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NSB UPS Battery®

AGM Thin Plate
Pure Lead - High Rate

NSB UPS Battery®
Application Manual

99.9% PURE LEAD

15+ YRS DESIGN LIFE

PROUDLY MADE IN THE USA

Table of Contents

AGM Thin Plate Pure Lead - High Rate

NorthStar UPS Quick Start Guide

Unpacking the Batteries

When received, the batteries should be inspected. Make sure the batteries were not damaged during transport, and that all the proper accessories were included in the delivery. If problems arise, please initiate a claim immediately.

Note: * indicates where further information can be found in the NSB UPS Application Manual. Warnings and notifications can be found on the label (shown below) which appears on each product. Be aware and adhere to all warnings which appear on the product

Installation

1. Before proceeding with the installation of the battery, review or determine the arrangement of the batteries for the application.

2. Checking the voltage spread is vital before connecting the monoblocks in series. Refer to section 10.2 for more information.

3. If installing multiple parallel strings, the cabling to each string should be the same size and approximate length resulting in the same resistance per string.
**(Battery Connection to Load/Charger 10.12)*

4. The cable size selected should consider allowable voltage drop of ≤ 0.5V
**(Battery Connection to Load/Charger 10.12)*

5. Carefully install batteries into position as determined. The battery should be oriented so that the negative (-) post of one battery is adjacent to the positive (+) post of the next adjacent battery.

6. Make sure the batteries are all evenly spaced approximately 10mm (3/8 inch) apart.

7. Check that all contact surfaces are clean, and then install the bloc or cell connectors and the terminal screws using the torque value printed on the battery label. **(Commissioning/Installation 10.9)*

8. The insulation covers should be put back after all connections have been completed.
**(Commissioning/Installation 10.10)*

Charging

9. It is highly recommended to give the batteries a refreshing charge prior to commissioning. Failure to observe these conditions may result in greatly reduced capacity and service life. **(Charge 10.14)*

Charging Regime Prior to Qualification Testing

Case 1)
For batteries that have a date code older than 6 months:
a. Equalization charge the battery strings at 2.41vpc for four hours
b. Reduce voltage to 2.35vpc for eight hours
c. Reduce voltage at battery to 2.27vpc and float for at least four hours to let all the gas generated during charging recombinate.

Case 2)
For batteries that have a date code less than six months:
a. Refresh/Boost charge the battery string at 2.35vpc for twenty-four hours
b. Reduce voltage at battery to 2.27vpc and float for at least four hours to let all the gas generated during charging recombinate.

10. The optimum level for float charging the NSB UPS batteries is 2.27 volts/cell at 25°C (77°F). **(Charge 2.2)*

- **a.** Example: 40 battery string = 544.8V
- **b.** Example: 32 battery string = 435.8V

11. If the ambient temperature increases above 25°C (77°F), a thermal compensation of -2 mV/cell/°C is recommended. Conversely, if the temperature decreases below 25°C (77°F), the voltage should be increased by 2 mV/cell/°C. **(Charge 2.2)*

12. Verify the battery string voltage matches the rectifier output voltage. **(Maintenance 11.3)*

13. If a voltage difference is identified due to a voltage drop in the cables, then the rectifier must be adjusted until the battery string voltage is within battery specification.

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1 Introduction

UPS batteries from NorthStar Battery (NSB) Company provide excellent high-rate discharge and recharge performance for mission critical applications. Absorbed-Glass-Microfibre (AGM) technology is utilized, which means the electrolyte is fully absorbed in a very fine glass mat. This allows for very efficient recombination of any gas generated during the charging process. The release of gas from NSB batteries is very low, hence natural ventilation is sufficient for both cooling and the dissipation of any gas formed during inadvertent overcharge. Hence, NSB UPS batteries can be used safely in offices and with mains equipment.

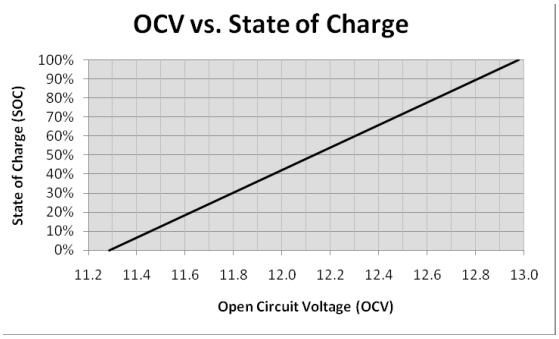
NSB UPS batteries excel at providing both short duration high amperage pulses, low rate long duration deep discharges and high cyclic capabilities.

