阀 控 铅 酸 电 池

20 至 200 安培小时容量

MPS 及 UPS电池定期保养说明书

目录

VRLA 电池系统
定期保养及检修指南

总　资　料

本小册系为 20 至 200 安培小时容量 Liberty VRLA 电池的定期保养和故障检修提供指南。

其他可和本指南结合应用的说明小册有:

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MPS 及 UPS 系列阀控式密封铅酸蓄电池（VRLA）系统总说明

这一电池系统通常是一组 2 伏的电池室或 6, 10 或 12 伏电池串联成一个提供较高电压的系统. 例如, 如图 1 所示,四只标称 12 伏的电池 可以串联而成为有 48 伏标称电压的一个 24 室的系统。

多列串联的电池可以并联成为一个容量等于各单列容量总和的总系统。例如图 2 所示，两个各为 48 伏 90 安培小时

容量的串联能够并联而提供 180 安培小时的 48 伏。

Liberty 品牌的 MPS 及 UPS 系列电池是一种利用氧再化合循环的铅酸电池。主要成功之处是减少了电解液生成气体而造成的水分损失。电解液吸附在极板间的吸水间隔板内而不再流动。其结果是电池不再需要加水，对于电解液的保养——也就是没有加水的要求和空间，更不要逐室测量电解液比量。

VRLA 电池安全问题

VRLA 电池的保养和服务需要熟悉铅酸电池知识、人身安全要求和设备安全知识的人员进行实施和监督。非专职人员必须远离电池和保养活动。

电气事故

电池系统有电击和高短路电流的危险。保养 VRLA 电池的必须注意下列告诫：

1、去除一切个人金属物件 （手表，戒子等）。

2、应用绝缘工具。

3、穿戴全套眼镜和橡皮手套。

4、注意电路极性。

5、不要连接或断开带电电路。

6、把电池搬上金属架上时，先用接地故障探测指示器检查，保证电池没有接地的疑虑。没有此指示器时，可测量电池与架之间的电压是否为零。若不，即须在进行其

他操作前探明其原因并完成纠正。

7、电池上面不可放置金属工具及硬件。

8、在进行人身或设备会接触带电导体的保养时 ,应尽可能用绝缘毯子覆盖电池系统暴露部分。

用于 VRLA 电池充电的某些类型整流器电路可能没有外线绝缘变压器。在电池系统上进行保养和收集数据时便必须特别小心。

VRLA 电池有时装在出入不便的箱内。同样，在电池系统上进行保养和收集数据时必须特别小心。

处理回收

用过的铅酸电池是要回收利用的。电池里装有铅和稀硫酸。处理时必须按照当地政府的规定。不要置于地面、湖泊或其他非特许的地方。

化学事故

VRLA 电池里溢出的任何液体都是含有稀硫酸的电解液，会伤害皮肤和眼睛，能导电，有腐蚀性。

皮肤如果接触了电解液，应立刻用水彻底冲洗，电解液如果进入眼睛须用清水彻底清洗 10 分钟或用特殊的中和性洗眼液，并立刻就医照料。

任何溅出的电解液该用“溅液包”里的特殊溶液或 1 磅(约 0.454 公斤）重碳酸钠加 1 加仑水(约 4.5 升)的溶液予以中和。

火灾、爆炸和热事故

铅酸电池在过度充电时可能溢出含氢的爆炸性气体。

电池附近不要吸烟或带来火星。

搬动电池之前先触碰一下一个接地的金属物体，释放掉可能在人身上存在的静电荷。

不要在密封容器里给电池充电。各电池之间要留 0.5 英寸(5~10mm)间隔供对流冷却。如果是装在箱里的，木箱和房间必须适当通风防止可能排出的气体累积。

告诫

切不可拆卸 Liberty VRLA 电池的排气阀或加水。这很不安全并将使保证失效。

VRLA 电池定期保养的准备

为了最佳的可靠性，推荐每季度检查一次电池系统。如果电池系统已安装收集电气和环境数据的自动监控系统，那么季度检查可只限于评价记录数据和目视检查电池。

一般，定期保养中须检查的项目有：

系统充电电压

环境温度

电池控制装置的温度

装置间连接件的电阻和松紧度

单只电池的浮充电压

瞬间高放电率负载试验

电池系统容量试验

对各只电池的电阻，阻抗或导电性的实验，尽管是任选的仍然值得推荐作为定期保养的基础。这数据及其趋势对系统的故障检修有巨大帮助，还可确定是否需要进行系统容量实验。

开始定期保养活动之前保证所有要求的保养工具、设备和安全措施齐全无缺和功能正常。通知每一个将参与保养或维修活动的人员。

还要，给电池里所有单元都编号以便进行专对该单元的记录和数据分析。

要求的保养工具和设备

VRLA 电池的维护和故障检修至少要求有下列工具和设备：

1、数字伏特计

2、套筒扳手，绝缘

3、活络扳手，绝缘

4、扭矩扳手，时磅计

5、橡皮手套

6、全套面罩

7、塑料围裙

8、便携眼药水

9、灭火器（C 级）

下列为根据进行保养类型而选用的设备。

1、毫欧计

2、电池电阻，阻抗或导电率试验组件

3、100 安培瞬时负载试验组件

4、系统负载组（直流负载在电池上进行，交流负载用一个 UPS 输出进行）

季度保养

每季度必须完成下列检查。

1、保证电池房清洁，无垃圾及光照良好。

2、保证所有应用的安全设备无缺并功能正常。

3、测量和记录电池房内空气温度。

4、目视检查电池：

a、清洁度

b、端子的损坏或发热痕迹

c、外壳或盖的损坏

d、过热痕迹

5、在电池上测量和记录电池系统直流浮充电电压。此时也可任选测量和记录交流纹波电压。

6、测量电池每个极性对地的直流电压以探测接地故障。

7、若有可能，测量和记录电池系统直流和交流浮充电流。

8、测量和记录电池控制设备的温度。探测电池侧面中心部位或电池负极端子的温度。

9、测量和记录各单元直流浮充电压。

10、测量和记录系统平衡电压。

半年保养

1、重复各项季度检查。

2、随机测量和记录各单元的电阻、阻抗和电导以分析个别单元发展趋势和探测个别单元与正常单元之间异常情况。

年度保养

1、重复半年度的所有检查。

2、重新拧紧所有单元间的连接硬件至表二上的值。如果已进行连接电阻测量并没有发现超过原始安装时值 20%，这项可以省略。

两年保养

此电池每两年必须进行一次负载下的电池容量试验，或进行服务设备要求下的电池放电率试验。最理想的是和原始安装时验收试验的结果相同。一旦发现电池已达 85%定额便必须进行每年的容量实验。容量试验的说明资料为《容量试验》。

数据分析和纠正行动

定期保养活动中累积的数据须记录在附表 1 所示的表格

里。下文说明如何解释数据和采取纠正行动。但本说明并不是包罗无遗的，分析和纠正行动的决策更必须由熟悉 VRLA 电池及其操作和故障情况的人员来做。

环境及电池温度

VRLA 电池虽在极端温度下也能工作，但标准数据是 77°F（25°C）时测量结果。理想的操作温度范围是 70°F（21°C）至 80°F（27°C）。在较冷温度下操作会减少预期备用操作时间，在较暖温度下操作则会缩短电池寿命和增加热失控状态的可能。

高出 77°F（25°C）每 18°F（10°C）就会缩短电池 50% 的寿命。室内温度过高必须用适当的通风和空气调节机来纠正。

超过 122°F（50°）的温度下 VRLA 电池切不可充电，这会造成热失控。

串列里的各电池都不得超过环境温度 18°F（10°C）以上。如果串列里个别单元温度特别高，该单元就可能遭到热失控。这种场合，充电电流应立即终止，找出事态根源进行纠正。

