Note hook up sequence under pic. Ensure this is done in a well ventilated area. Some small sparking can or may normally occur. If you have significant sparking when hooking up the last neg lead on the discharged battery abort attempt.**

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**Note: The Optima family, the 6TAGM (Hawker, Exide and Batcore), and new Gil / Teledyne 24VDC VRLA batteries have proven to be very recoverable, and rechargeable multiple times from extreme discharge.**



Example: Paralleled batteries. This can be used to try and break sulfation crystal connections and get low VDC batteries to start charging. Hook up sequence.

1. Pos lead on good battery
2. Pos lead on Bad or depleted Battery
3. Neg lead on good battery
4. **Last: Neg lead on bad or depleted battery. If you observe significant sparking immediately stop and tag battery as bad / unserviceable.**

# Batteries Dismounted – Charging with the Pallet, Pro-PC, or Dual 12V Chargers

11. Hook the Pallet, Pro-PC or Dual 12V lead to the discharged battery that is paralleled with the good battery. See example at right.

Does charger engage battery and start charging?

NO

1<sup>st</sup> Attempt. Check connections and cables. Wiggle connections to ensure good contact, then try again. Does charger engage now?

YES

NO

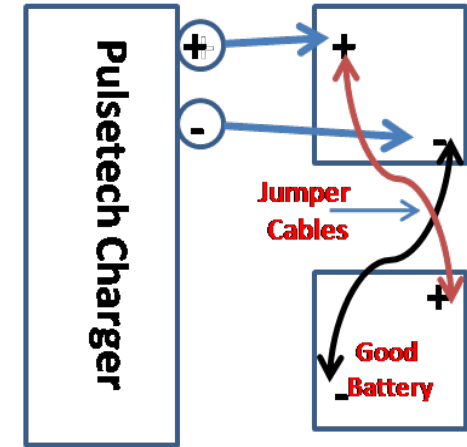
12. Let charger run for a few seconds and disconnect the negative jumper cable lead on the good battery. This may take several attempts. If after several attempts it does not work the battery may be unserviceable. Did the charger stay engaged with the low VDC or discharged battery when the jump battery is disconnected?

YES

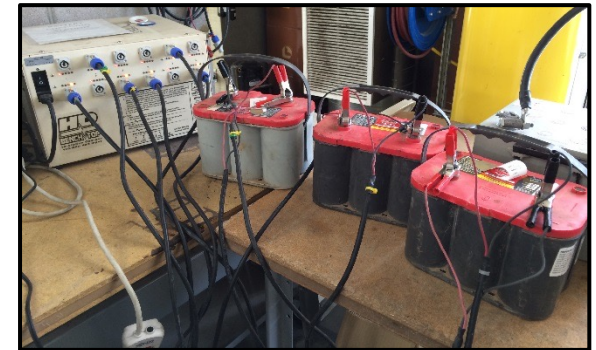
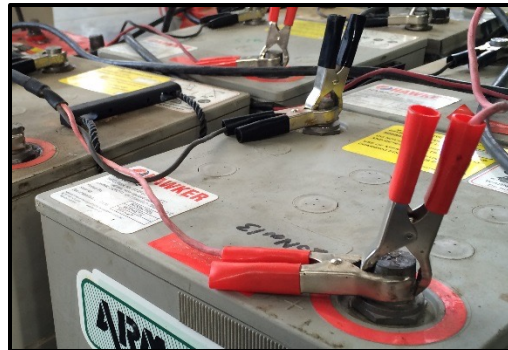
Now connect a second set of charging leads to the depleted battery. **DO NOT ATTEMPT THIS WITH A NON-PULSTECH CHARGER.** See examples at right.

Go to back to step 2, page 18.

## Batteries in Parallel



Connect charger to good jump battery and turn on. If the channel engages the jump battery the charger is working correctly. Next check the jumper cables to ensure they are serviceable. If these are good, the battery is bad and should be turned in as unserviceable.