2 Charge

In order to maximize the life of the UPS batteries, it is recommended that the battery be fully recharged following an outage.

2.1 Determining State of Charge (SOC)

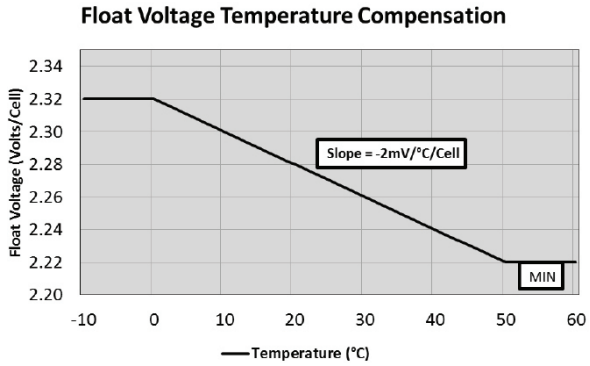
The SOC of a battery can be determined by measuring the open-circuit-voltage (OCV) of the battery. If the battery has been recently recharged, a rest period of at least 3 hours is required before taking measurements. The relationship between OCV and SOC for the NSB UPS batteries is displayed in the following graph:



A fully charged NSB UPS battery will measure approximately 13.0 V.

2.2 Thermal Compensation

The optimum level for float charging the NSB UPS batteries is 2.27 volts/cell at +25°C (+77°F). If the battery temperature increases above this level, a thermal compensation of -2 mV/cell/°C is recommended. Conversely, if the temperature decreases below 25°C, the voltage should be increased by 2 mV/cell/°C. The graph below shows values for an individual cell.

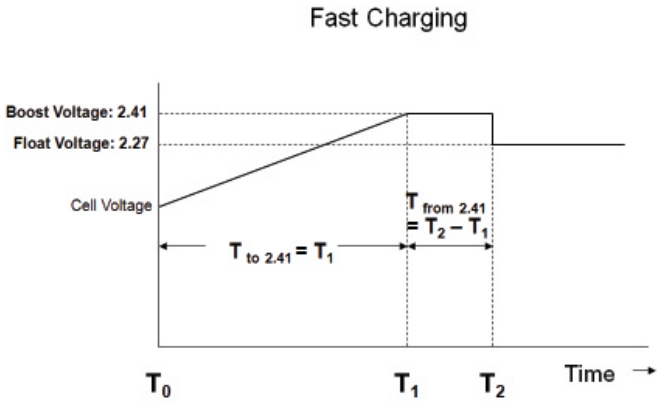


2.3 Fast Charging

If the charging system is properly sized, a fast charging regime will serve to minimize the time needed to recharge NSB UPS batteries. This can be beneficial, for maximizing the cycle life of the product.

In a fast charging regime, the charging system is assumed to be adequately sized to provide the power needed (see Section 2.4). Fast charging is conveniently achieved by using a higher charging voltage. This method maintains the charge current at a high level during the second half of the charging process. As a result, a discharged battery bank will be returned to a fully charged state in a shorter time.

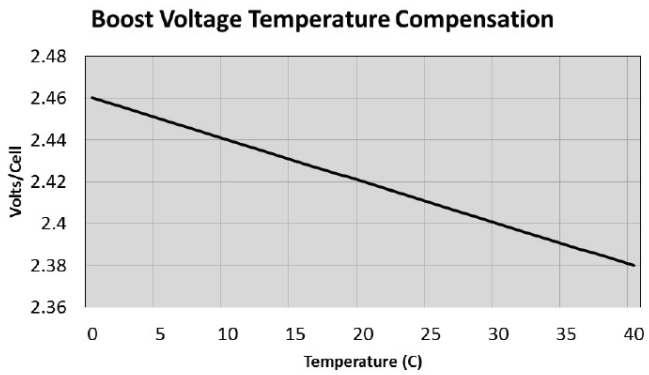
The increased voltage setting is known as boost voltage. In a fast charging regime the boost voltage shall be 2.41 Volts/Cell provided that the temperature is a nominal +25°C (+77°F). The following graph shows the recommended charging profile following a 100% DOD cycle:



Standard Product Charge Rate	Time to recharge from 100% DoD		
	$T_{to\ 2.41}$ (T_1)	$T_{from\ 2.41}$ ($T_2 - T_1$)	Total (T_2)
1xI10	10	4	14
2xI10	4	4	8
4xI10	1.8	4	5.8

The table above shows the time needed to recharge following a 100% DOD cycle, depending on the maximum charge current available. If the DOD is less than 100%, the total recharge time will be less. To prevent overcharge, the duration from T1 to T2 (i.e. the time at 2.41 Volts/Cell) should always be limited to 4 hours, and then the rectifier voltage returned to the recommended float voltage.