如果发生了热失控，电池系统便须进行容量实验，必要时予以更换。

电池目视检验

<u>溶液清洁度</u>

每只电池的清洁和正确间距至为重要。盖子上累积污垢、尘埃和水分能形成导电途径而产生端子之间短路或接地故障。

电池清洁时应置于开路位置。清洁用布浸重碳酸钠水溶液，不要用清洗窗子或玻璃清洁剂。用某些石油清洁剂可能损坏电池塑料容器，造成破碎和龟裂。

端子

弯曲或损坏的端子能产生高的接触电阻或产生负载下会熔断的裂纹。损坏了端子的电池必须调换。

如果保护油脂在端子上已经熔化而流到盖子上，这是连接发热的指示，这就很可能是连接的松动或高电阻。这时就须拆下连接件，检查损坏情况，清除后再正确安装。

电池系统浮充电电压

比重 1.280 至 1.300 的 VRLA 电池的推荐电池系统浮充电电压等于系统内电池室数乘以 77°F（25°）时，每室 2.25 至 2.30 伏的范围，例如，一个 30 只每只 12 伏（6 单元）电池的串列，77°F（25°）时浮动充电范围应是 405 至 414VDC（180 单元 2.25V/℃ 最小及 180 单元 2.30V/℃ 最大）。

遇到极端温度时浮充电电压须有温度补偿。温度补偿系数是华氏每度为-0.0028V/F°（摄氏每度为-0.005V/C°）。

例如，电池正常温度为 90°F（高出 77°F13°F）时，平均浮充电电压便必须降低 0.036V/℃（13°F 每°F 的 0.0028V/F°）至 2.21-2.26 之间的范围。在有 180 个单元的电池这便是

397.8-408.6VDC。这就能有效地减少升温时热失控的可能。

电池在 冷”温度下操作时 ,例如 60°F(比 77°F 低 17°F) ,充电电压便须增加且改进充电时间。例如，充电范围可能增加每度-17°F -0.0028V/˚F 或 0.048V/˚C。那么 180 单元的串列上将是 413.6 至 422.6VDC。

如果一只电池经多次放电而原就充电不足，它在每次放电后不能重新充足。而容量逐步降低。这情况可用延长的均衡充电（例如 48 至 72 小时）予以纠正。但是这情况如果持续太久，极板可能出现不可逆转的硫酸化作用而必须换掉。

延长的过度充电会造成更多的浮充电流，极板格栅腐蚀，一定数量电解液生成气体后而变干涸。导致电池过早老化和容量损失。

延长期间严重的过度充电能引起热失控状态，更必须调换电池系统。

在测量电池系统直流浮充电压时可顺便测量电池系统两端的交流纹波电压。如果交流纹波是正弦波形，其最大读数应是小于直流浮电压 0.5%Vrms。例如,直流浮充电压为 414VDC 的 180 单元串列便是 2.07Vrms。用示波器测量纹波时，若浮充电压是在 414VDC，那么最大 P--P 值应是浮充电压的 1.5%,即 6.2V(P—P)。

电池上过大的交流纹波电压会造成电池产生气体和发热，可缩短寿命。

电池系统接地故障探测

如果电池充电用的整流器具备接地故障探测能力，即应经常留意其指示器以确保系统安全。一旦探测到故障，在电池系统作进一步保养之前，先予断开和纠正。

如果整流器没有接地故障探测电路，可以用数字伏特计测量电池电极和地线（接地架或房间）间的电压。若测有电压则说明电池至地线有短路或有漏电流，有接地故障的电池单元 的大约位置是从系统输出端起测量得的电压除以平均每一电池单元充电电压的值。例如 ,测得至地的电压为 135VDC，充电电压为 2.25V/C，那么，接地故障大约在从电池系统输出端起的第 60 只电池单元（10 个 12 伏单元）。

电池系统浮充电流

如果能测得直流浮充电流，它就能指示出电池系统的正常电流接收能力的大小。根据每一串列充电电压和温度，每一串列的浮电流将大致如图 3 所示。77°F（25°C）时，温度每升 18°F（10°C），浮充电流大约增大一倍。

如果直流浮充电流是零，这是电池串列里有了开路，如果浮充电流高出预期值，则可能是电池温度升高了或串列里有短路单元。无论是那一种情况，均应予以确定和纠正，因为温度升高和单元短路都会导致热失控。

单只电池的浮充电压

电池串列以平均每室 2.25--2.30 伏充电时，并不是所有的单元都在准确的平均电压上浮充，每个单元的阻抗和氧再化

合率均略有不同，所以在同样的浮充电流下会出现稍有不同的浮充电压。例如，所有在用每单元 2.30 伏充电的一串列 12 伏的电池并没有在 13.9 伏直流上浮置而在 13.3--14.5 之间变动，这仍然是正常的，一个系统如果在安装时平衡了 24 小时，或服役了较长时间，这一浮电压的分布一般会有减小。

表 1 中提到的直流浮充电压是指一个串联串列里电池两端测得的最小和最大直流浮充电压。如有个别电池测得值过低，可能是有了短路的单元。如果有个别单元测得值过高，这可能是某个室内电阻增加的指示。如果有个别单元测得浮充电压极高而该串列里各单元平衡指示接近开路值，此高电压的单元可能已经开路。

串列里短路的室会导致高电压加到串列里其余良好的单元上，并出现较高电流。例如，一 24 单元的串列以 55.2VDC 充电，其中有 2 个短路单元，其余 22 个单元便将以 2.5V/C（55.2VDC/22 单元）充电，并导致电流增加，无疑最终会造成热失控。

里面有短路或开路单元的电池，一般可以通过比较各个单元的阻抗，或比较各个单元二端测得的交流纹波电压来予以确定。

不要对怀疑有短路或开路单元的电池进行高放电率负载试验，这是很危险的，单元内部火花会引燃内部气体。

对怀疑有短路或开路的室的电池只有立即拆下更换。

有关单只电池浮充电压测量和说明的其他资料，请参阅小册《综合试验》。

高放电率瞬时负载试验

高放电率瞬时负载试验是串联串列里单只电池的功能试验，这不能代替容量试验，但至少能够指示电池在达到试验负载的安培容量时是否功能正常。用于 20 至 200 安培范围里的电池的典型负载为 100 安培。施加试验负载后 10 秒钟，单元的电压应该是平均至少 1.7V/C（在 12、10、6 伏电池上分别为 10.2、8.5、和 5.1VDC）,否则电池即应被怀疑为有短路，开路，已放电或者极高电阻及低容量。

对怀疑有短路或开路单元的电池切不可进行高放电率瞬时负载试验。作这项试验必须戴全套面罩，因为单元内部的一个火花会引燃电池内的剩余气体。

有关本试验及按电池型号期望的最低电压的其他资料均在小册《综合试验》内。

阻抗试验

VRLA 电池一般的报废情况是极板格栅腐蚀，极板活性材料劣化和电解液有些干涸。不寻常的报废情况是导电途径劣化和电解液过度干涸。这些情况都会影响的各单元和增加各单元的电阻，定期测量阻抗及各单元电阻和电导的数据。就能指示串联系列的全面逐步劣化和容量损失的趋势。其发展见图 4。

个别单元里急剧的改变可能表明有短路、开路，单元内干涸和有的单元导电途径劣化。

一串列电池二端出现的交流纹波电压可以按串列内各个单元两端的相对电阻按比例再分割。所以在没有阻抗、电阻或电导试验设备时，可以用数字伏特计测量各个单元两端的交流纹波电压后相互比较并与平均标准值做比较，即可得到他们的相对值和所处状态。

如果电池电阻比新的时候增加了 30%，该电池便应该再作试验以确定其原因，必要时，可对该电池或系统进行容量试验以保证其可靠性。

有关这一问题更详细的信息请参阅《阻抗和导电试验》小册。

单元间连接电阻

若存在高的单元间连接电阻及硬件连接松动，放电时产生过大的电压降以致减少供电时间，严重时造成电池端子熔化和火灾发生。

所有连接的接触面必须刷干净，去除一切氧化铅和污物，再用特种防氧化油脂保护和拧紧。

连接硬件可能因时间和电池系统重复循环而有些松动。所以要重新拧紧达到有关数据表所载，用于该型号电池的数据，表 2 列具电池端子类型和推荐扭矩值。

性能和容量试验

电池劣化到定额容量的 80%时必须换掉，也就是如果一个电池系统新的时候能够供电 100 安培一个小时，到后来同样一个小时只能供电 80 安时便必须换掉了。如果 100 安培是实际负载而且必须供电至少一个小时，那么电池新的时候必须是原设计能供电 125 安培一个小时的。在原先设计电池时这个 1.25 的因子就称为老化因子。