Examples: Left pic: Double leads hooked up to one battery. Right pic: Bench top with dual leads going to 3 batteries. These systems have individual channels that are controlled by microprocessors and can effectively double the charge amperage when this is done. **Again...this can only be done with PulseTech Pallet, Pro-PC or Dual 12V Chargers.**

**END – Batteries Dismounted Charging with the Pallet Charger.**

# Batteries Dismounted – Charging with the World Charger

1. Take World Charger clamps and hook to depleted battery.  
Turn on Charger.  
Did the charger engage the battery?

YES

NO

2. Allow charger to run thru charge cycle.  
After charge cycle is complete the 100% charge complete light will illuminate.  
Note: 100% light illuminated **does not** always mean charge cycle has completed successfully. It is rather an indicator that you should now check the condition of the battery.

Jump battery to get charge started.  
Note: PulseTech chargers are extremely safe systems. However, precautions should be taken when jumping one battery to the next. Follow the steps on page 21 and 22.



Example: World Charger charging a 12V battery.

3. Initial test;  
Test battery with conductance tester.  
What does the conductance tester read?

GOOD & PASS #4

CHARGE & RETEST #4

Bad Battery  
Go to Next Page

Run battery through another charge cycle. This may take multiple times for a highly sulfated, severely discharged battery. Some batteries may take quite sometime to recover, even several days for a severely discharged 6TAGM.  
**If after charge you receive a bad battery reading on the conductance tester, or the battery reaches a level of charge below it's rated capacity and stops gaining charge turn in as unserviceable.**

4. Tester reads good, or good and pass.  
Has battery reached rated VDC and CCAs?

YES

NO

5. Allow battery to sit a **minimum of 4 hours (preferably 24hrs)** and retest.  
Does battery still read good VDC and at or near rated CCAs?

YES

6. **Good battery.**  
Place on shop stock or reissue.

## Batteries Dismounted – Charging with the World Charger

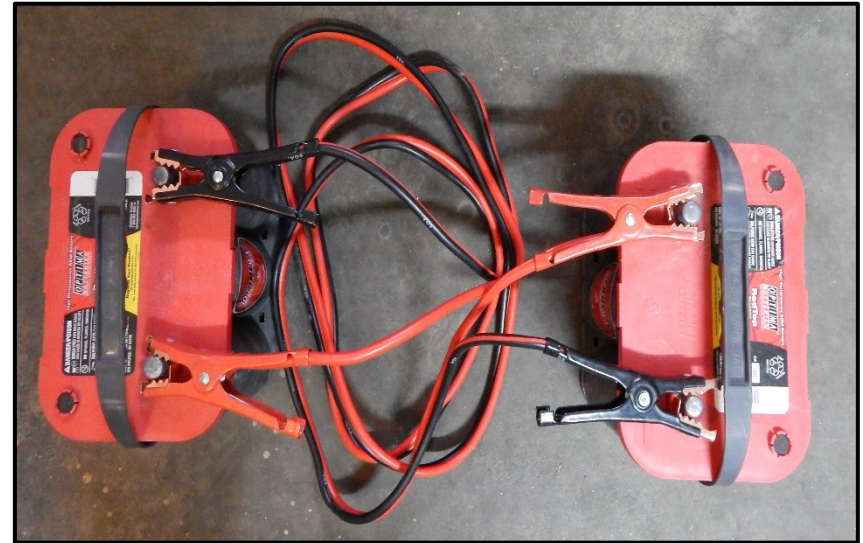
7. The world charger can push higher amperage (20) and has been proven to recover low VDC and highly sulfated batteries.

8. Find a battery that the charger starts to charge. When using the Pro HD it is suggested that you find a battery that is absorbing 30+ amps if possible.

9. Parallel the discharged battery to the good battery. See example at right. Note hook up sequence under pic. Ensure this is done in a well ventilated area. Some small sparking can or may normally occur. If you have significant sparking when hooking up the last neg lead on the discharged battery abort attempt.

Goto next page.

Note: The Optima family, the 6TAGM (Hawker, Exide and Batcore), and new Gil / Teledyne 24Vdc VRLA batteries have proven to be very recoverable, and rechargeable multiple times from extreme discharge.