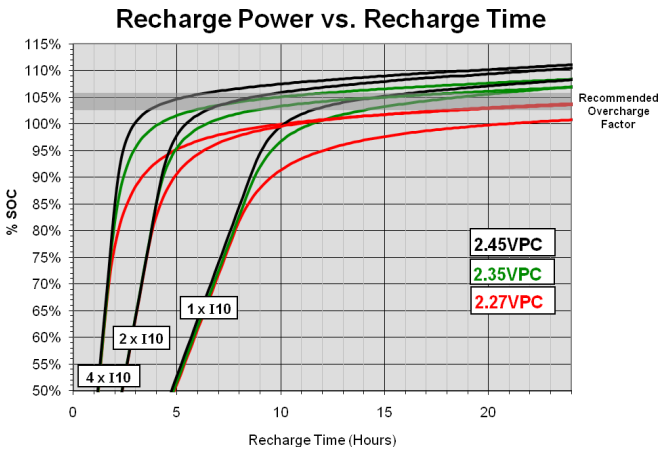
If the battery temperature increases above +25°C (+77°F), it is recommended that a thermal compensation of -2 mV/cell/°C be applied to the boost voltage. Conversely, if the temperature decreases below 25°C, the boost voltage should be increased by 2 mV/cell/°C. The graph below shows values for an individual cell:



2.4 Recharge Power

Depending on the charging system, recharge times can vary greatly following an outage. If the recharge power is relatively low, it will take longer to fully recharge a battery. It is recommended to provide a regular overcharge factor of between 103% and 106% SOC after a discharge.

The following chart shows the time required to fully recharge an NSB UPS battery from a complete 100% DOD discharge, as a function of rectifier voltage and available current.



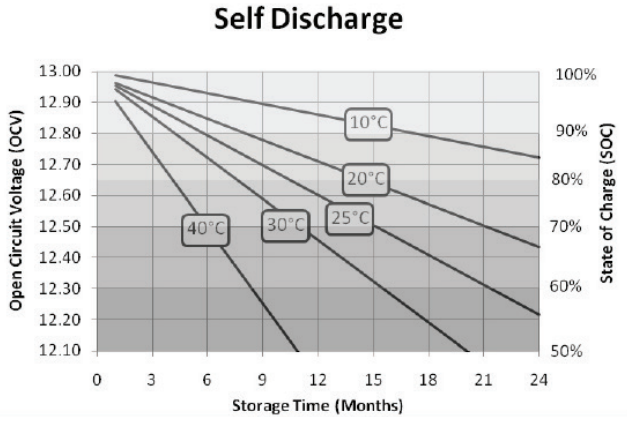
2.5 Ripple Current

Unacceptable levels or ripple current from the charger or the load can have a major impact on battery internal heat generation, cause permanent damage, and reduce service life. It is recommended to limit the continous ripple current to a maximum of 5 amperes per 100 Ah rated battery capacity.

3 Discharge

3.1 Storage and Self Discharge

During storage, lead-acid batteries will gradually self-discharge. It is recommended that battery OCV be maintained above 12.1V at all times in order to avoid irreversible capacity loss. The rate of self-discharge increases with increasing temperature. For example, a battery at 25°C will drop from 90% to 60% in 15 months, whereas the same unit at 40 °C will take just 6 months. As a result, maintenance charging needs to be performed more frequently at higher temperatures.



3.2 End of Discharge Voltage (EODV)

In the event of a deep discharge, a recommended minimum end-of-discharge voltage (EODV) should be used to avoid over discharge. A value of 1.80 Volts/cell is common, but this value should be adjusted based on the discharge rate. The following table provides a guide for EODVs at various discharge rates.

Discharge Rate (hours)	EODV (Volts/Cell)
20	1.85
10	1.80
5	1.75
1	1.70
.25 (15 min.)	1.67

EODV can be controlled using a Low Voltage Disconnect (LVD) as part of the load circuit.

3.3 Cold Temperature Performance

Colder temperatures can prolong battery life because corrosion processes within the positive plates of the battery slow down as the temperature decreases. Unfortunately, lower temperatures also lower the capacity of lead-acid batteries. As battery temperature drops below the recommended operating temperature of +25° C (+77°F), the battery capacity decreases.