电池容量降到定额的 80%是指极板格栅已经腐蚀和膨胀，极板活性材料已经劣化电解液已经开始干涸。此时，电池容量下降,就该退出服务。

当然，电池调换还有其他原因，譬如，不再支持负载最小的要求时间－－即使电池仍有大于 80%的定额。还有，电池到达定额的 80%这一点时，即使是最小的负载，电池也不应继续工作。

VRLA 电池各项数据是在 77°F（25°C）的值。重要的是要知道在较低温度下操作当然不会损坏电池，但工作时间会减少，随温度降低的性能下降因素备载小册《容量试验》。

在较高温度下连续工作会使电池加速老化，比 77°F（25°C）每高出 18°F（10°C）电池老化就会比正常快一倍。这一问题的详细资料备载小册《预期寿命和温度》。

VRLA 电池定期保养摘要

VRLA 电池仅电解液方面不需要保养。但为了保证电池的可靠性，进行推荐的定期保养仍十分重要。推荐的定期保养

无论是通过手工操作抑或自动监控系统都是旨在确定系统容量的劣化程度、探测能影响系统可靠性的其他因素或个别电池的任何异常情况。

表 1　VRLA 电池的症候和解决

症候	可能原因	可能后果	纠正行动
容量试验结果			
77°F 时减少操作时间并有平稳的电压下降	正常用旧	终至不能支持负载，随后有室短路危险	到达 80%额定容量时或提前换掉电池系统
77°F 时，操作时间减少并有电压分步下降或电压平台	有个别低容量室	放电时有反相电池单元－－反相的单元变得极烫而且不能再充满	换掉隔离出的低容量电池
开始放电时电压下跌过多，甚至在开始数秒钟已跌破最低电压限度	电池太冷		加热电池
	电缆太小	过大电压降	加并联电缆
	高电阻连接	过大电压降	清洗及再安装连接
	电池定额容量太小		增加要求的并联串列
	短路单元	单元变热,会发展至热失控;内部火花会导致爆炸	换掉短路故障单元并评价整个串列
温度检查			
室温升高	缺少适当的空	减少电池寿命	冷却室温或接

	气调节/通风系统		受电池寿命的减少的现实
电池温度升高	室温升高	减少寿命及可能热失控	改善室内空调
	电池箱通风不良	减少寿命及可能热失控	改善电池箱通风系统
	放电－－充电循环	若不超过 18°F (10°C) 则正常	限制再充电电流
高电流充电	高充电电压	这一合成现象能导致热失控	限制充再充电电流
			减到规格以内
	短路电池单元		换掉短路电池及评估串列
电池外观检查			
上盖/容器碎裂	运输或撞击损坏	单元干涸或接地故障,内部气体引燃造成危险	换掉损坏单元
盖/容器爆炸	电池内导电路径熔化或单元内短路产生的火花点燃电池内部,因外来原因所积累的	爆炸时造成人员伤害和设备损坏；不能支持负载	调换损坏单元和评估串列的平衡

	气体.此可发生于电池保养不良或电池寿命完结后继续使用.		
外壳有烧焦的地方	容器碎裂电解液露至接地架等,接地故障	坐架带电等会造成人身伤害	清除接地故障和换掉失效单元,评估串列平衡
		能造成冒烟或电池着火	
		能造成热失控	
外壳永久性变形(肿胀)	可能由于高温度环境，过度充电,过大再充电电流，短路单元，接地故障或上列事项的组合所造成的温度失控.	可能造成释放腐蛋臭的硫化氢，电池着火和不能支持负载	换掉电池系统和纠正导致热失控的环境条件
腐蛋臭	可能原因有高环境温度，过度充电，过高充电电流，短路单元，接地故障，或以上	臭味是热失控延长的产物	换掉电池系统,纠正导致热失控的项目

	项目的合并		
端子上有熔化的油脂	可能是因为连接松动或由于脏的接触面，或因连接处腐蚀造成的高电阻是接触处发热。	过大电压降可能会缩短操作时间或损坏端子	如果连接损坏,清洁和重新组装
		严重时会使端子熔融和引燃电池盖	换掉任何端子损坏的电池
端子上有腐蚀	可能因为制造时残留电解液或电池端子密封漏出的电解液侵蚀了单元间的连接	增加接触电阻使高速放电时增加接头发热及加大电压降	拆下连接,清洁连接面、端子区并密封涂上抗氧化油再妥善安装. 如果端子区渗漏明显,则必须换掉电池
直流电压检查			
77°F(25°C)时系统浮置电压平均大于2.3V/单格	充电器输出设定不正确	过度充电会导致产气过多和电解液干涸以至发生热失控的危险	再调整充电机输出至推荐值
77°F(25°C)时系统浮置电压平均小于2.25V/单格	充电机输出设定不正确	充电不足会造成其后充电循环时工作时间减少和容量逐	重新调整充电机输出电压到推荐值. 将电池系统均衡充

		渐丧失．若任其发展，极板上便会生成不可逆转的硫酸铅造成容量永远丧失	电48至72小时及进行容量试验．如果容量丧失是永久性的，即须调换整个电池系统
系统均衡电压大于平均2.4V/C	充电机均衡充电电压调整不正确	过度充电会导致产气过多和电解液干涸以至发生热失控	重新调整充电机输出电压到推荐值
系统均衡电压小于平均2.4V/C	充电机均衡充电电压调整不正确	均衡和增压充电效果不大并且将要求延长时间	尽可能再调整充电机输出电压至推荐值或许可较长均衡充电时间
个别电池浮充电压小于平均2.2V/C；（6室电池为13.3VDC；5室电池为11.1VDC；3室电池为6.6VDC）	可能有个别电池短路，这可用检查阻抗或电导来证实	负载下操作时间缩短．浮充电流增加，放电时单元发热，潜在热失控危机.	调换个别电池
个别电池浮充	可能个别电池	无法支持负	换掉个别电池

电压大于平均2.42V/C; 6室电池为14.5VDC; 5室电池为12.1VDC; 3室电池为7.3VDC	存在开路单元.这可凭检查(零)浮充电电流或检查电池的电阻(很高)来证实	载，能造成引燃室内气体的内部电弧	
电池系统输出端子与地(架)之间测得有电压或自动监控设备接地故障指示有故障	电池容器损坏使电解液漏到接地表面(架)上	人员电击事故.可造成严重伤害或致命 容器损坏处可能着火,或电池燃烧	查明接地故障的源头及调换电池
交流纹波电压检查			
系统上的交流纹波(峰一峰)电压大于直流浮充电压值4%	充电机输出滤波不良	过大交流纹波会使电池以纹波频率循环,导致发热和极板活性材料劣化	改善充电机输出滤波
串列里个别电池出现交流纹	电池有了高交流纹波电压，	缩短操作时间	检验电池状态并按要求换掉

波电压二倍于串列里其他典型电池	便会有成比例的高阻抗，这须再作性能评价.这类电池可能有了劣化的导电通道或有干涸、短路或开路的单元	存在导致热失控的潜在危机	
浮充电流检查			
整串列的浮充电流为零	串列里有电池或连接断开,这可借检查浮充电压或交流纹波电压或检查个别电池阻抗予以确证	不能支持负载.放电时如果有内部电弧便会引燃电池室内气体.	调换有开路单元的电池或修理该断开(或松动)的外部连接
		如果电池外接线有断开/松动,在负载下便会损坏端子	
77°F(25°C)浮充电压下浮充电流超过额定容量每安培小时 3.0 毫安	电池还没有重新充满	电池不在 100%的容量范围	确定各项原因并采取必要行动
	电池温度高于 77°F(25°C)	导致热失控	

	电池里有短路单元	导致热失控	
	根据其程度，电池正在进入或已经热失控	热失控的最后结果是电池熔融和放出硫化氢及火灾	
10 秒高放电负载测试			
端子电压恰好低于 10 秒点规定的最小电压	电池可能未充满或电池容量略有下降	会减少操作时间	将电池充满
端子电压明显低于 10 秒点规定的最小电压	电池已经放电或导电通道、极板格栅、活性材料或电解液劣化	减少操作时间	充电及再测试电池或按要求调换
	单元短路	导致热失控	
	单元开路	不能支持负载	
电池阻抗/电导试验			
阻抗/电阻增加到新时原始值的 50%或导电性降至新装值的 50%	电池已放电或电池导电途径、极板格栅、活性材料，电解液容量劣化	减少操作时间	充电并再测试电池或按要求调换
	单元短路	导致热失控	

	单元开路	不能支持负载	
连接硬件电阻紧密度检查			
连接电阻较原阻值（安装初始值）增加20%	连接外忽冷忽热，以致扭矩松脱及连接电阻增加	松动的连接会造成热损坏或熔融于大电流放电时	按要求重新拧紧连接
	连接里的污染会导致腐蚀和端子高电阻	大电流放电时过大的电压降,造成操作时间减缩	纠正污染源,清除接触面区域,用抗氧化油脂涂接触面再组装
连接硬件的紧密度小于规定的“扭矩”值	反复充放电循环造成连接的忽冷忽热使连接松脱,电阻增大	在高放电时,松动的连接能使端子发热损坏甚至溶解	按要求再拧紧连接

LIBERTY™

免维护阀控式铅酸蓄电池（26至200安培小时容量）
Valve Regulated Lead Acid Battery (26 To 200 AMPERE-HOURS CAPACITY)

MPS12-XXX系列
UPS12-XXX系列

用 户 手 册
Maintenance Instructions

DYNASTY DIVISION
C&D TECHNOLOGIES, INC.

