GE
Critical Power

# *HR Series Batteries*

# *Product Manual*

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# *HR Series Batteries*

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# 1 Introduction: Product Description and Customer Services

## Introduction

This product manual supplies information on the GE Critical Power 2000 HR Series Battery. The HR Series Batteries, shown in Figures 1-1 through 1-3, are valve-regulated lead-acid batteries. All of the battery components and the manufacturing processes meet strict specifications and quality standards.

### Product Description

The HR Series Battery is a valve-regulated rechargeable stationary lead-acid battery designed to meet specific and often unique and/or high rate application requirements. The HR Series Battery was designed to ensure long life and high discharge rates for short duration, to provide reliable service and to reduce lifetime maintenance costs. It is especially useful in applications where space is limited, high discharge rates, comparatively high cycle or operating temperatures are expected, and minimal maintenance is desired. The HR Series Battery is an excellent choice in valve-regulated batteries for standby reserve applications.

# *Specifications*

**Table 1-A: HR Series Battery Specifications**

| HR Series Model No. | Nominal Voltage | Comcode | Amp-Hrs @ 8 Hr Rate | Amp-Hrs @ 5 Min Rate | Charging Method | Dimensions WxDxH | Electrolyte Volume (approximate) | Total Weight |
|---|---|---|---|---|---|---|---|---|
| 12HR30ET | 12V | 407606227 | 25 | 10 | Constant Voltage or Constant Current | 6.6”x5.4”x7.4” | 1. 5 liter | 26.2 lb |
| 12HR30SX | 12V | 407606235 | 25 | 10 | Constant Voltage or Constant Current | 6.6”x7.1”x5.0” | 1.5 liter | 25.8 lb |
| 12HR40SX | 12V | 407606243 | 37 | 15 | Constant Voltage or Constant Current | 7.9”x6.6”x6.8” | 2.5 liter | 34.5 lb |

The 12HR30ET comes equipped with the standard cable assembly shown in Table 1-B.

**Table 1-B: 12HR30ET Cable Assembly**

| Comcode | Wire Length | Wire Size | Battery Termination | Customer Interface | Capacity |
|---|---|---|---|---|---|
| 407606227 | 25 in. | 14 Guage | 2 Ring Terminal | 1 (2-Pin) Amp 35077-1 | 12 Amps |

Optional cable assemblies available for all HR Series Batteries are listed in Table 1-C.

**Table 1-C: HR Series Battery Optional Cable Assemblies**

| Comcode | Wire Length | Wire Size | Battery Termination | Customer Interface | Capacity |
|---|---|---|---|---|---|
| 407606599 | 2x25 in. | 14 Gauge | 2 Ring Terminal | 1 (2-Pin) Amp 35077-1 | 12 Amps |
| 407606581 | 4x25 in. | 10 Guage | 2 Ring Terminal | 1 (4-Pin) Amp 350779-1 | 24 |
| 407606565 | 2x25 in | 8 Guage | 2 Ring Terminal | 2 Ring Terminal (1/4 in. Bolt Size) | 55 |
| 407606573 | 2x25 in | 2 Guage | 2 Ring Terminal | 2 Ring Terminal (1/4 in. Bolt Size) | 140 |

## *Benefits*

**High Rate Capabilities:** The HR Series Batteries have very high volumetric and gravimetric power densities at high rates of discharge. The HR Series batteries offer excellent high rate capabilities due to their thin plate design.

**Simple Maintenance:** Because of its copper alloy posts, leakproof post seal and valve-regulated design, the HR Series Battery is virtually maintenance-free and requires only recording of battery voltage and temperature every 6 months.

**Space Efficiency:** The HR Series Batteries provide extremely high energy density compared to flooded designs.

**Improved Safety:** The HR Series Battery is ideal for most operating environments because of its leakproof seals, flame retardant jar, flame arrestor, and cover that meets UL94-V0, and low gassing rate (compared to flooded design).

## *Features*

### Valve Regulated Design

The valve regulated design and construction prevents electrolyte leakage and minimizes water loss and maintenance throughout the design life of HR Series batteries. During normal operation, oxygen is generated at the positive electrode and recombined at the negative electrode with a
95-99% efficiency. In conventional (flooded) lead-acid cells, during normal float operation, these electrochemical reactions result in water loss from the electrolyte. The self-resealing pressure release safety valves in HR Series batteries are designed to allow controlled escape of gases from within the cells without periodic venting of internal gases. In addition, the safety valves prevent the build-up of excessive internal pressure resulting from abusive charging conditions.

**Warning**

| |
|---|
| Some oxygen and hydrogen will escape through the battery container and safety valves. To avoid explosion, never store or operate batteries in a gas tight environment. |

## *Additional Features*

- Minimal maintenance requirement
- Easy installation and replacement
- High reliability
- Flame retardant polypropylene oxide (UL 94V0) container and cover.
- Long float life: 8 years at 77$^{o}$F (25$^{o}$C)
- 200 cycles at 80% depth of discharge
- High energy density
- Better than 99% recombination efficiency at normal float voltage at 77ºF.
- Flame arrester
- Pure lead/tin positive grids for low corrosion and high life cycle
- Leakproof post seals over the useful life of the battery
- Low water vapor transmission
- Low float current

## *Reference Documents*

Product manuals, product line brochures, and software are available on-line at www.gecriticalpower.com
Software includes Easy View and SNMP MIB

| Document | Title |
|---|---|
| | Infinity M Product Line Brochure – Specifications and Ordering Guide |
| H5692448-AD | NE System, 24V and/or 48V Assembly Drawing |
| CC848815341 | Galaxy Pulsar Plus Family Product Manual |
| 108994645 | Galaxy Millennium II Installation and User's Guide |

## *Contact Information*

Phone: +1 888 546-3243
Email: PE.TechSupport@ge.com
Web site: www.gecriticalpower.com

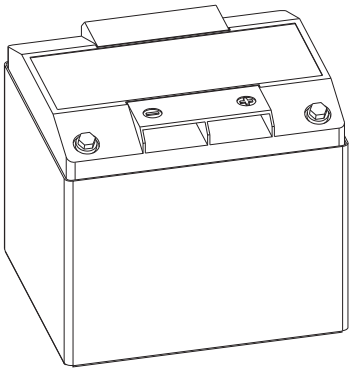

***Figure 1-1: 12HR30SX Battery***

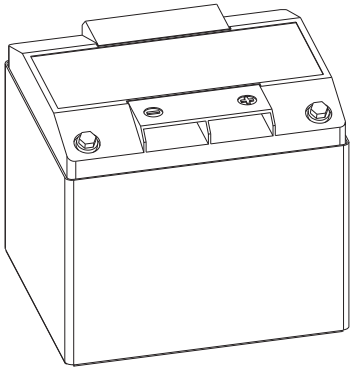

***Figure 1-2: 12HR40SX Battery***

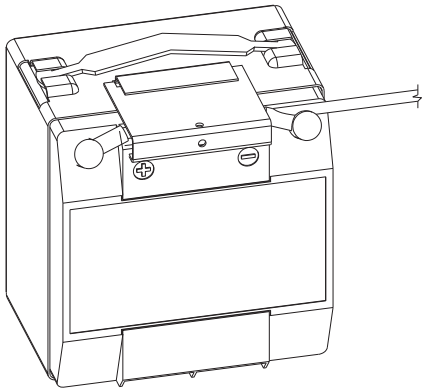

***Figure 1-3: 12HR30ET Battery***

# 2 Installation and Testing

## *Safety Precautions*

Read the following safety precautions carefully before attempting to unpack and install the batteries. Fully brief everyone permitted access to battery areas, working near batteries, or working with batteries on the hazards associated with lead-acid batteries. Additional information can be found in the Material Safety Data Sheet (MSDS) in Appendix C.

Batteries contain electrolyte (sulfuric acid and water), a highly corrosive substance. Wear protective equipment (e.g., rubber gloves, rubber aprons, full face mask, and splash-proof goggles) when handling batteries or cells. **The MSDS in Appendix C, under "Special Precautions" contains first aid information that everyone needs to understand before having access to the batteries**.

.