4 Useful Life

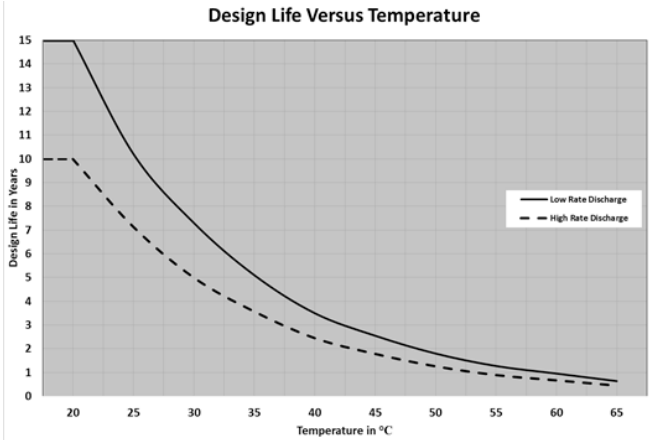
4.1 Shelf Life

NSB UPS batteries may be stored for up to 2 years provided that the OCV is never allowed to fall below 12.1 V. Failure to provide the required maintenance charging (see Section 3.1) may lead to irreversible capacity loss.

4.2 Design Life vs. Temperature

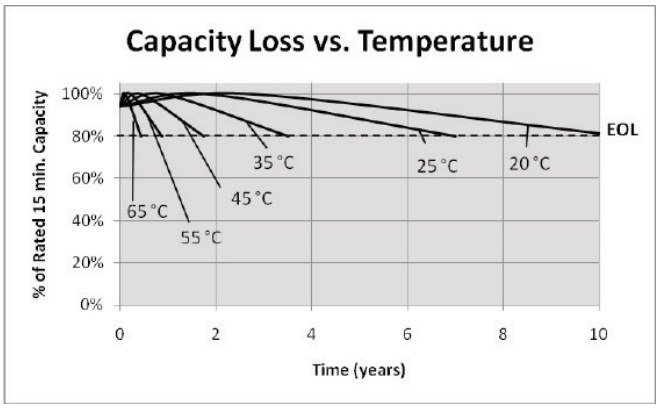
Lead-acid batteries operating under float conditions are continually being charged. As a result, the lead grids within the positive plates undergo slow corrosion, which is a normal aging mechanism under float duty. Typical UPS applications require short duration high discharge current (5 to 15 minute rates) to support the load. It should be noted that the presence of grid corrosion increases internal resistance which, in turn, decreases the available power. This behaviour is more obvious for higher-rate UPS duty, than during the lower-rate telecom applications.

The rate of grid corrosion increases with increasing temperature and, as a result, the temperature of batteries has a large affect on their float life. For each increase of 10°C, float life will decrease by a half. For example, if the temperature rises from the recommended operating temperature of +25°C, to +45°C, the expected life of the UPS battery will decrease from 10 years to less than 3 years (see chart below).



As seen in the above graph, the batteries design life will vary significantly due to differences in discharge rates and environmental temperatures.

Under float duty, a battery is considered to have reached its end of life (EOL) when it can no longer deliver 80% of its original rated capacity. For example, a 100 Ah battery has reached EOL when its discharge capacity has dropped below 80 Ah. The relationship between capacity loss during float duty and battery temperature is shown in the following chart:



5 Technical Specifications

For detailed technical specifications, please refer to the product data sheets provided at www.northstarbattery.com

6 Battery Safety

For full information please read the Safety Data Sheet (SDS). The SDS document is titled SDS-430-00607 and can be downloaded from the internet at www.northstarbattery.com

When dealing with Valve Regulated Lead Acid (VRLA) Batteries some additional safety information is required.

	Please read and observe the installation and operation instructions.
	When working on batteries wear appropriate Personal Protective Equipment (PPE). Refer to battery MSDS for complete list.
	Do not expose the battery to an open flame or other ignition source. During operation an explosive mixture of hydrogen gas may accumulate.
	Battery terminals are always energized and, if short-circuited, cause electrical arcing. Always use insulated tools.
	Batteries are heavy objects. Use proper handling equipment safety gear during installation.
	Inappropriate lead acid battery disposal can result in environmental contamination. Please dispose of batteries according to local regulations.
	Battery may be returned, shipping pre-paid, to the manufacturer or any distributor for recycling.
	Batteries contain concentrated sulfuric acid in water. Any fluid found outside the batteries should be regarded as acid.
	Clean all acid splash in eyes or on skin with plenty of clean water. Then seek medical help. Acid on clothing is to be washed with water
	Risk of explosion or fire. Avoid any short circuit. Metallic parts under voltage on the battery, do not place tools or items on top of the battery.