上海西恩迪蓄电池有限公司(中美合资)
SHANGHAI C&D BATTERY COMPANY LIMITED

地址：中国上海浦东新区北蔡安建路 100 号
Add: 100Anjian Road, Beicai
Pudong New Area Shanghai 201204
People's Republic of China

Telphone(电话)：021-58911160/11162 ext. 115
Special Hot Line(询问热线)：021-58446046
Fascimile(传真)：021－58955435

Office(办事处)

Beijing Office(北京办事处)：
Telphone（电话）：010-68945751
Fascimile（传真）：010-68498637

Guangzhou Office(广州办事处)：
Telphone/Fascimile（电话/传真）：020-38807269
Telphone（电话）：020-38807168＊24181

Chengdu Office(成都办事处)：
Telphone（电话）：028-6528920
Fascimile（传真）：028-6528930

Table of Contents

DYNASTY VRLA BATTERY SYSTEM

PERIODIC MAINTENANCE AND TROUBLESHOOTING GUIDE

General Information

This pamphlet provides a guide for use during periodic maintenance and troubleshooting of the LIBERTY VRLA batteries of 20 through 200 ampere hours capacity.

Other instructional pamphlets which can be used in conjunction with this guide include:
1.Integrity Testing 41—7264
2.Impedance and Conductance Testing 41--7271
3.Acceptance and Capacity Testing 41—7135

C&D LIBERTY VRLA
Battery System General Description

In general the battery system is a group of 2 bolt cells of 6, 10 of 12 volt batteries connected in a series string to provide a total system of higher voltage. For example , as shown in Figure 1, four of the nominal 12 volt batteries may be connected in series to provide a 24 cell system with a nominal ıf 48 volts.

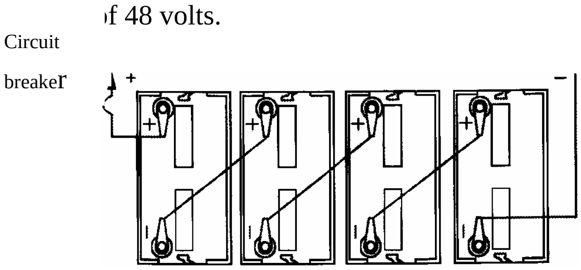


Figure 1-Series Connected String of Batteries

Multiple strings of the series connected batteries may be connected in parallel to provide a total system with a capacity of the sum of the capacities of the individual strings. For example , as shown in Figure 2 , two each 48 volt 90 ampere hour capacity strings can be connected in

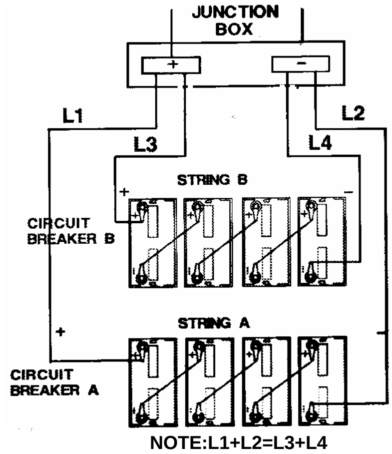


Figure 2-Parad **Stings** of Batteries

The LIBERTY VRLA battery is a lead acid battery which facilitates an oxygen recombination cycle. The net result is that under normal conditions there is minimal gas emission and loss of water from the electrolyte is immobilized in either a gel form or is absorbed separator between the plates. Consequently , the battery is maintenance free in terms of electrolyte maintenance-that is, there is no requirement nor capacity to add water to the cells or to measure the electrolyte specific gravity.

VRLA Battery Safety Concerns

Maintenance and servicing of the LIBERTY VRLA battery should only be performed and supervised by personnel knowledgeable of lead acid batteries and required personal safety and equipment safety precautions. Keep unauthorized personnel away from the batteries and maintenance activities.

Electrical hazards

Battery systems present a risk of electrical shock and high short circuit currents. The following precautions should be observed when maintaining VRLA batteries:

1. Remove all personal metal objects (watches, strings, etc.)
2. Use insulated tools
3 Wear full eye protection and rubber gloves.
4. Observe circuit polarities.
5. Do not make or break live circuits.
6. Prior to handling batteries on a metal rack, assure the battery is not inadvertently grounded by observing the ground fault detector indicator. In its absence, measure the voltage between the battery and the rack. It should be zero. If not, determine the cause and correct prior to proceeding.
7. Do Not lay metal tools and hardware on top of the batteries.
8. As appropriate, use an insulating blanket to cover exposed portions of the battery system when performing extended maintenance that could result in personal or equipment contact with the energized conductors.

Certain types of rectifier circuits used in charging the VRLA battery may not include a line isolating transformer. In these cases extreme caution should be exercised when maintaining and collecting data on the battery system.

The VRLA battery is sometimes enclosed in cabinets with very limited access. Again ,extreme caution must be exercised when maintaining and collecting data on the battery system.

Disposa

Lead acid batteries are to be recycled. Batteries contain lead and dilute sulfuric acid. Dispose of in accordance with Federal , State and local regulations. Do not dispose of in a landfill, lake or other unauthorized location.

Chemical Hazards

Any gelled or liquid emissions from a VRLA battery is electrolyte which contains dilute sulfuric acid which is harmful to the skin and eyes; is electrically conductive; and is corrosive.

If electrolyte contacts the skin ,wash immediately and thoroughly with water. If electrolyte enters the eyes, wash thoroughly for 10 minutes with clean water or a special neutralizing eye wash solution and seek immediate medical attention.

Neutralize any spilled electrolyte with the special solutions contained in a “pill kit” or with a solution of 1 lb. bicarbonate of soda to 1 gallon of water.

Fire ,Explosion and Heat Hazards

Lead acid batteries can contain an explosive mixture of hydrogen gas which can vent under overcharging conditions.

Do not smoke or introduce sparks in the vicinity of the battery.

Prior to handling the batteries ,touch a grounded metal object, such as the rack ,to dissipate any static charge that may have developed on your body.

Do not charge batteries in a sealed container. The individual batteries should have 0. 5 inches of space between the batteries to allow for convection cooling. If contained, assure the container or cabinet and room have adequate ventilation to prevent an accumulation of potentially vented gas.

VRLA Battery

caution

Do not attempt to remove the vents(valves) from the LIBERTY VRLA battery or add water. This presents a safety hazard and voids the warranty.

Handling Hazards

The individual batteries may weigh from 25 to **100** pounds depending on part number. Exercise care when handling and moving batteries. Assure the use of appropriate handling equipment.

Preparation for VRLA Battery Periodic Maintenance

There is little difference between the periodic maintenance associated with a VRLA battery and a vented (wet) cell battery with the exception of that related to the liquid electrolyte. Naturally, it is not required to measure electrolyte specific gravity or add water to the VRLA cells.

For optimum reliability, it is recommended that the battery system be monitored quarterly. If the battery system incorporates an automatic monitoring system to gather the electrical and environmental data, the quarterly checks are limited to the evaluation of the recorded data and a visual check of the battery.