**DANGER**

**The use of insulated tools is mandatory. Never place uninsulated metal objects on top of a battery. Remove all metal jewelry such as rings and watches when working on or near batteries.**

Storage type batteries differ from other sources of power in that they are delivered to the points of installation as live units. A storage battery gives no indication, by its appearance, of the potential energy stored in it. Lead-acid storage cells/ batteries have enormous short circuit capability which can result in serious burns or create dangerous projectiles from the object

causing the short. Exercise extreme care to avoid any short circuits across the cell and/or battery terminals. Also, in a grounded battery system, use extreme care not to short any metal objects from the ungrounded battery terminal to ground (which can include the equipment metal chassis, building structure, cable racks, etc.). Shorting a cell or battery may result in damage to the battery and/or injury to personnel in the area. A tool or other metal object causing the short may be thrown or vaporized due to the energy produced by the battery or battery system. Shorted batteries may also explode.:

**DANGER**

**Battery gases can be highly explosive.**
**NO sparks (including static electric) or open flame are allowed near battery modules.**
**Do not smoke near batteries**

All lead-acid batteries generate hydrogen gas, even under open circuit conditions. If not permitted to escape, this gas can build up to explosive concentrations. NEVER tamper with or block the vent caps of the HR Series batteries. Damaged or clogged vent caps may result in an explosion due to excessive internal pressure. Such an explosion could short circuit other battery modules and result in a fire. ALWAYS place batteries in a well-ventilated area. Avoid creating sparks, including those from static electricity, or the use of an open flame near batteries since the gas generated by batteries is highly explosive. Before performing each work operation, firmly touch a ground to discharge the static electricity from your body.

To direct attention to the possible source of danger from battery gases, it is recommended to post one or more warning signs, lettered in large characters, in a conspicuous location near the batteries.

If the battery is to be installed on an electrically conducting surface, place a nonconducting mat or surface between the battery and the conducting surface. The stand and shelves supplied by GE Critical Power are typically coated with an nonconductive epoxy paint and, therefore, a mat is not necessary.

***First Aid*** Refer to the MSDS in Appendix C under “Special Precautions”.

***Safety Certification***

The HR series batteries comply with the requirement for sealed battery/cell pressure release test of UL924, Standard for Emergency Lighting and Power Equipment and UL1989 Standard for Standby Batteries.

## *Installation Tools, Materials and Test Equipment*

The following tools, materials, and test equipment are recommended for installation, maintenance and testing of the batteries.

- Chemical safety goggles and safety hard hat
- Acid resistant gloves, rubber overshoes and apron
- Lime and/or soda (sodium bicarbonate or sal soda)
- Cleaning cloth
- Combination wrench set, screwdrivers
- Sandpaper or abrasive cloth
- Thermometer
- DMM (Digital Multimeter) Fluke 8060 A or equivalent (The accuracy of an equivalent meter should be 0.05 percent on the dc scale.)

***Unpacking and Handling***

Use appropriate material handling equipment to ensure personnel safety and equipment protection while installing the batteries. Move crated batteries to a convenient predetermined area where the appropriate unpacking and handling equipment and tools are available.

The following items are provided with each pallet.

- NO-OX-ID A
- Hex-Head Cap Screws
- Flat Washers
- Product Manual

If possible, inspect the battery visually for shipping damage before it is completely unpacked. If it is determined that the battery should be returned to the manufacturer, it will be easier to return at this point than if the battery has been completely unpacked.

***Specific Unpacking Instructions***

1. Examine the shipping container and record any signs of external damage.

2. Search for any indications of acid spillage during shipment. Record any indications of acid spillage on the bill of lading before signing.
3. Check batteries for fractured jars and covers. Batteries with fractured jars and covers are defective and must not be used.
4. If the battery is found to be damaged when received, a claim can be initiated for replacement. The original battery must be shipped back in the original carton.

In case of accidental acid spillage, sprinkle lime or baking soda on the spillage; allow it to absorb the electrolyte, and then sweep it up and dispose of it in Federal, State, and Local Regulations. After unpacking, immediately check again for electrolyte spills.

**DANGER**

**Wear eye protection devices and rubber gloves when using lime on electrolyte spills. Wash hands and face thoroughly after use.**

## *Battery String Location and Installation*

The HR Series battery can be mounted in battery stands to create battery strings of various voltages.

HR Series batteries may be installed in an upright position or horizontal position as required by the specific application for the batteries.

Do not install batteries so that their weight is supported by the terminal connections.

Batteries contain hazardous material. Users need to take precautionary measures to contain spills, particularly those that might result from catastrophic failures such as earthquakes or tornadoes. Base your need for a spill containment system on building design and federal, state, and local codes and ordinances.

The operating environment must comply with the National Electric Code Article 110, “Requirements for Electrical Installations” and Article 480-8, “Battery Locations” and any applicable state and local regulations

### *Environmental Requirements*

The HR Series Battery, like all lead-acid batteries, is affected by its ambient temperature. The HR Series Battery can tolerate extreme temperatures in the range of -40° to 140° F (-40° to 60°C for short, infrequent periods (not more than 72 consecutive hours and not more than a total of 15 days in one year). Nevertheless, try to prevent the battery from being exposed to extreme temperatures.

Battery temperatures above $77^{o}$ F ($25^{o}$ C) decrease battery life while increasing battery capacity. For battery temperatures lower than $77^{o}$ F ($25^{o}$ C) the capacity will decrease, but battery life will not be adversely affected.

Battery temperatures within the same string must be maintained within $10^{o}$ F ($5.5^{o}$ C) of each other. When batteries must be installed where they will be exposed to heat radiation or direct sunlight, provide shields for the radiators or blinds for the windows to maintain the recommended temperature gradient. In particular the top row of a multi-tiered stand is apt to have a higher environmental temperature than the bottom. Where necessary, use fans or other means of ventilation to minimize the temperature variation.

**Note**

**The battery equipped with a metal jacket can survive short, infrequent periods (not more than 72 consecutive hours and a total of not more than 15 days in one year) of extreme temperature between -40° and 140°F (-40° to 60°C). Operating HR Series batteries for any significant interval of time outside the recommended voltage and/or temperature range will cause reduced performance and premature failure.**

## *Initial Performance and Installation*

To ensure full charge and adequate initial performance, charge the batteries at the time of installation according to the following guidelines:

### *Battery Storage*

The HR Series Battery is shipped fully charged. The maximum time that a charged HR Series Battery may stay on open circuit is six months at 77° F. The “charge by” date stamped on the

shipping container is the date at which the battery will have been on open circuit for six months. If the batteries cannot be put into service by this date, follow one of the maintenance procedures below and record the actions taken until the normal installation can be initiated.

**Caution**

**If the storage temperature exceeds 90° F (32° C), the time the battery stays on open circuit should NOT exceed four months.**

**DANGER**

**For maximum safety, batteries should NOT be handled during charging.**

- Maintain the battery on continuous float charge operation (13.62±0.06 volts per battery) until the normal installation can be done.
- Charge at 13.68±0.06 volts per battery (2.28 volts per cell), 8 hours a day, 5 days a week until the normal installation can be done.
- Protect the batteries from rain and sunlight.
- Never place objects on the battery.
- Provide adequate ventilation.

***Initial Charge*** The purpose of an initial charge is to compensate for self discharge that occurred in the interval between manufacture and installation. Under normal circumstances, the battery will regain most of its capacity after several hours float charge; 90% capacity should be obtained within 24 hours of float-charge. See Table 2-A for detailed initial charging instructions.

**Table2-A: Initial Charging**

| Battery Condition | Action |
|---|---|
| All batteries have similar date codes and storage histories and none are more than six* months old or, if they are, they have been maintained properly. | Make voltage and polarity checks and connect string(s) to plant. Charge at the float voltage of 13.68 ± 0.06 volts per battery. |
| Batteries have dissimilar date codes (more than one week apart) or storage histories. | Using an external charger, charge the string at 15 volts per battery until all batteries have voltages within 0.06 volts of each other. Continue this charge an additional 24 hours. Reduce to plant float voltage for 24 hours. Do not charge for more than 48 hours at the higher voltage (15 volts). Make voltage and polarity checks and connect string(s) to plant. |
| Batteries are older than six* months and have not been maintained or have an open circuit voltage of less than 12.0V. | Do not install. Replace batteries. |

*If storage temperature exceeds $90^{o}$ F ($32^{o}$ C), the open circuit time should not exceed four months.

## *Placing a Battery String Into Service*

Batteries should be in service within 48 hours of initial charge. If a battery is left on open circuit for more than 48 hours after the initial charge, treat it as if it had never received an initial charge.

Before connecting parallel strings together or individual strings to the plant bus, make three voltage measurements:

1. Make the first reading across the string to verify that the

batteries are connected properly and that the polarity is correct. (The string voltage should equal at least 12.6 volts times the number of batteries.)