Batteries are supplied in a fully charged state and must be unpacked carefully to avoid very high short-circuit currents terminals of opposite polarity. Use care when handling and moving batteries. Appropriate lifting equipment must be used.

6.1 Keep away from open flames

In case of accidental overcharge, a flammable gas can leak from the safety vent. Discharge any possible static electricity from clothes by touching an earth connected part.

6.2 Tools

Use tools with insulated handles. Do not place or drop metal objects on the battery. Remove rings, wrist watches and articles of clothing with metal parts that may come into contact with the battery terminals.

7 Determining Battery Manufacturing Date

Location of Serial Numbers

The battery serial numbers are located in two places on the battery case.

The first is on the front of the battery. The manufacturing date is also located on this label below the serial number.

The second is on the right hand side towards the rear of the battery (see picture below).

Manufacturing codes are limited to 12 alphanumeric digits:

- The first two digits specify the model of the monobloc.
- The remaining ten digits are a random, non-sequential serial number which is unique to this particular monobloc and will not be duplicated.

8 Handling

8.1 Receiving the shipment

Carefully examine the battery shipment upon arrival for any signs of transit damage and that it agrees with the materials list or packing slip. Be very careful not to inadvertently discard any accessories contained in the packing material. Batteries contain sulfuric acid in glass fiber separators. Use rubber gloves when handling broken or damaged containers in case of acid leakage.

In addition to safety requirements (see section 6) special care should be taken when handling batteries. The following are some DOs and DON'Ts.

8.2 Do

- Always use the handles on the batteries when lifting or carrying them.
- Always perform a visual inspection of the battery prior to handling. If any damage or electrolyte leakage is detected during this inspection do not install the battery.
- Always use the battery packing from new batteries for transporting old batteries for proper disposal. Having batteries loose during transportation can lead to an accidental short circuit between terminals, or to damage of the batteries and electrolyte leakage.

8.3 Don't

- Never drag a battery along the floor. Doing so could cause damage to the battery case leading to leakage of electrolyte and damage to equipment.
- Never install a battery that has been dropped. A dropped battery could have internal damage causing premature failure or unsafe operation.
- Never drill, or in any other way attempt to breach the battery case.
- Do not move the batteries using the battery terminals. The terminals are not designed to support the weight of the battery, and damage to internal components could result.

9 Storage

9.1 Storage conditions

Below is a list of equipment that is recommended to be on hand in the area where batteries are stored.

- DC volt meter
- Battery chargers
- Mechanical lifting device (such as a fork lift etc.)
- Appropriate Personal Protective Equipment (PPE), which is listed in the battery SDS

The SDS document is titled SDS-430-00607 and can be downloaded from the internet at www.northstarbattery.com

It is strongly recommended to store the batteries in a clean, cool and dry environment.

The batteries should be stored in the original containers. The packaging serves to protect the batteries from harsh environmental conditions and accidental damage. If they must be removed, palletize them, and utilize as much of the original packaging as possible.

Since the batteries are supplied charged, storage time is limited. During storage, lead-acid batteries will gradually self-discharge. The rate of self-discharge increases with increasing temperature. As a result, maintenance charging needs to be performed more frequently at higher temperatures. In order to easily charge the batteries after prolonged storage, it is advised not to store it more than:

- 24 months at ambient temperature no warmer than 77°F (25°C)
- 20 months at 86°F (30°C)
- 11 months at 104°F (40°C)

Give the battery a freshening charge before the end of the recommended storage interval. A refreshing charge shall be performed with at least 2.27 V/cell at 77°F (25°C) for at least 5 days. Failure to observe these conditions may result in greatly reduced capacity and service life.

FAILURE TO CHARGE AS NOTED VOIDS THE BATTERY'S WARRANTY

9.2 Shelf Life

NorthStar batteries have a two year shelf life at +25° C (+77°F).

10 Commissioning/Installation

10.1 Unpacking the Batteries

When received the batteries should be inspected. Make sure the batteries were not damaged during transport, and that all the proper accessories were included in the delivery. If problems arise, please initiate a claim immediately.