In general the types of checks to be made during the periodic maintenance include:

1. System charging voltage
2. Ambient temperature
3. Battery pilot unit temperatures
4. Interunit connection hardware resistance or tightness
5. Individual battery float voltage
6. Momentary high rate load test
7. Battery system capacity test

A test of the individual unit resistance, impedance or conductance, while optional, is also recommended on a periodic basis. This data and its trend can be a valuable aid in troubleshooting the system and predicting the need for a system capacity test.

Prior to starting the periodic maintenance activity assure that all required maintenance tools and equipment and safety equipment is available and functional. Notify anyone who will be affected by the intended maintenance or troubleshooting activity.

Also,all units in the battery should be numbered so as to facilitate the recording and analysis of data unique to each unit.

Required Maintenance Tools and Equipment

At a minimum, the following tools and equipment are required to maintain and troubleshoot the LIBERTY VRLA battery.

1. digital voltmeter
2. socket wrenches, insulated
3. box end wrenches ,insulated
4. torque wrench calibrated in in.-lbs.
5. rubber gloves
6. full face shield
7. plastic apron
8. potable eyewash
9. spill kit
10. fire extinguisher (class C)

The following equipment is optional depending on the type of maintenance to be performed.

1. micro-ohm meter
2. battery resistance, impedance or conductance test set
3. 100 amp momentary load test set
4. system load bank (DC if to be performed at the battery and AC if to be performed by loading a UPS output)

VRLA Battery

Quarterly Maintenance

The following checks should be completed quarterly.

1. Assure the battery room is clean, free of debris and well lighted.

2. Assure that all facility safety equipment is available and functional.

3. Measure and record the air temperature within the battery room.

4. Visually inspect the battery for:
   a. cleanliness.
   b. terminal damage or evidence of heating.
   c. container or cover damage.
   d. evidence of overheating.

5. Measure and record the battery system DC float charging voltage at the battery. Optionally measure and record the AC ripple voltage at this time also.

6. Measure the DC voltage from each polarity of the battery to ground to detect any ground faults.

7. If possible, measure and record the battery system DC and AC float charging current.

8. Measure and record the temperature of the battery pilot unit. Sense the temperature on the side of the unit in the center or at the negative terminal of the unit.

9. Measure and record the individual unit DC float charging voltage.

10. Measure and record the System Equalization Voltage.

Semi --_ Annual Maintenance

1.Repeat the quarterly checks.

2.Optionally perform the 10 sec. high rate (e. g.100 amp) load test to assure the individual batteries are functional.

3. Optionally measure and record the resistance/ impedance/conductance of the individual units to trend the condition of the individual units over time and to detect dramatic differences between individual units and the norm.

Annual Maintenance

1. Repeat the semi-annual checks.
2. Retorque all the interunit connecting hardware to the values noted in Table 2. This can be omitted if the connection resistance is measured and found to have not increased more than 200o from the value at installation.

Bi --_ Annual Maintenance

The battery should be capacity tested every two years at the service load or at the battery rating related to the service requirements. Ldeally , this will be the same rate at which it was acceptance tested when originally installed. Once the battery is found to be at 85% of rating, it should be capacity tested annually. Capacity testing instructions are found in the bulletin “Acceptance and Capacity Testing”_# 4141--7135.

Data Analysis and Corrective Actions

The data accumulated during the periodic maintenance activities should be recorded on a form such as shown in Appendix One. Following is an explanation of how the data would be interpreted and the correction action to be taken. However, it must be recognized that this explanation is not all inclusive and the analysis and corrective action decision must be made by personnel familiar with VRLA batteries and their operation and failure modes.

Environment Ambient and Battery Temperature

While the VRLA battery wil function at extremes of temperature, it is rated at 77ºF (25ºC)and the ideal operating temperature range for the VRLA battery is 70 (2JfC) to 80º F (27ºC). Operation at cooler temperatures will reduce the anticipated standby operating time while operation at warmer temperatures will detract from the battery life and will increase the potential of a thermal runaway condition.

The battery will experience a 500o reduction of life for each 18ºF (10ºC) above 77ºF (25ºC). High ambient room temperature should be corrected through the use of appropriate ventilation and air conditioning.

The VRLA battery should not be charged at temperatures exceeding 122º F (50º C). A thermal runaway condition could result.

The individual batteries within the string should not exceed the ambient temperature by more than 18 F (10ºC). If the entire battery or individual units temperatures are excessively high, the respective units may be experiencing thermal runaway. In this situation the charging current should be terminated and the cause of the situation should be determined and corrected.

If thermal runaway has occurred, the battery system should be capacity tested and replaced if necessary.

Battery Visual Inspection
Container Cleanliness

It is important that the individual batteries be clean and properly spaced. An accumulation of dirt or dust and moisture on the covers can produce a conductive path between the terminals or to ground which could result in short circuits or ground faults.

When batteries are cleaned, they should be on open circuit. For cleaning, use a cloth moistened in a solution of bicarbonate of soda and water. Do not use cleaners of unknown solutions such as window or glass cleaners and solvents. Use of certain petroleum based cleaners will damage the battery plastic containers and could cause them to crack and craze.

Container and Cover Damage

Should a crack or other penetration of the container or cover of a battery be noted, it should be replaced. A crack in the container could allow conductive electrolyte to wick from the battery and create a ground fault. A ground fault could lead to melting and burning of the container.

A hole in the cover, even without wicking of the electrolyte, can also be a serious situation. The hole will allow drying of the electrolyte in the subject cell resulting in an eventual high resistance and heating of the subject cell.

Containers which are severely swollen and permanently deformed have been overheated and experienced thermal runaway. Thermal runaway will also cause the batteries to gas and dry out and will damage the plates. In this case the entire battery string should be replaced.

Terminals

Bent or otherwise damaged terminals can produce high resistance connections or can hide a fracture that could fuse open under load. Batteries with damaged terminals should be replaced.

If the protective grease at a termination has melted and flowed onto the cover, it is an indication that the connection has been hot and this is, in all probability, the result of a loose or high resistance connection. In this situation the connection should be disassembled, inspected for damage, cleaned and properly reassembled.

Battery system Float Charging Voltage

The recommended battery system float charging voltage for the LIBERTY VRLA Batteries with a specific gravity of **1, 280** to **1, 300** is equal to the number of cells in the system multiplied by the range of **2. 25** to **2. 30** volts per cell at **77º** F (25ºC). For example, a string of **30** each **12** volt (6 cell) batteries should be float charged within the range of **405** to **414** VDC(**180** cellsX**2. 25**V/C minimum and **180** cellsX**2.30V/C** maximum)at **77**ºF(**25**ºC).

When temperature extremes are encountered the float charging voltage should be temperature compensated.

The temperature compensation coefficient is — 0. 0028V/C per degree F (--0. 005V/C per degree C).

For example, if the battery normal temperature is **90**ºF (**13º** above **77**ºF) the average float charging voltage range should be reduced **0.036** V/C (**13~X0. 0028** V/C per F)to between **2. 21** and **2. 26** V/C. For a **180** cell battery this would be **397. 8** to **408. 6** VDC. This will help reduce the potential for thermal runaway at elevated temperatures.

If the battery operates at _ cold_ temperatures, for example 50 F (17º below 77º F) , the charging voltage can be increased to improve recharge time. For example, the charging voltage range could be increased by ---_17ºX_0. 0028 V/C per degree or 0. 048 V/. For the **180** cell string this would be 413. 6 to 422.6 VDC.

If the battery is undercharged for a period during which there have been multiple discharges, the battery will not fully recharge following each discharge and it will provide progressively lower capacity. This condition may be correctable with an extended equalization charge (e g. 48 to 72 hours). However, if the situation has continued for too long a time, irreversable sulfation of the plates may have occurred and the battery may have to be replaced.

Extended overcharging will cause excessive float current, corrosion of the plate grids, gassing and drying of the limited amount of electrolyte. This constitutes premature aging of the battery and loss of capacity.

Severe overcharging for extended periods can induce a thermal runaway condition. This would also necessitate replacement of the battery system.

While measuring the battery system DC float charging voltage it may also be convenient to measure the AC ripple voltage appearing across the battery system. If the AC ripple voltage is a sinusoidal waveform the maximum reading should be less than 0.5% Vrms of the DC float voltage. In the case of 180 cell string floating at 414 VDC, this is 2. 07 Vrms. When measuring the ripple with an oscilloscope, the maximum p --_ p value should be 1.5% of the float voltage or 6. 2 Vp -- p when floating at **414 VDC.**

Excessive AC ripple voltage across the battery could cause gassing and heating of the battery which would result in reduced life.