2. Make the second measurement across the plant charge and discharge battery buses. The voltage difference between the string and plant should not exceed 0.05 volts unless the plant is at 0 volts because the chargers are turned off. If a larger differential exists, the string should be charged at the plant voltage (or the plant voltage lowered) until the voltage differential is less than 0.05 volts. (This should prevent arcing during the final connection.)

3. Make the final reading to record voltages of individual batteries. Record these in the battery maintenance record. See "Battery Voltage" in Section 3, Maintenance, for battery voltages.

## *Replacing a Battery in a String Already in Service*

New HR Series batteries may be intermixed directly into an existing string of older HR Series batteries (of the same nominal capacity) when necessary for replacement purposes.

Should it become necessary to replace one or more batteries in a battery string, the replacement battery(s) must be charged according to Table 2-B. Do not exceed the time on charge shown in Table 2-B. Following the initial charge, keep the battery(s) on continuous float at 13.62 volts per battery until the replacement can be made. The time between discontinuing the float charge and the completion of replacement should not exceed 24 hours.

**Table 2-B: Time on Charge**

| Volts per HR Series | Days on Charge |
|---|---|
| 13.62±0.06 volts | 7 days |

## *Installation Records*

The "Installation Battery Report" (see Appendix A) is an important part of the maintenance records. It is required for warranty validation. The installer is required to fill out the report and turn it over to the maintenance organization as part of their permanent records.

Use the "End of Charge Voltage" column in the report when the initial charge was at other than float voltage. Measure and record the voltage and current readings just prior to lowering the voltage to the float value.

Read and record the "Float at Turnover Voltages" after the cells have been at float voltage for more than one hour, provided that the rectifier is not at the current limit. These readings are the only ones required when a string is charged at float voltage, as is usually the case.

When a single replacement battery is being installed in a existing string, record both the "End of Charge Voltage" and the "Float at Turnover Voltage." Record the "Float at Turnover Voltage" one hour after the battery is installed in the string. Include a brief description of the charging procedure. For example: "Battery was charged at a central location for 2 days at 14.10V and then floated at 13.68V for 2 weeks before being brought to this site for installation. The battery was on open circuit for about 13 hours in transit."

# 3 Maintenance

## *Introduction*

Maintenance routines for the HR Series Battery are simple compared to flooded batteries. Proper maintenance ensures good performance. The maintenance routines are divided into two groups. Table 3-A provides the required maintenance procedures and intervals for the HR Series Batteries. The intervals in Table 3-A are the maximum allowed. **Failure to adhere to these maintenance schedules will void the warranty.** If possible, perform the maintenance routines more frequently, preferably on a quarterly basis. Table 3-B lists other suggested routines. The far right column in Tables 3-A and 3-B reference the appropriate section of this manual for performing the task. Use the form in Appendix A for a maintenance record.

**Table 3-A: Required Maintenance Intervals**

| Routine | Action | Interval | Reference (Heading in this Section) |
|---|---|---|---|
| String Voltage | Measure/ Record | Six months | Battery string float voltage |
| Battery Voltage | Measure/ Record | Six months | Battery voltage |
| Battery Temperature | Measure/ Record | Six months | Battery temperature |
| Battery, Rack, Inter-Battery Connections | Inspect, Clean (If Necessary) | Six months | Clean and inspect |

**Table 3-B: Suggested Maintenance Routines**

| Routine | Action | Interval | Reference |
|---|---|---|---|
| Discharge Test | Measure/ Record | Optional | Discharge capacity test |

## *Battery String Float Voltage*

It is extremely important to maintain the battery at the proper float voltage. The float voltage is determined as follows:

Battery String Voltage = recommended float voltage per battery x number of batteries

For example, a 4-battery string of HR Series batteries should be floated at:

Battery String Voltage = 13.62 volts x 4 batteries = 54.48 volts

The recommended float voltage per battery is 13.62 volts ± 0.06 volts at battery temperature of 77°F (25°C). A Fluke 8060A DMM (Digital Multimeter) is suitable for battery voltage readings. The accuracy of an equivalent meter should be 0.05 percent on the dc scale. Check the meter periodically for accuracy and calibration.

## *Battery Voltage*

Read individual battery voltages periodically to ensure that they are floating properly. Readings for each battery must be within ±0.12 volts of the string average (the string average is calculated by dividing the string voltage by the number of batteries in the string). Any battery that reads less than 13.02 volts is considered to be shorted and must be replaced. Because float readings are affected by discharges and recharges, these readings must be taken when the batteries have been on continuous, uninterrupted float for at least one month.

## *Charging Voltage Ripple*

The amount of ac voltage ripple present on the charging voltage for the battery can seriously affect battery performance. Excessive ripple could result in sharply reduced battery life and increased gassing rates. Both the amplitude and frequency of the ripple affect the degree of battery degradation. As a guideline,

**Caution**

Be very careful when making voltage readings to prevent accidental grounding or shorting of leads during measuring operations. Connections at the meter must be secure and free of any possibility of touching without first disconnecting the test leads from the battery. Remove test lead connections at the battery immediately after each reading is taken. Review the safety precautions.

the charging voltage ripple for the HR Series battery should not exceed 60mV peak to peak per [six-cell] battery or last longer in duration than 8mSec. **AC charging ripple greater in magnitude than 60mV peak to peak per battery or longer in duration than 8mSec should not be used without prior consent of GE Critical Power; failure to comply can void the Warranty.**

## *Battery Temperature*

The HR Series batteries, like all lead-acid batteries, are affected by their ambient temperature. The HR Series batteries can tolerate extreme temperatures (up to 140° F or 60° C) for short, infrequent periods. Nevertheless, make every effort to prevent the battery from being exposed to extreme temperatures. Elevated battery temperatures (greater than $77^{o}$ F or $25^{o}$ C) decrease battery life. Temperatures below $77^{o}$ F ($25^{o}$ C) result in lower battery capacity . Applications should allow for battery temperatures within the same string to be within $10^{o}$ F ($5.5^{o}$ C) of one another. Since hot air rises, the top row of a multi-tiered stand configuration is apt to have higher temperatures than the bottom row. Where necessary, use fans or other means of ventilation to minimize temperature variations between batteries in the same string. You may measure battery temperature by taping a thermometer to the surface (on the can) of one battery and waiting two minutes before reading.

In order to reduce the effects of sustained high temperature operation, the battery float voltage should be reduced at higher battery temperatures. One commonly used method reduces float voltage by 18mV/°C/battery for battery temperatures above 77°F (25°C).

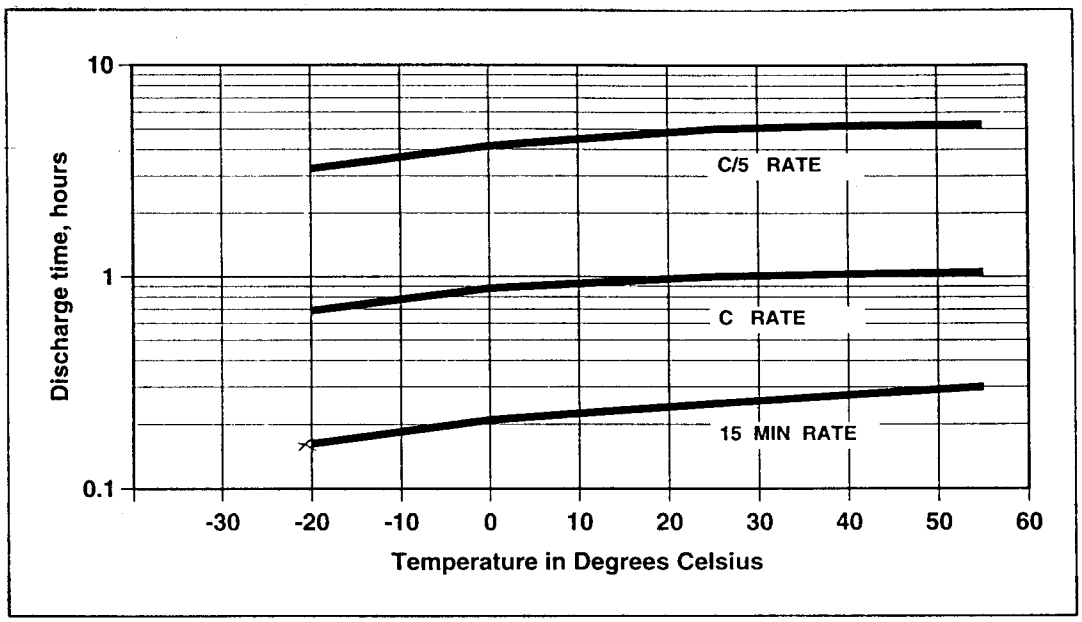


***Figure 3-1: Capacity as a Function of Temperature***

## *Clean and Inspect*

Inspect the battery plant visually twice a year. If necessary, clean the batteries and racks using a soft cloth dampened in water. Inspect the inter-battery connections for corrosion. Report any sign of acid or corrosion to GE Critical Power.