10.2 Checking the Voltage Spread

Before connecting the monoblocs in series, the voltage variation must be checked. If the voltage varies more than 0.15 V between the highest and the lowest monobloc voltage, the monoblocs should be charged individually before being connected in series. Refer to the recharge table(s) in this manual for the particular monobloc type used.

10.3 Installation

Install in clean, dry area. NorthStar batteries release negligible amounts of gas during normal operation, because they have a high gas recombination efficiency. They can be installed near the mains equipment. Batteries must be installed in accordance with federal, state and local law regulations and manufacturers instructions.

10.4 Temperature

Avoid placing the battery in areas of high temperature or in direct sunlight. The battery will give the best performance and service life when working at a temperature between 68°F (20°C) and 77°F (25°C). The usual operating temperature is between -4°F (-20°C) and 113°F (+45°C). Operating limits have been tested between-40°F (-40°C) and +158°F (+70°C).

10.5 Ventilation

Under normal conditions gas release is very low and natural ventilation is sufficient for cooling purposes and inadvertent overcharge, enabling NorthStar batteries to be used safely in open spaces in offices and with mains equipment. However, care must be taken to ensure adequate ventilation when the batteries are placed in cabinets. If cabinets are used they must be ventilated.

10.6 Security

All installation and ventilation must comply with the current federal, state and local regulations.

10.7 Putting the Batteries in Place

NorthStar battery racks or cabinets are recommended for proper installation. Assemble the rack according to instructions. Place the battery blocs or cells on the rack and arrange the positive and the negative terminals for connection. Make sure the batteries are all evenly spaced approximately 10mm (3/8 inch) apart, aligned and resting on a flat surface. It is strongly recommended that the surface the batteries rest on is acid resistant, and electrically insulated. It is important that the battery is mounted firmly.

10.8 Battery Terminal Preparation

To minimize contact resistance, it is important that the terminals of the battery be cleaned of any oxidation. Lightly brush the terminal contact surface areas with a brass bristle brush, or the equivalent, and then apply a light coat of antioxidant grease such as a conductive NO-OX-ID to the surfaces to protect the terminal from future oxidation or corrosion. Wipe clean prior to installing hardware.

10.9 Torque

The maximum torque load of intercell connector bolts is provided on the front battery label based on the size of the battery. A loose connector can cause problems in charger adjustment, erratic battery performance, and possible damage to the battery and/or personal injury. Finally, install the connector covers (optional).

Battery model	Recommended torque	Maximum torque with FT adapter	Max torque with solid link
NSB12-310	8.0 Nm (71 in-lbs)	N/A	8.0 Nm (71 in-lbs)
NSB12-425	8.0 Nm (71 in-lbs)	N/A	8.0 Nm (71 in-lbs)
NSB12-540	8.0 Nm (71 in-lbs)	N/A	8.0 Nm (71 in-lbs)
NSB12-170RT	8.0 Nm (71 in-lbs)	N/A	8.0 Nm (71 in-lbs)
NSB12-245RT	8.0 Nm (71 in-lbs)	8.0 Nm (71 in-lbs)	8.0 Nm (71 in-lbs)
NSB12-365RT	8.0 Nm (71 in-lbs)	8.0 Nm (71 in-lbs)	8.0 Nm (71 in-lbs)
NSB12-425RT	8.0 Nm (71 in-lbs)	8.0 Nm (71 in-lbs)	8.0 Nm (71 in-lbs)
NSB12-450RT	8.0 Nm (71 in-lbs)	8.0 Nm (71 in-lbs)	11.0 Nm (100 in-lbs)
NSB12-650RT	8.0 Nm (71 in-lbs)	8.0 Nm (71 in-lbs)	11.0 Nm (100 in-lbs)
NSB12-730RT	8.0 Nm (71 in-lbs)	8.0 Nm (71 in-lbs)	11.0 Nm (100 in-lbs)

10.10 Connecting the Batteries

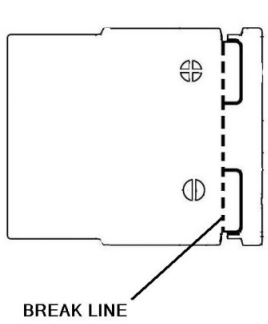
Please be aware of the risk of short circuits when connecting batteries in series strings. A short-circuit can result in the arcing of very high currents. Circuit breakers or other means of disconnection should be in an open or off position.

A torque wrench, set to proper torque values according to the battery label, must be used for making the terminal connections. When heavy cables are used they need to be supported with cable ties in order to limit stress on the battery terminals.