Battery System Ground Fault Detection

If the rectifier used to charge the battery has a ground fault detection capability, the indicator should be observed to determine the safety of the system. If a ground fault is indicated, it should be isolated and corrected prior to further maintenance on the battery system.

If the rectifier does not have a ground fault detection circuit, use the digital voltmeter and measure the voltage from each polarity of the battery to ground (the grounded rack or cabinet). A detected voltage would indicate a short or leakage current from the battery to ground. The approximate location of the cell with the ground fault ,from the battery system output terminal, would be the measured voltage divided by the average per cell charging voltage. For example, if the measured voltage to ground was 135 VDC and the charging voltage was 2. 25 V/C,the ground fault would be approximately 60 cells (ten 12 volt units) from the battery system output terminal.

Battery System
Float charging Current

If the DC float current can be measured,it can provide an indication of the proper current acceptance of the battery system. Depending on the charging voltage per string and the temperature, the float current per string should be approximately that shown in Figure 3. The float current will approximately double for each 18ºF_ (10ºC) above 77ºF(25ºC)

If the DC float current is zero there is an open circuit in the battery string. If the float current is higher than anticipated, it may be due to elevated termperature of the battery or shorted cells within the string. In either case the cause should be determined and corrected. Elevated temperatures and shorted cells are both situations which can lead to thermal runaway.

Individual Battery
Float Charging Voltage

While the battery string may be charged at an average of between 2. 25 and 2. 3 volts per cell ,not all cells will float at the exact average vlotage.
Each cell has a somewhat different impedance and rate of oxygen recombination and will therefore exhibit a slightly different float slightly different float voltage at the same float current. For example, all the 12 volt batteries in a string charged at 2. 3 volts per cell will not float at **13. 9** VDC but may **vary from 13.** 3 to **14.** 5 and still be normal. If the system is equalized for 24 hours upon installation, or with an extended time in float service, this spread in float voltage will normally decrease.
Table 1 indicates the minimum and maximun DC float voltages to be measured across batteries in a series string. If an individual battery measures too low, it may be an indication of a shorted cell. If an individual unit measures too high. it may be an indication of increased resistance within the cell. If one unit measures very high while the balance of the units in the string indicate near the open circuit value, the high voltage cell may have an open circuit.

Shorted cells within the string will lead to increased voltage applied to the remaining good cells in the string and higher folat current. For example, A 24 cell string charging at 55. 2 VDC (2. 3V/C) which has 2 shorted cells will be charging the remaining 22 cells at 2. 5 V/C(55. 2VDC/22 cells)and the resulting increase in float current is sure to result in eventual thermal runaway.

A battery with a shorted or open cell can usually be confirmed by comparing the impedance of the individual units or by comparing the AC ripple voltage measured across the individual units.

Do Not perform a high rate load test on batteries that are suspected of having a shorted or open cell. This would be hazardous since a spark internal to the cell could ignite the internal gases.

A battery suspected of having a shorted or open cell should be removed and replaced immediately.

More information concerning the measurement and interpretation of individual battery float voltages is contained in the pamphlet_ Integrity Testing"_ **4-41** _7264.

High Rate Momentary Load Test

The high rate momentary load test is a functional test of the individual battery within the series string. It does not replace a capacity test but it does indicate if the battery is functional at least up to the ampere capability of the test load. A typical load used for batteries in the 20 to 200 ampere range is **100** amperes. The voltage of the unit 10 seconds after application of the test load should be at least 1. 7 v/c average(10. 2,8.5 and 5.1 VDC for 12,10 and 6 volt batteries respectively) or the battery should be suspected of being open, shorted, discharged or of very high resistance and low capacity.

Never perform the high rate momentary load test on a battery suspected of having a shorted or open cell. Full face protection should always be worn during this test, since a spark internal to a cell could ignite the residual gasses within the cell.

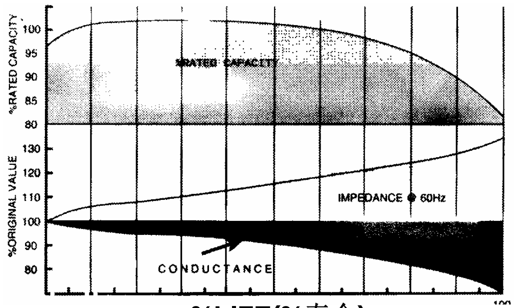
More information concerning this test and the minimum voltages to be expected by part number is contained in the pamphlet _Integrity Testing_ #41_7664.

Impedance Testing

The normal wearout mode of the VRLA battery includes corrosion of the plate grids, deterioration of the plate active material and some drying of the electrolyte. Abnormal failure modes would include deterioration of the conductive path and excessive drying of the electrolyte. These processes will all increase the resistance of the affected cells and periodic measurement of the impedance,resistance or conductance of the cells and trending of this data can indicate string uniform gradual degradation and loss of capacity with time. This is shown in Figure **4.**

Rapid changes in individual units may indicate shorted, open and drying cells and cells with deteriating conductive paths.

When an AC ripple voltage appears across a string of batteries it will be subdivided



%LIFE(%寿命)

Figure 4_VRLA Battery Lmpedance and Conductance vs.Capaclty and Age.

across the individual units in the string proportional to their relative resistance. Therefore in the absence of an impedance, resistance or conductance test set, the AC ripple voltage across the individual units can be measured with a DVM and compared to each other and the norm as an indication of their relative resistance and condition.

If the resistance of the batteries has increased by 300 over that when it was new, the battery should be further tested to determine the cause and if necessary the battery or system should be capacity tested to assure reliability.

More information on this topic is contained in the pamphle _Impedance and Conductance Testing_ #41_-7271.

Interunit Connecting Resistance

High resistance in the interunit connections and loose connecting hardware can cause excessive voltage drop during discharge resulting in reduced operating time and in the extreme case even cause melting of the battery terminals and potentially a fire.

The contacting surfaces of all connections should be brushed clean, removing all lead oxide and contamination, protected with a special antioxidation grease, and tight.

The connection hardware may loosen somewhat with time and repeated cycling of the battery system. The connection hardware should be retorqued to the value indicated for the battery part number as shown on the relevant data sheet. A summary of the battery terminal types an the recommended torque values is given in Table 2.

Performance and Capacity Testing

When the battery degrades to **8000** of its rating it should be replaced. That is ,if a battery system could support **100** amperes for 1 hour when new, it should be replaced when it can only support 80 amperes for the same 1 hour period. If 100 amperes is the actual load and this must be supported for a minimum of one hour, the battery should have been originally sized to provide 125 amperes for the one hour when new. This sizing factor of 1. 25 is referred to as the aging factor when originally sizing the battery.

When the battery capacity declines to 80% of rating is it an indication that the plate grids are corroded and expanded; that the plate active material has deteriated and that the drying of the electrolyte has occurred. The battery should be removed from service and replaced at this time.

Naturally, the other criteria for battery replacement is when it no longer supports the load for the minimum required time _ _ even if the battery is still greater than 800o of rating. However, even at minimal load, the battery should not remain in service beyond that point when it is at 800o of rating.

The VRLA batteries are rated at 77_F (25C). It is important to recognize that operation at lower temperatures, while it does not harm the battery, will reduce the operating time. Performance derating factors for reduced temperature are found in the pamphlet" Acceptance and Capacity Testing" # 41- 7135.

Continuous operation at elevated temperatures will result in accelerated aging of the battery. For each 18T(10C)above 77T(25C)the battery will age at twice the normal rate. Additional information on this topic is found in the pamphlet "Life Expectancy and Temperature" #41-7329.

Summary of Periodic Maintenance for VRLA Batteries

The VRLA battery is maintenance free only as related to the electrolyte. For assurance of the battery reliability it is still important to perform the recommended periodic maintenance. The recommended periodic maintenance ,whether performed manually or via automated monitoring systems, is designed to determine the gradual degradation of the system capacity and to detect any abnormal system or individual battery condition which could impact system reliability.