## *Retorquing Inter-Battery Connections*

The inter-battery connections are made during installation and will require periodic retorquing. Retorque these connections using an insulated 7/16-inch socket and torque wrench set at 80 inch-pounds.

## *Discharge Capacity Test*

Since the HR Series Battery is an 8 year battery at 77° F (25° C), this test is not required as a routine maintenance procedure. However, a discharge test is the best way to determine if sufficient reserve power is available.

The discharge capacity test should be run directly off float charge without prior boost charge. Battery strings to be tested should be on float for at least one month without a boost charge or power failure exceeding 30 minutes.

There are several different methods that can be used in testing the capacity of the string. In general, the more definitive the test, the longer and more difficult it is to perform. For example, measuring individual battery voltages after 15 minutes on a plant load discharge will highlight batteries with only 25% capacity. However, it usually requires a 5 hour, off-line discharge test to spot a 5% fading in capacity.

If you decide that a discharge test should be part of the maintenance program, try to carry out the test consistently from site to site and interval to interval. In this way, comparisons and trends can be easily noted. In selecting a test the choices are as follow:

- single battery or string
- partial or full discharge
- constant or variable load

The easiest test to run is to shut off the ac power and let the plant load discharge the batteries until 20% to 50% of the capacity has been removed. The disadvantage of this type of test is that the current may not be constant throughout the discharge, from interval to interval, or from site to site. This disadvantage can be overcome by adding an external load to the bus. This load can be adjusted throughout the discharge to maintain a constant current.

In light of the above, a one-hour discharge similar to the plant load of a single battery string off-line is the preferred routine maintenance test. The one-hour discharge rate to 11.4 volts is a reasonable value since it will leave approximately 60% reserve at a lower rate. A single-string, off-line, five-hour rate to 10.5 volt discharge test should only be done on those rare occasions where a very accurate appraisal of the capacity is required. It is not suggested to be used on a routine basis. To carry out a discharge test properly, measure and record the time, current, battery voltages and initial battery temperature. The

thermometer should be accurate to within 2°F (1°C) to achieve reasonable accuracy. The current and the time should be measured to an accuracy of 3% and the module voltage measured to the nearest millivolt.

## *Capacity*

The capacity of a battery is expressed as a percent of its rated value. For example, if a battery is discharged at the 8 hour rate and it lasts 8.50 hours to reach 10.5 V/Battery, it is said to have 106% or its rated capacity. Figures 3-1 and 3-2 illustrate the effect of temperature on capacity for 12HR30 and 12HR40 batteries at the C/8 discharge rate.