Check that all contact surfaces are clean, and then install the bloc or cell connectors and the terminal screws. Tighten the screws securely. Follow the polarity to avoid short circuiting of cell groups. Finally connect the battery terminals. The insulation covers should be put back after all connections have been completed.

See the following figures:

Insulation Cover



10.11 Front Terminal Adapter

NSB UPS batteries may be ordered with optional front terminal adapters if front terminal access is required in the installation.

19” Battery w/ Front Terminal Adapter

23” Battery w/ Front Terminal Adapter

10.12 Battery Connection to Load/Charger

Select the proper size and type cable and busbar per the NEC or other applicable code which can handle the charge and discharge current related to the battery. The cable size selected should also consider the cable resistance per foot and the voltage drop allowed between the battery output terminals and the load.

A cable voltage drop of no more than 0.5V is recommended.

10.13 Parallel Battery Strings

The following guidelines should be followed when operating parallel strings of batteries:

- Batteries should all be of the same model number
- Each string should be connected to an individual disconnect or circuit breaker
- Cabling to each string should be of the same size and approximate length resulting in the same resistance per string.

- The size cable selected should consider the NEC code, allowable voltage drop and maximum load current expected per string.
- All parallel strings should be joined in parallel at a separate busbar, "J" box or the UPS.
- Applications with more than five parallel strings should contact NorthStar Battery.

10.14 Commissioning the Batteries

Batteries lose some initial charge during shipment and storage, therefore it is highly recommended to give the batteries a refreshing charge prior to commissioning. Failure to observe these conditions may result in greatly reduced capacity and service life.

Charging Regime Prior to Qualification Testing

Case 1)
For batteries that have a date code older than 6 months:
a. Equalization charge the battery strings at 2.41vpc for four hours
b. Reduce voltage to 2.35vpc for eight hours
c. Reduce voltage at battery to 2.27vpc and float for at least four hours to let all the gas generated during charging recombinate.

Case 2)
For batteries that have a date code less than six months:
a. Refresh/Boost charge the battery string at 2.35vpc for twenty-four hours
b. Reduce voltage at battery to 2.27vpc and float for at least four hours to let all the gas generated during charging recombinate.

10.15 Battery Sizing Calculator

The UPS Battery Sizing Calculator is designed to help determine the number of VRLA battery strings required to support a UPS load.

Step 1: Calculating the power required from the battery system, KWb.

The power required from the battery (KWb) to support the UPS load can be calculated manually. To calculate the KWb, you need the following information, Size of UPS in KVA, Power Factor and Inverter Efficiency.

The KWb can be calculated using the formula below.

KWb = ((Size of UPS) x (Power Factor))/(UPS Efficiency)

For example,

KWb= ((800KVA) x (1.00)) / 0.975 = 820.5 KWb

Step 2: Calculate the watts/2V cell required to support KWb load

The DC Link Voltage is required in order to determine the number of 12V batteries required in the string, as well as the power required from the battery in watts/cell. Each lead acid VRLA battery has six (6), 2V cells connected in series to make a 12V battery.

The watts/cell can be calculated using the formula below.

Watts/cell = ((KWb) x (1000 watts/KW) / (DC Link Voltage/2V per cell)
For example on a 480V UPS,

Watts/cell = ((820.5KWb) x (1000 Watts/KW) / (480V/2v/cell) = 3419 watts/cell

Step 3: Determine the watts/2V cell available from battery.

To determine the number of parallel battery strings required to support the load, the watts/2V cell for specific batteries, runtimes and end voltages needs to be determined. In order to determine the following information is required:

Required Run Time - How long does the load need to be supported?

End Cell Voltage - Voltage at which the UPS stops the discharge.

Temperature Compensation - Adjustment to compensate for power loss or gain due to changes in temperature from 25°C.

Safety or Aging Factor - A Safety or Aging Factor can be used to adjust the power required. NorthStar recommends that at a minimum a 5% safety factor is used to compensate for cable losses within a cabinet.

For our example:

Runtime = 10 Min
End Voltage = 1.67VPC
Temperature = 25°C
Safety Factor =5%

The watts/2V cell can be found in the NorthStar's Constant Power Discharge Ratings Tables. For a 10min discharge and an end voltage of 1.67 vpc the NSB12-730RT provides 899 watts/2V cell.

To apply the Safety or Aging Factor multiple the watts/2V cell by (100%-Safety Factor) 95% = 899 watts /2V cell x (100% – 5%) = 854.3 watts/ 2V cell.