TABLE 1- VRLA Battery Symptoms and Solutions

Symptom	Possilbe Causes	Possilbe Result	Corrective Actions
CAPACITU TEST RESULTS			
Reduced operating time at 77F with smooth voltage decline,	Normal wear out	Eventual failure to support the load followed by potential for shorted cells.	Replace battery system when at 80% of rated capacity or before.
Reduced operating time at 77F with step voltage decline or voltage plateaus.	Individual low capacity cells.	Reversed cells during discharge_reversed cells will become very hot and will not fully recharge.	Replace the isolated low capacity batteries.
Excessive initial voltage drop even to the point of dropping load in the first several seconds.	Battery is cold.		Heat the battery.
	Cabling is too small. High resistance connections.	Excessive voltage drop.	Run parallel cables.
		Excessive voltage drop.	Clean and reassemble connections.
	Battery is undersized.		Add required parallel strings.
	Shorted cells.	Cells will become hot, could develop thermal runaway; internal arcing could result in explosion.	Replace isolated units with shorts and evaluate entire string.
TEMPERATURE CHECKS			
Elevated room temperature.	Lack of adequate air conditioning/ventilation.	Reduced battery life.	Cool the room or accept reduced battery life.
Elevated battery temperature.	Elevated room temperature.	Reduced life and potential thermal runaway.	Improve room air conditioning.
	Inadequate cabinet ventilation,	Reduced life and potential thermal runaway.	Improve cabinet ventilation and temperature.
	Discharge-Charge cycle	Can be normal if not exceeding 181F (10C) increase.	Limit recharge current.
	AC ripple current greater than 5 amperes rms/ lOOAh battery capacity.	Reduced life and potential thermal run away.	Determine cause of excessive AC ripple current and correct.

TABLE 1-VRLA Battery Symptoms and Solutions (Cou't)

Symptom	Possible Causes	Possible Result	Corrective Actions
High current recharge.	High charging voltage.	This combination can lead to thermal runaway.	Limit recharge current.
			Reduce to within specifications.
	Shorted cells.		Replace shorted cells and evaluate total string.
VISUAL BATTERY CHECKS			
Cover/container crack.	Handling or impact damage.	Cell dry out or ground fault. Potential internal gas ignition.	Replace damaged unit.
Cover/container explosion,	Ignition of cell internal gasses due to external source, fusing of internal conductive path, or internal spark due to shorting. This potential exists for batteries not maintained and continued in service beyond useful life.	Personal injury and equipment damage at time of explosion,	Replace damaged unit and evaluate the balance of string.
		Failure to support load.	
Burned area on container.	Crack in container wicking electrolyte to grounded rack, etc. Ground fault.	Could result in personal hazard due conductive path to rack, etc.	Clear the ground fault and replace defective unit. Evaluate balance of the string.
		Could result in smoke or a battery fire.	
		Could result in a thermal runaway.	
Permanently deformed (swollen)container.	Thermal runaway possibly caused by high temperature environment, overcharging, excessively high recharge current, shorted cells or a ground fault or a combination of these items.	Could result in the emission of hydrogen sulfide which is detectable as a rotten egg odor, battery fire and inability to support the load.	Replace the battery system and correct the items leading to the themal runaway condition.

TABLE 1- VRLA Battery Symptoms and Solutions (Cou’t.)

Symptom	Possible Causes	Possible Result	Corrective Actions
VISUAL CHECKS (CONTINUED)			
Rotten egg odor.	Possibly caused by high temperature environment, overcharging , excessively high recharge current, shorted cells or a ground fault or a combination of these items.	Odor is a product of extended thermal runaway.	Replace the battery system and correct the items leading to the thermal runaway.
Melted grease at terminals.	Connections were hot probably due to excessive resistance caused by loose connection ,dirty contact surfaces or corrosion within the connection.	Excessive voltage drop perhaps leading to short operating time or damaged terminals.	Clean and reassemble the connection if undamaged. Replace any battery with damaged terminals.
		In extreme case could lead to melted terminal and ignition of the battery cover.	
Corrosion at terminals.	There is possibly either residual electrolyte from manufacturing or electrolyte leaking from the battery terminal seal that is attacking the interunit connector.	Increased connection resistance and resulting increase in the connection heating and voltage drop at high rate discharge.	Disassemble connection, clean ,coat connecting surfaces and terminal area and seal with antioxidation grease and appropriately reassemble the connection. If leakage about the terminal area is obvious ,the battery should be replaced.
DC VOLTAGE CHECKS			
System float voltage greater than 2. 3V/C average at 77V (25~C)	Charger output set incorrectly,	Overcharging will cause excessive gassing and drying of the electrolyte and will contribute to potential thermal runaway.	Reset the charger output voltage to the recommended value.

VRLA Battery

TABLE 1- VRLA Battery Symptoms and Solutions (Cou't.)

Symptom	Possible Causes	Possible Result	Corrective Actions
DC VOLTAGE CHECKS (CONTINUED)			
System float voltage less than 2. 25V/O average at77TF(25C).	Charger output set incorrectly,	Undercharging will result in a gradual loss of operation time and capacity with successive discharge cycles. If allowed to persist, an irreversible level of lead sulfate will develop on the plates with the result of a permanent loss of capacity.	Reset the charger output voltage to the recommended value. Equalize the battery system for from 48 to 72 hours and perform a capacity test. If capacity loss is permanent. replace the total battery system.
System equalize voltage is greater than 2. 4V/C average.	Charger equalization voltage is set incorrectly,	Overcharging will cause excessive gassing and drying out the electrolyte and will contribute to potential thermal runaway.	Reset the charger output voltage to the recommended value.
System equalize voltage is less than 2. 4 v/c average.	Charger equalization voltage is set incorrectly,	Equalization and boost charging will be less effective and will require extended time.	If possible,reset the charger output voltage to the recommended value or accept longer equalization time.
Individual battery float voltage less then 2. 2V/C average, 13.3 VDC for 6 cell battery. 11. 1 VDC for 5 cell battery. 6.6 VDC for 3 cell battery.	Potentially the individual battery has a shorted cell. Could be verified with an impedance or conductance check.	Reduced operating time under load. Increased float current. Heating of cell during discharge. Contributes to potential thermal runaway.	Replace the individual battery.
Individual battery float voltage greater than 2.42 V/C average, 14.5 VDC for 6 cell battery. 12. 1 VDO for 5 cell battery. 7.3 VDO for 3 cell battery.	Potentially there may be open cell in the individual battery. This can be confirmed by checking for zero float current or checking for a very high impedance of the batter	Failure to support the load. Could result in an internal arc which could ignite the gasses within the cell.	Replace the individual battery.

TABLE 1-VRLA Battery Symptoms and Solutions (Cou't.)

Symptom	Possible Causes	Possible Result	Corrective Actions
DC VOLTAGE CHECKS (CONTINUED)			
DC voltage measured between either of the battery system output terminals and ground (rack)or a ground fault indicated by automatic monitoring equipment.	Damaged battery container allowing electrolyte to wick out to the grounded surface (rack).	Personnel shock hazard which could result in serious injury or electrocution. Potential burning of the container at damaged area or battery fire.	Determine the source of the ground fault and replace battery.
AC RIPPLE VOLTAGE CHECKS			
AC ripple(p-p)voltage on the system is greater than 4% of the value of the DC float voltage,	Poor filtering of the charger output.	Excessive AC ripple could cause the battery to cycle at the ripple frequency and result in heating and deterioration of the plate active material.	Improve the charger output filtering.
Individual battery in string exhibits AC ripple voltage of twice that of the other typical batteries in string,	Battery with the high AC ripple voltage has a proportionately higher impedance and should be further evaluated for performance. Subject battery could have a deteriorating conductive path or a dry, shorted or open cell.	Reduced operating time. Potential conditions could be conducive to thermal runaway.	Verify the battery condition and replace as required.