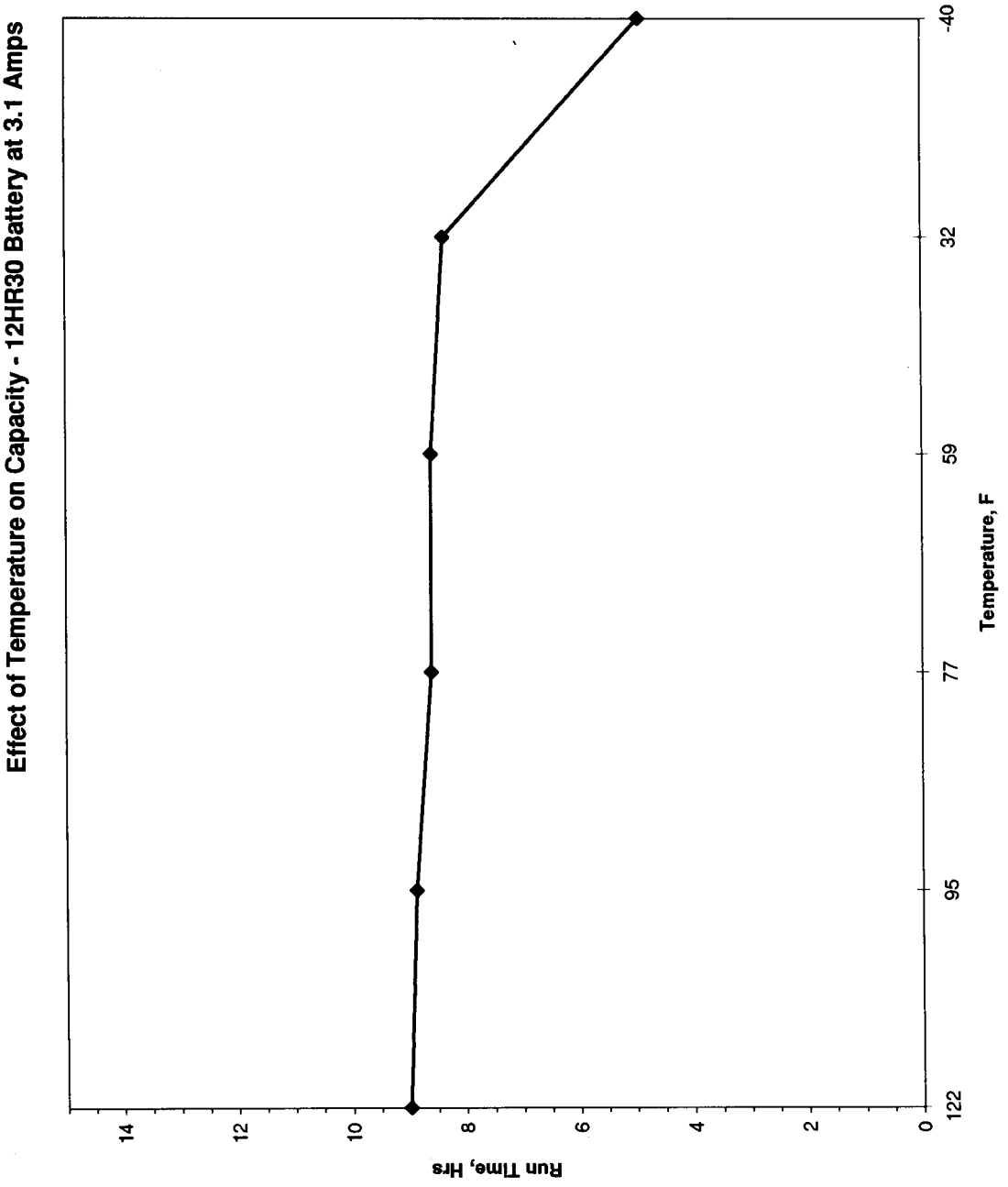


***Figure 3-2: Temperature/Capacity - 12HR30***

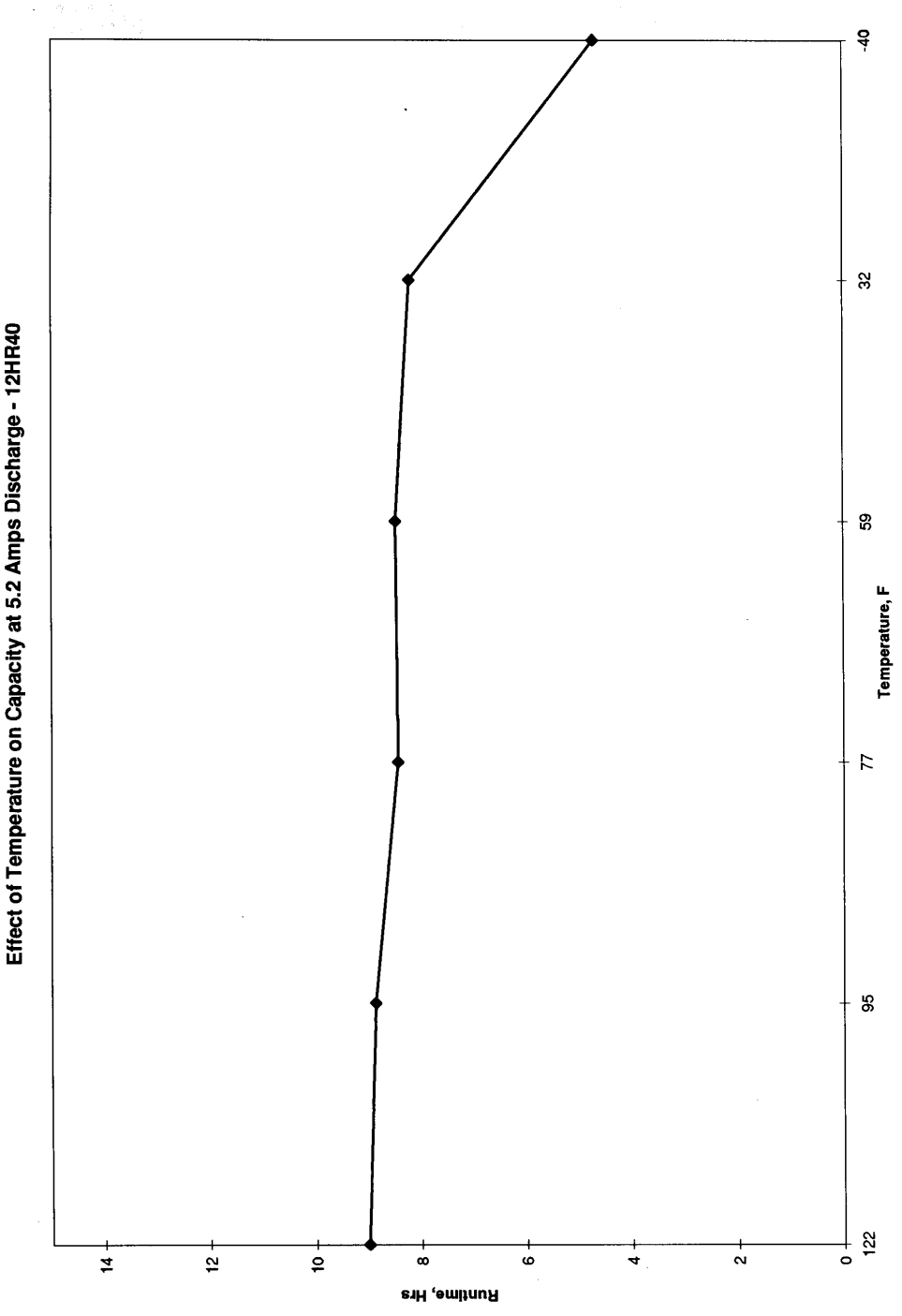


***Figure 3-3: Temperature/Capacity - 12HR30***

***Recharge After Discharge***

Recharge at the normal float voltage of 13.62 volts per battery. The recharge should begin as soon as possible after the discharge.

## *Boost Charge*

A boost charge is applied to the batteries for two reasons, to shorten the recharge time and to correct battery float voltage imbalance. During a boost charge, water loss due to electrolysis is greatly increased. In starved electrolyte cells, frequent or prolonged boost charges can result in premature failure caused by cell dry-out. Boost charging at elevated battery temperatures can be especially detrimental to the batteries. **Therefore, boost charging the HR Series batteries is not recommended without the concurrence of GE Critical Power.**

## *Opening the Battery Connections*

**DANGER**

An explosion could occur when sparks are created near the battery string. Check that the batteries are not charging or discharging before loosening or removing battery connections as sparks may occur. As always, adequate ventilation must be provided.

**Caution**

Overtightening of the inter-battery connectors could strip the bolt and/or nut threads resulting in loose connections.

Ensure that all battery connections are tight with the exception of the connection that is being opened.

**Note**

Use insulated torque and 6-point socket wrenches to tighten connections.

## *Flame-Arrestor Vent Feature*

Each HR Series battery contains six pressure-regulating vents (one per cell) located in the jar cover. The vents are covered with a porous plastic disk which acts as a flame arrestor. The vents and flame arrestor are maintenance free and do not require attention under normal circumstances.

**Warning**

| |
|---|
| Do NOT allow gas vents to become clogged or excessive internal pressure may result. |

## *Acid Spills and Corrosion*

**Warning**

| |
|---|
| Clean only the metal battery stands with a wire brush.<br>Never bring the wire brush close to terminals or inter-battery connectors. |

Any sign of battery acid on the batteries, battery steel can, stands, floor or signs of metal corrosion on the stands or bus bars indicates the possibility of an acid leak. Replace batteries which are leaking as soon as possible. To determine if a liquid is indeed battery acid, sprinkle a small amount of baking soda on it. If a fizzing type reaction occurs, the liquid is battery acid. Replace the leaking battery. Clean corrosion on metal battery stands with a metal brush. Recoat the corroded area with epoxy.

# *4 Operation*

## *Service life*

HR Series batteries have an expected life of 8 years in float-standby application where the maximum annual battery temperature is 77°F (25°C). Battery temperature exceeding 77°F (25°C) will decrease expected life by approximately 50% for each 18°F (10°C) increase in average temperature. Therefore, it is important to consider the temperature of the battery environment when designing equipment or determining battery life expectancy.

## *Charging*

HR Series batteries may be charged either by constant potential or constant current methods. A potential of 13.62 ±0.06 volts per 12V battery for constant voltage or a constant current which results in 13.62 to 13.68 volts per 12V battery is recommended for float-standby applications at 77°F (25° C). If the batteries must be operated in high temperature (greater than 77°F or 25° C) environments, it is recommended that the battery float voltage be reduced by approximately 18mv/°C/battery for temperatures above 77°F (25°C) and the battery float voltage be increased by approximately 24 mv/°C/battery for temperatures below 77°F (25°C).

**Note**

The maximum recommended operating range is -40° to 140°F (-40° to 60°C) battery temperature. Operation of HR Series batteries for any significant interval of time outside the recommended voltage and/or temperature range will result in reduced performance and premature failure.

## *Capacity*

The discharge capacity of HR Series batteries is directly related to temperature and inversely related to the discharge rate. See Figures 4-1,through 4-12 for characteristic discharge curves.