Example: Paralleled batteries. This can be used to try and break sulfation crystal connections and get low Vdc batteries to start charging. Hook up sequence.

1. Pos lead on good battery
2. Pos lead on Bad or depleted Battery
3. Neg lead on good battery
4. Last: Neg lead on bad or depleted battery. If you observe significant sparking immediately stop and tag battery as bad / unserviceable.

# Batteries Dismounted – Charging with the World Charger

10. Hook the World Charger to the discharged battery that is paralleled with the good battery. See example below.

11. Turn on Charger. Does charger engage battery and start charging?

NO

1<sup>st</sup> Attempt. Check connections and cables. Wiggle connections to ensure good contact, then try again. Does charger engage now?

NO

Connect charger to good jump battery and turn on. If the system engages the jump battery the charger is working correctly. Next check the jumper cables to ensure they are serviceable. If these are good, the battery is bad and should be turned in as unserviceable.

YES

12. Let charger run for 5 minutes with the batteries paralleled. After 5 minutes disconnect the negative jumper cable lead on the good battery. Did the charger stay engaged with the low VDC or discharged battery when the jump battery is disconnected?

YES

YES

Go back to #2 Page 20

**END – Charging with World Charger**



Example: World Charger connected to depleted battery, which is paralleled to a good battery. Because this charger is capable of a 20 Amp output you can charge multiple batteries at once if needed.

# Charging 24V Batteries with the Dual 24V Charger

1. Take the Dual 24 Charger clamps and hook them to depleted 24V batteries, or 2 smaller 12 V batteries in series. Turn on Charger. Did the charger engage the batteries?

YES

2. Allow charger to run thru charge cycle. After charge cycle is complete the 100% charge complete light will illuminate. Note: 100% light illuminated **does not** always mean charge cycle has completed successfully. It is rather an indicator that you should now check the condition of the battery.

3. Initial test; Test battery voltage with multimeter. Is battery voltage above 24V? If charging 2 - 12V batteries in parallel test each battery separately (see page 13).

Battery OCV

Good

Bad

4. Allow battery to sit a **minimum of 4 hours (preferably 24hrs)** and retest. Does battery still read good VDC?

YES

5. **Good battery.**  
Place on shop stock or reissue.

NO

Ensure the 24V battery or 2 twelve V batteries in series have at least 6VDC. If below 6V parallel another like battery to get the VDC up above 6V. Note: PulseTech chargers are extremely safe systems. However, precautions should be taken when jumping one battery to another. Once above 6V retry to engage battery with Dual 24V charger.

Run battery through another charge cycle (step 2 above). This may take multiple times for a highly sulfated, severely discharged battery. **If after charge you do not see significant OCV increase or receive a bad battery reading on the conductance tester (12V battery test), or the battery reaches a level of charge below it's rated capacity and stops gaining charge turn in as unserviceable.**



Example: Dual 24V Charger charging a couple 24V AGM batteries.



Example: Dual 24V Charger charging a 24V AGM battery and 2 - 12V batteries in series.



# Pro12 – Maintaining new or reconditioned 12V batteries

1. The Pro12 is an easy to use battery maintainer. This system is designed to maintain new or reconditioned 12V batteries that are dismantled from equipment.

2. Hook the lead of the Pro12 to up to 12 batteries at once. Keep in mind it will only engage 12 V batteries.

3. Power on system. Plug into AC power, either 110 or 220V. Then push the power button once. The system should turn on and begin cycling through channels.



Red power / reset switch on bottom of Pro12.

4. The system will now cycle through each battery connected. Check LED lights.

Green Light

**Green Light:** Battery is charged and ready for issue when needed. No further action required at this time.

Yellow Light

**Yellow Light:** Battery is marginally charged. You can run it on the Pro12 for a while or even days. However, if the battery light indicator does not reach green or goes red the battery will need to be charged on a regular charger for a while and then place back on the Pro12.

RED Light

**RED Light:** Battery is discharged. Charge battery on a regular charger and then place back on the Pro12.



Example: Pro12 maintaining reconditioned batteries.