TABLE1-VRLA Battery Symptoms and Solutions (Cou't)

Symptom	Possible Causes	Possible Result	Corrective Actions
FLOAT CHARGING CURRENT CHECKS			
Float current to the string is zero.	A battery or connection in the series string is open. This can be verified via the float voltage check or AC ripple voltage or impedance check of the individual batteries.	Failure to support the load. If an internal arc should occur during discharge ,it could ignite the gasses internal to the cell.	Replace the battery with the open cell or repair the open! loose external connection.
		If there is a open/loose connection in the external conductive path, it could damage the termination under load.	
Float current exceeds 3.0 Millie amperes per ampere hour of rated capacity at 77F (25C)at float voltage.	Batteries are not yet fully recharged.	Not at 100% of capability.	Determine the specific cause and take necessary corrective action.
	Batteries are above 77F (25C).	Conducive to thermal runaway.	
	Potentially shorted cells in battery.	Conducive to thermal runaway.	
	Depending on the degree, the battery may be entering or in thermal runaway.	Thermal runaway results in eventual meltdown of the battery and the potential of hydrogen sulfide emissions and fire.	
AC ripple current exceeds 5 amperes per 100 Ah rated battery capacity.	Poor filtering of the charger.	Excessive AC ripple current will result in battery heating, reduced service life and potential thermal runaway.	Improve the charger output filtering.
HIGH RATE 10 SEC. LOAD TEST			
Terminal voltage is marginally below the minimum voltage specified for 10 sec. point,	Battery is perhaps not fully charged or is an older battery that has been in service and is of somewhat lower capacity.	Perhaps reduced operating time.	Fully recharge the battery.
Terminal voltage is significantly below the minimum voltage specified for 10 sec. point.	Battery is discharged or battery conductive path ,plate grid or active material or electrolyte volume deterioration.	Reduced operating time.	Charge and retest battery or replace as required.
	Shorted.	Conducive to thermal runaway.	
	Open cells.	Will not support load.	

TABLE 1-VRLA Battery Symptoms and Solutions (Cou't)

Symptom	Possible Causes	Possible Result	Corrective Actions
BAITERY IMPEDANCE/ CONDUCTANCE TEST			
Impedance/resistance increase by 50% from original values when new or conductance decline to 50% or the value when new.	Battery is discharged or Battery conductive path, plate grid or active material or electrolyte volume deterioration.	Reduced operating time.	Charge and retest battery or replace as required.
	Shorted cells.	Conducive to thermal runaway	
	Open cells.	Will not support load.	
CONNECTION HARDWARE RESISTANCE/ TIGHTNESS CHECK			
Connection resistance increase of 20% or more from original value,	Repetitive cycles resulting in heating and cooling of connection can result in relaxation of torque and an increase in connection resistance.	Loose connections can result in heat damaged or melted terminals during high rate discharge.	Retorque the connection as required.
	Contamination within the connection can result in corrosion and high terminal resistance.	Excessive voltage drop during high rate discharge and resulting reduced operating time.	Correct the source of contamination ,clean the contact surface areas, grease the contact surfaces with antioxidant grease and reassemble.
Connection hardware tightness is less than the specified "retorque" value,	Repetitive cycles resulting in heating and cooling of connection can result in relaxation of torque and an increase in connection resistance.	Loose connections can result in heat damaged or melted terminals during high rate discharge.	Retorque the connection as required.

SC&D LIBERTY 蓄电池运行保养记录表

对应华为电信设备 48V 系统

SC&D LIBERTY BATTERY MAINTENANCE AND APPLICATION RECORDER

FOR HUA WEI EQUIPMENT 48V SYSTEM

公司名称 Company	华为技术(HUAWEI)
电池工作地点 (BATTERY LOCATION):	
蓄电池负责人 (BATTERY RESPONSIBLEBY):	电话(TEL:)
设备类型及编号 (EQUIPMENT TYPE AND NO:)	

浮充电压设定 Float Voltage	
蓄电池出厂代号(4 位数)Battery Date Code	
负载 System Load:(K.W. or A)	
均充电压设定 Eq.Volt	

日期(DATE)	室温(℃)T.(room)	电池表面(℃)T.(batt)	蓄电池电压 Battery Voltage(V)				系统浮充电压/电流 System Float Voltage/current(V/A)	备注 Remark
			1 号电池 NO.1	2 号电池 NO.2	3 号电池 NO.3	4 号电池 NO.4		
年 Y 月 M 日 D 安装前 Before Installation--OCV	-----							
年 Y 月 M 日 D 安装时连接牢固(可用 11 厘米固定扳手 FIXED COMMECTOR BETWEEN BATTERIES (MAY BY 11CM WRENCH)	-----	-----						
年 Y 月 M 日 D 安装后均充 24 小时,再浮充 3~7 天后浮充电压 After Installation Equalization Charge 24 Hours ,then float charge 3 to 7 days								
年 Y 月 M 日 D 首次容量验证(记录放电时间电池表面温度)First Capacity Checking (record the discharge time/temperature)			(小时 HRS)	(小时 HRS)	(小时 HRS)	(小时 HRS)	-----	
年 Y 月 M 日 D3 个月后浮充电压和维护记录 After 3 months floatvoltage and maintenance record								
年 Y 月 M 日 D6 个月后浮充电压和维护记录 After 3 months floatvoltage and maintenance record								
年 Y 月 M 日 D9 个月后浮充电压和维护记录 After 3 months floatvoltage and maintenance record								
年 Y 月 M 日 D12 个月后浮充电压和维护记录 After 3 months floatvoltage and maintenance record								
年 Y 月 M 日 D15 个月后浮充电压和维护记录 After 3 months floatvoltage and maintenance record								
年 Y 月 M 日 D18 个月后浮充电压和维护记录 After 3 months floatvoltage and maintenance record								
年 Y 月 M 日 D24 个月后浮充电压和维护记录 After 3 months								

floatvoltage and maintenance record								
年 Y 月 M 日 D27 个月后浮充电压和维护记录 After 3 months floatvoltage and maintenance record								
年 Y 月 M 日 D30 个月后浮充电压和维护记录 After 3 months floatvoltage and maintenance record								
年 Y 月 M 日 D36 个月后浮充电压和维护记录 After 3 months floatvoltage and maintenance record								

电池型号为 MPS12—100(100AH@20HRS 率)放电深度记录表(在 25 放电至 1.75V/C 为 100 安时容量			
放电电流 5A	放电时间 <6 小时 (30% 放电深度)DISCHARGE HOURS ARE LESS THAN 6 HOURS	放电时间 6~10 小时(50%放电深度) DISCHARGE TIME BETWEEN 6~10HOURS	放电时间>10 小时(100%放电深度) DISCHARGE TIME MORE THAN 10 HOURS
日期 DATE			

注:请用户认真填写上述表格,此表为质保条例的一部分,如果涂改则无效.备注内请标明电池表明是否整洁,电池有无损伤.此表提供的维护记录为重要部分,详细测试方法参见文件FORMN41—7135,41—7271,41—7264.

充电方法和运行条件必须持续符合以上海西恩迪蓄电池有限公司提供的由美国 C&D TECHNOLOGIES 大力神电池部出版的技术文件.

Note: Please fill in the form without modification because the form is a part of the Warranty . Please fill in remark for the battery surface or physical damage. The form is for the most important parts during application but not all. Regarding the test method please reference the technology doucuments FORM 41—7135,41—7271,41—7264 supplied by the C&D. The charging and operating conditions must be consistent must be consistent with the published instructions of C&D Technologies Dynasty Division.

数据和系统状态

Valve Regulated Lead Acid Batteries

Historical Data and System Status

Company(公司)	System Float Changing Vollage(系统浮充电压) VDC
Location(地点)	Late Batteries Installed(电池安装日期)
Supervisor in Charge(充电程序) Phone(电话)	Load (K.W.or Ampere)(负载 K.W 或安装日期)
Type CHARGER/Load(充电机(负载)类型)	System Equalize Voltage (系统均充电压) Amps(安培)
Unit Part Number(单元编号): Cells Unit(每单元室数)	Room Temperature(室温): U nit Temperature Rang (单元温度系列):

Date (日期)					Date(日期)				
Unit(单元) No(编号)	Charging Volts-Unit(单元充电电压)	Impedance(阻抗)Conductance(传导率)(交流毫伏)	10Sec.Vmin @100Amps.(100 安培 10 秒)(放电最低电压)	Connection Resisance (连接电抗)	Unit(单元) No(编号)	Charging Volts-Unit(单元充电电压)	Impedance(阻抗)Conductance(传导率)(交流毫伏)	10Sec.Vmin @100Amps.(100 安培 10 秒)(放电最低电压)	Connection Resisance (连接电抗)
1					31				
2					32				
3					33				
4					34				
5					35				
6					36				
7					37				
8					38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
17					47				

18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

COMMENTS (评估说明):____

ROMM VISUAL CHECKS(室内目视检查):______________________________

BATTERY VISUAL CHECKS(电池目视检查)______________________________

APPENDIX 1 (附表 1)