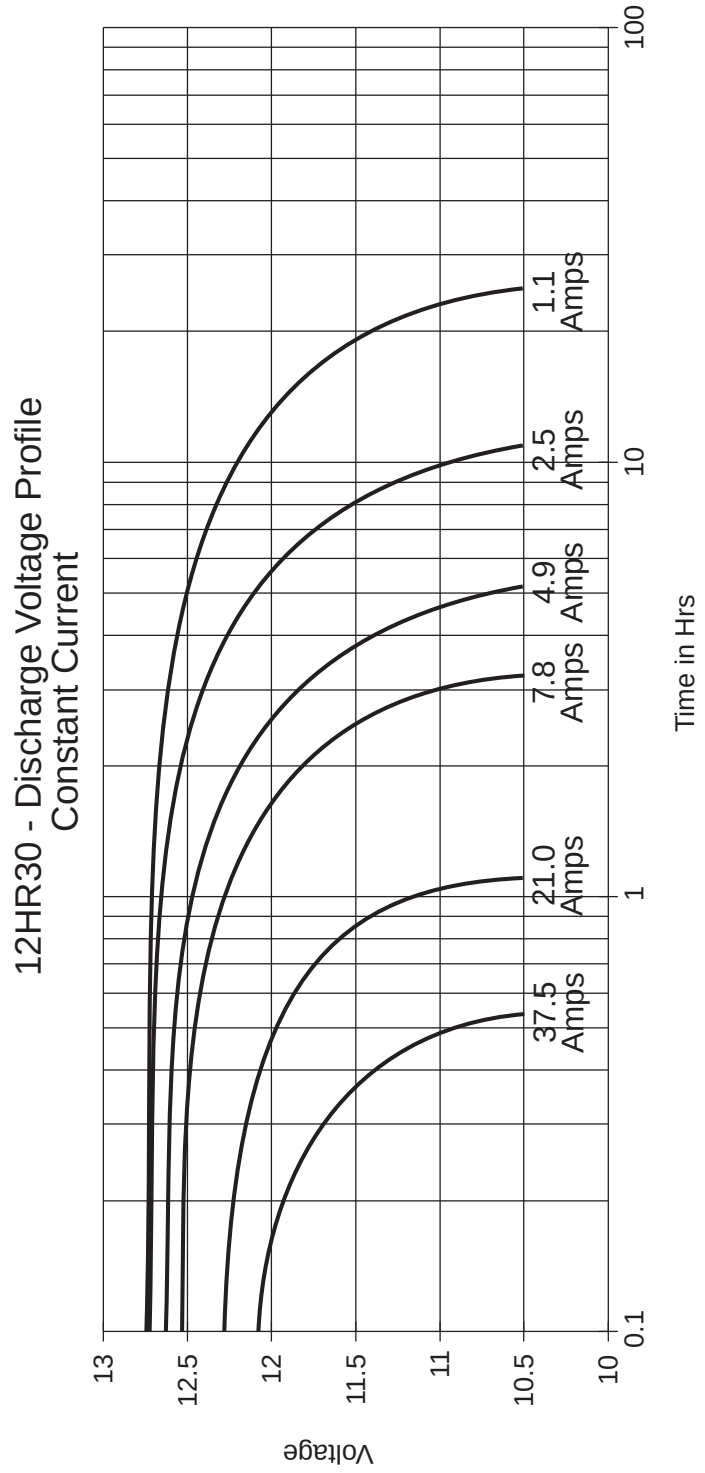


***Figure 4-1: Characteristic Discharge Curve 12HR30 (Constant Current Discharge to 1.75 VPC)***

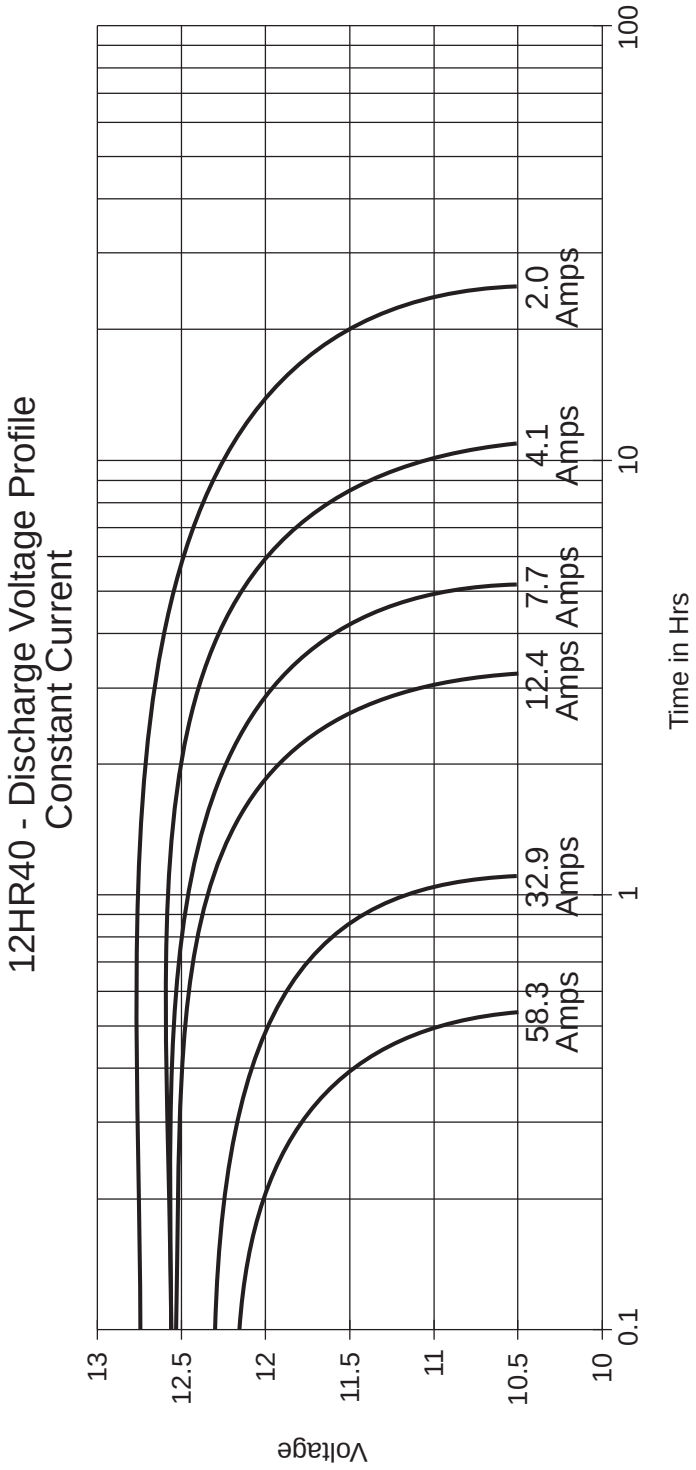


***Figure 4-2: Characteristic Discharge Curve 12HR40SX (Constant Current Discharge to 1.75 VPC)***

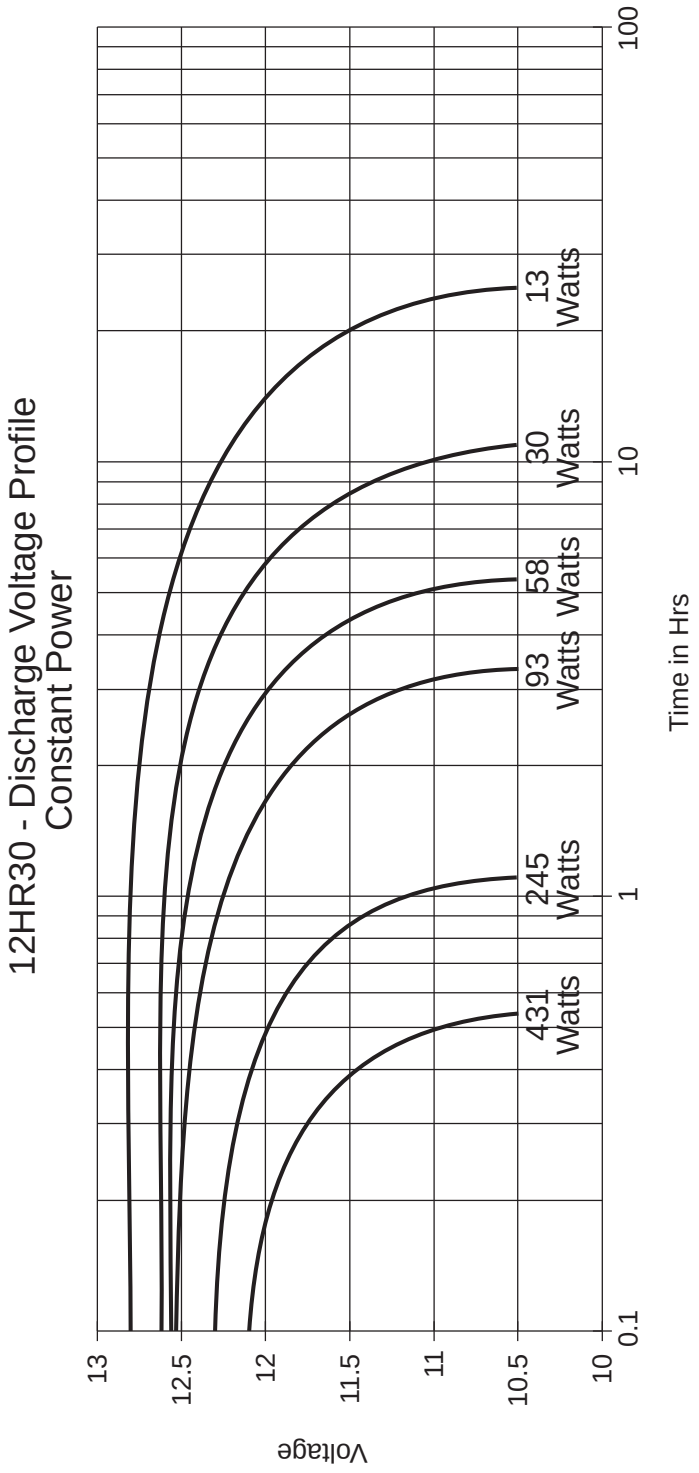