To calculate the number of strings required, divide the system watts/2V cell by the battery watts/2V cell.

For example:

System Requirement is 3419 watts/2V cell
Adjusted Constant Power for battery is 854.3

Number of Strings = (3419 watts/2V cell) / 854.3 watts/2V cell = 3.998 cabinets, Round up to the nearest whole number, or 4 strings of NSB12-730RT's required to support 800kW l

11 Maintenance

11.1 Preparation for Periodic Maintenance

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 visual check of the battery.

Batteries will stabilize over a 30 day period at which time the initial baseline for monitoring should be recorded.

11.2 Required Maintenance Tools and Equipment

At a minimum, the following tools and equipment are required to maintain and troubleshoot the batteries.

- Digital Voltmeter
- Socket Wrenches, Insulated
- Box End Wrenches, Insulated
- Torque Wrench calibrated in inch-lbs
- Appropriate level PPE (see NFPA 70E)
- Potable Eye Wash
- Spill Kit
- Fire Extinguisher (class C)

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

- Micro-ohm meter
- Battery resistance, impedance, or conductance meter.
- 100 amp momentary load test set.
- System load bank (DC if to be performed at the battery or AC if to be performed by loading the UPS output).
- Thermal imager or infrared temperature scanner

11.3 Quarterly Maintenance

The following checks should be completed quarterly.

- If installed, review all battery monitoring (BMS) data.
- Assure the battery room is clean, free of debris and well lighted.
- Assure that all facility safety equipment is available and functional.
- Measure and record the air temperature within the battery room.
- Immediately record the battery or shelf temperature when the cabinet doors are opened.
- With thermal imager or infrared temp scanner, check batteries and links hot spots.
- Visually inspect the batteries for:
  a. Cleanliness
  b. Terminal damage, evidence of heating or corrosion.
  c. Container or cover damage
  d. Case swelling
- Verify the rectifier voltage setting.
- Measure and record the battery system DC float charging voltage at the battery.
- Compare the rectifier setting and string battery voltage for consistency.
- Measure and record the AC ripple voltage.
- Measure the DC voltage from each polarity of the battery to ground to detect any ground faults.
- If possible, measure and record the battery system DC and AC float charging current.
- Measure and record the individual unit DC float charging voltage.

11.4 Semi-Annual Maintenance

- Repeat the quarterly checks.
- Optionally perform the 10 sec. high rate (e.g. 100 amp) load test to assure the individual batteries are functional.
- If no battery monitoring service (BMS) is installed, 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.

11.5 Annual Maintenance

- Repeat semi-annual checks.
- Re-torque the intercell connector bolts to 71 in-lbs.
- Equalization charge of 2.41vpc for 6 hours.

11.6 Bi-Annual Maintenance

The battery should be capacity tested every two years at the service load or at the battery rating related to service requirements. Ideally, 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. The above record taking is the absolute minimum to protect the warranty. This data will be required for any warranty claims on the batteries.

11.7 Cleaning

The plastic battery containers are not compatible with many commercially available chemicals including cleaning products and insecticides. These chemicals can damage the battery case and cause leakage of sulfuric acid. If the battery needs to be cleaned, use water. Do not spray insecticides directly on the batteries.

12 Warranty Information

A warranty sheet provided by NorthStar needs to be filled in for each installation and returned by e-mail to the following address:

quality@northstarbattery.com

13 NorthStar ACE® FCC / IC Specific Information

All our NorthStar ACE® batteries have been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:Reorient or relocate the gateway.

- Reorient or relocate the gateway.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult an experienced technician for help.

This device complies with part 15 of the FCC Rules and with Industry Canada's license-exempt RSSs. Operation is subject to the following two conditions:

1. This device may not cause interference; and
2. This device must accept any interference, including interference that may cause undesired operation.

Cet appareil est conforme aux RSS d'exemption de licence d'Industrie Canada. L'opération est soumise aux deux conditions suivantes:

1. *Cet appareil ne doit pas causer d'interférence ; et*
2. *Cet appareil doit accepter toute interférence, y compris les interférences pouvant entraîner un fonctionnement indésirable de l'appareil*

Caution: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. The device must not be co-located or operating in conjunction with any other antenna or transmitter.

L'appareil ne doit pas être situé au même endroit ou fonctionner avec d'autres antennes ou émetteurs.

The ACE Gateway equipment operating in the 2.4 GHz band requires a separation distance of at least 20 cm. This distance must be maintained between the user and product when the product is operating.

14 Contacts

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