***Figure 4-3: Characteristic Discharge Curve 12HR30 (Constant Power Discharge to 1.75 VPC)***

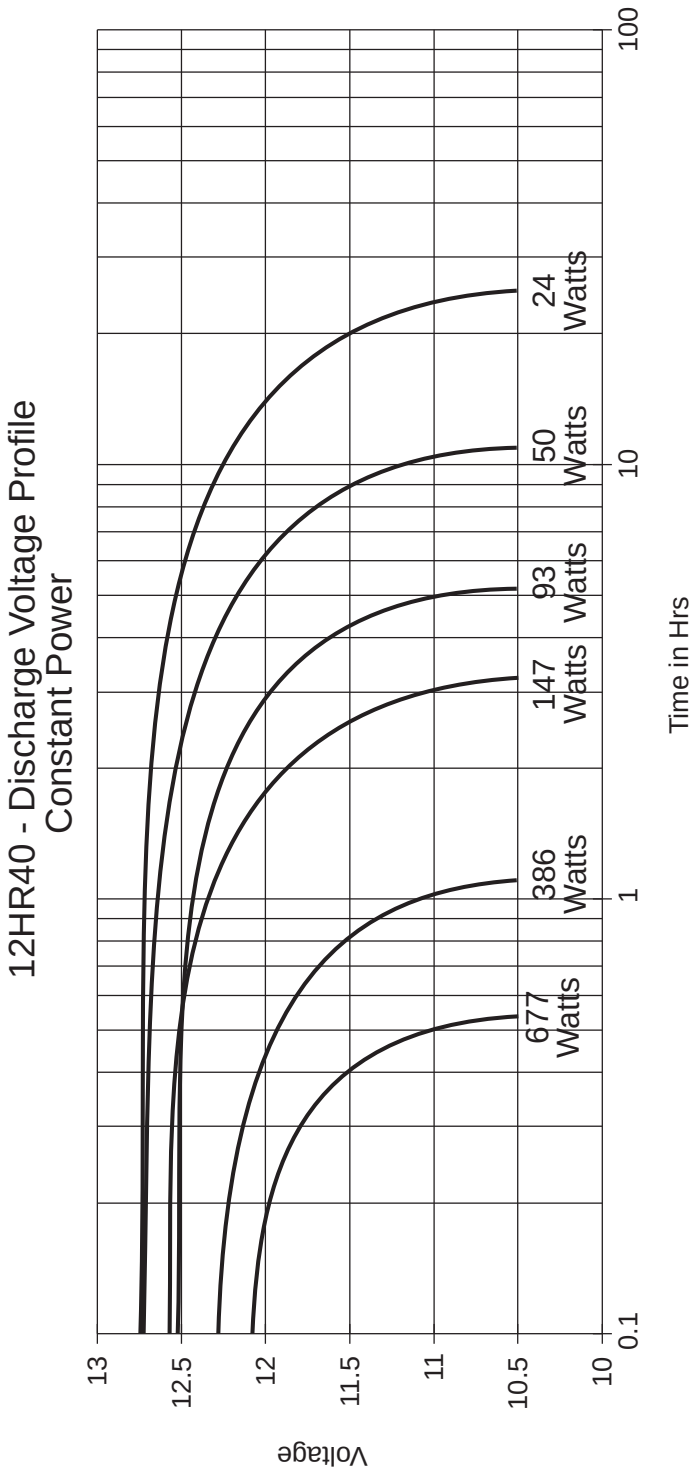


***Figure 4-4: Characteristic Discharge Curve 12HR40SX (Constant Power Discharge to 1.75 VPC)***

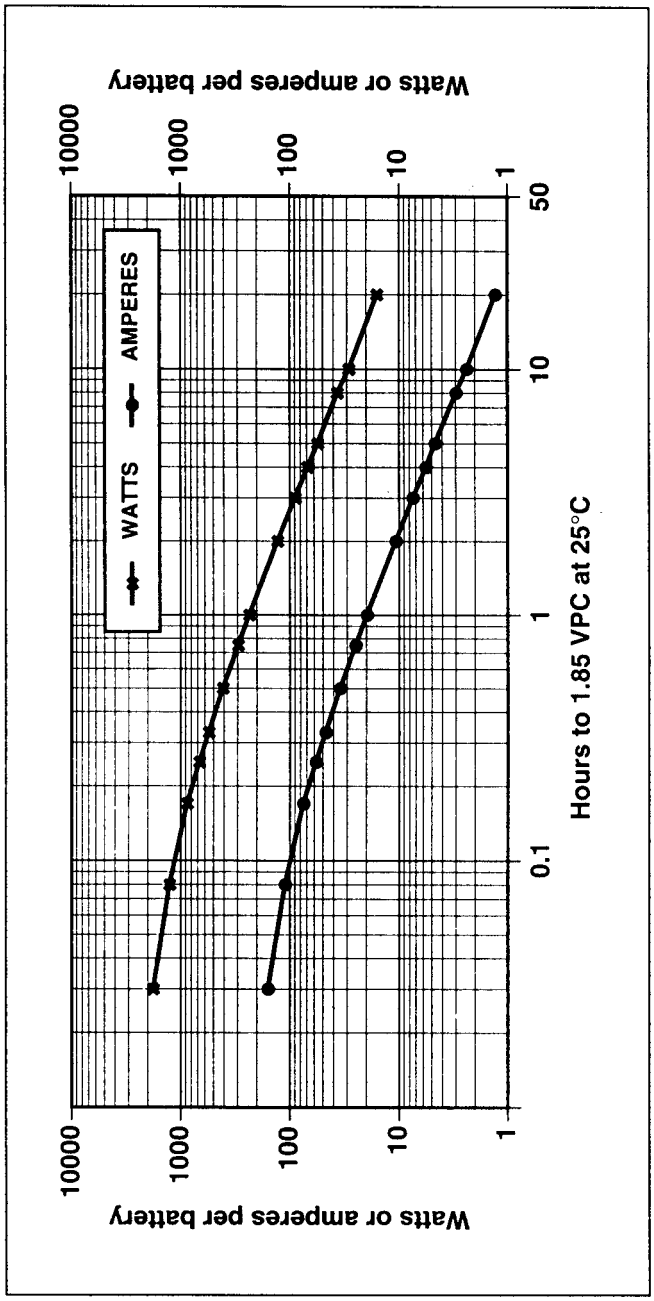


***Figure 4-5: 12HR30SX and 12HR30ET Discharge to 1.85 VPC***

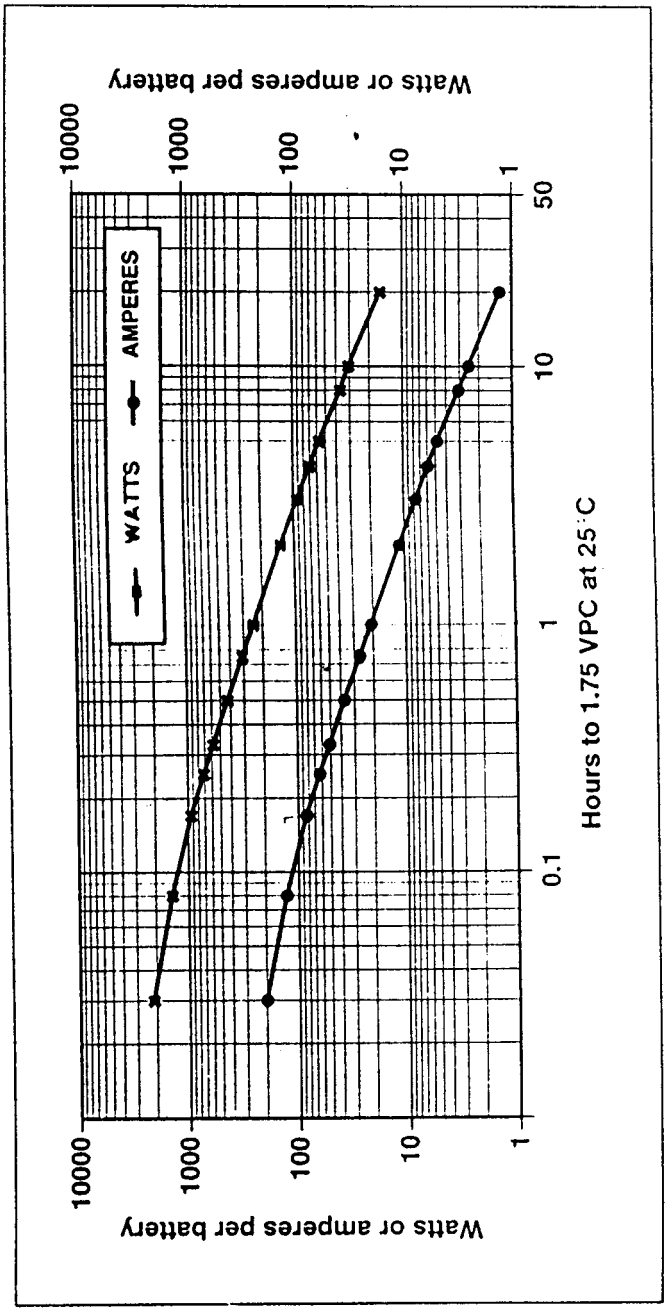


***Figure 4-6: 12HR30SX and 12HR30ET Discharge to 1.75 VPC***

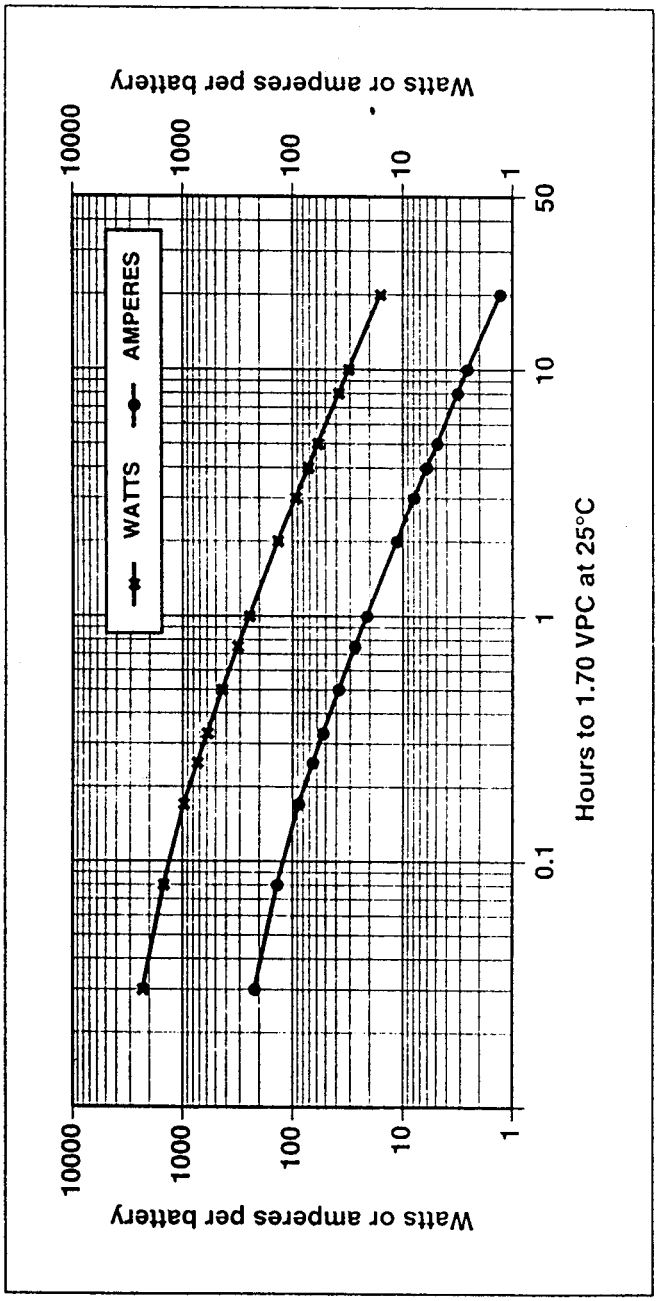


***Figure 4-7: 12HR30SX and 12HR30ET Discharge to 1.70 VPC***

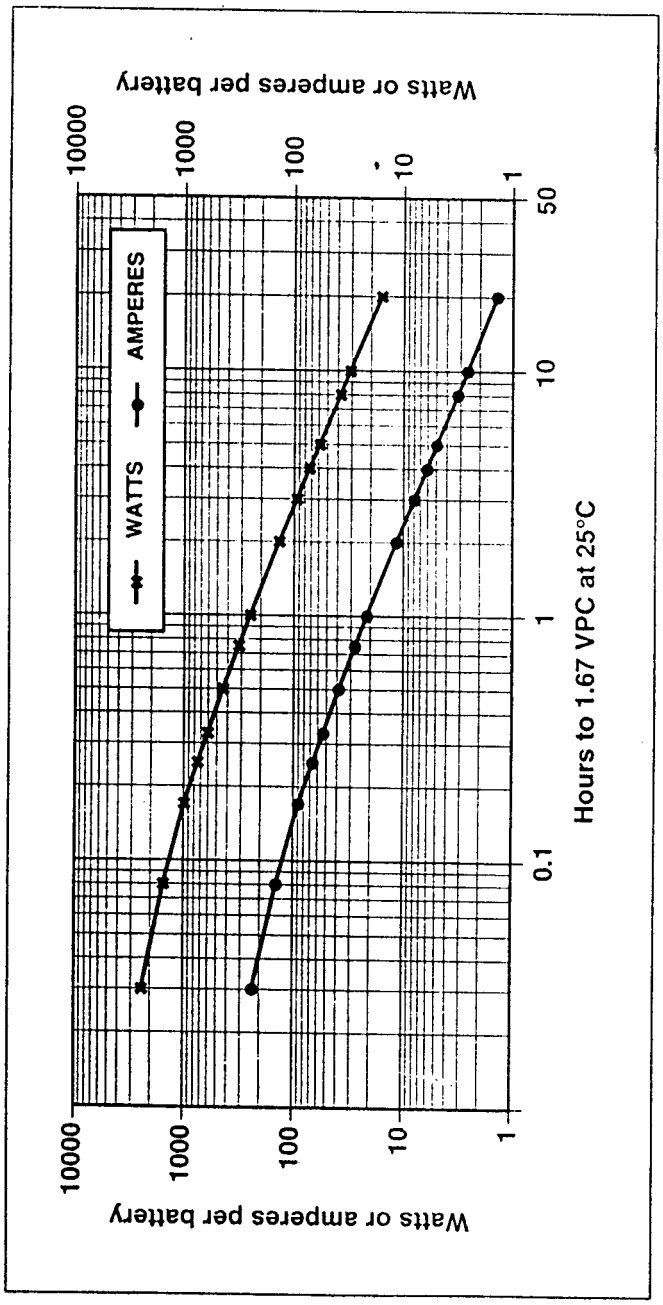


***Figure 4-8: 12HR30SX and 12HR30ET Discharge to 1.67 VPC***

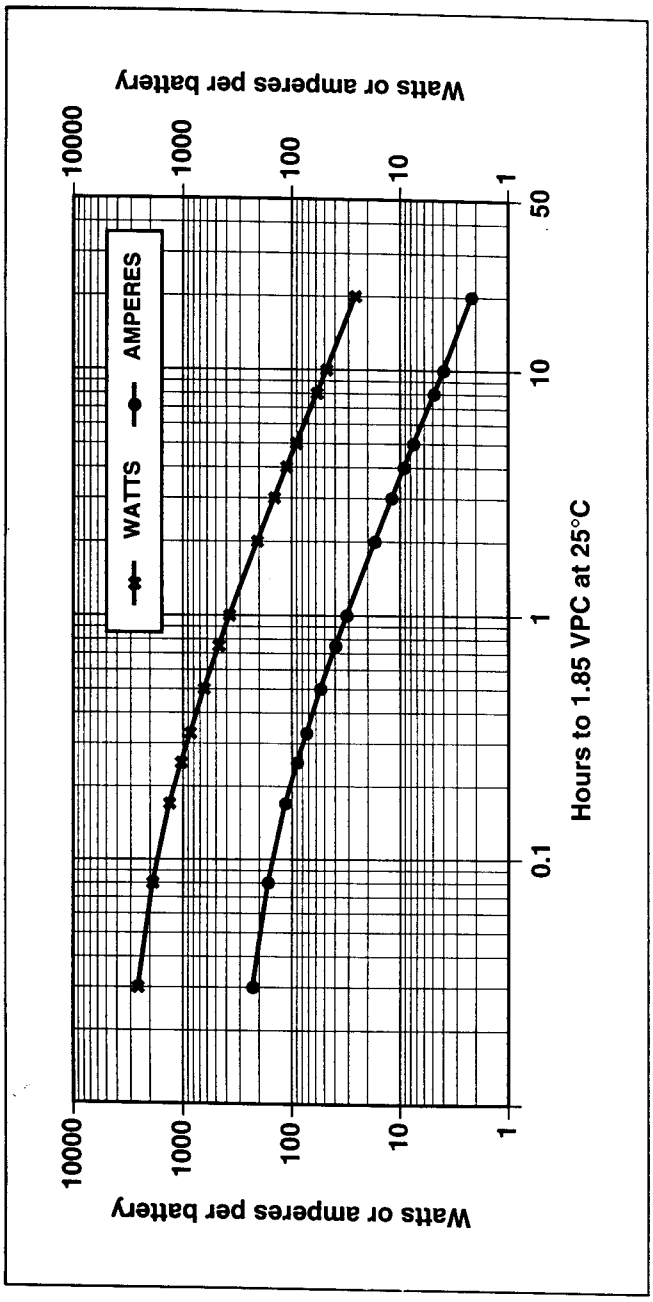


***Figure 4-9: 12HR40SX Discharge to 1.85 VPC***

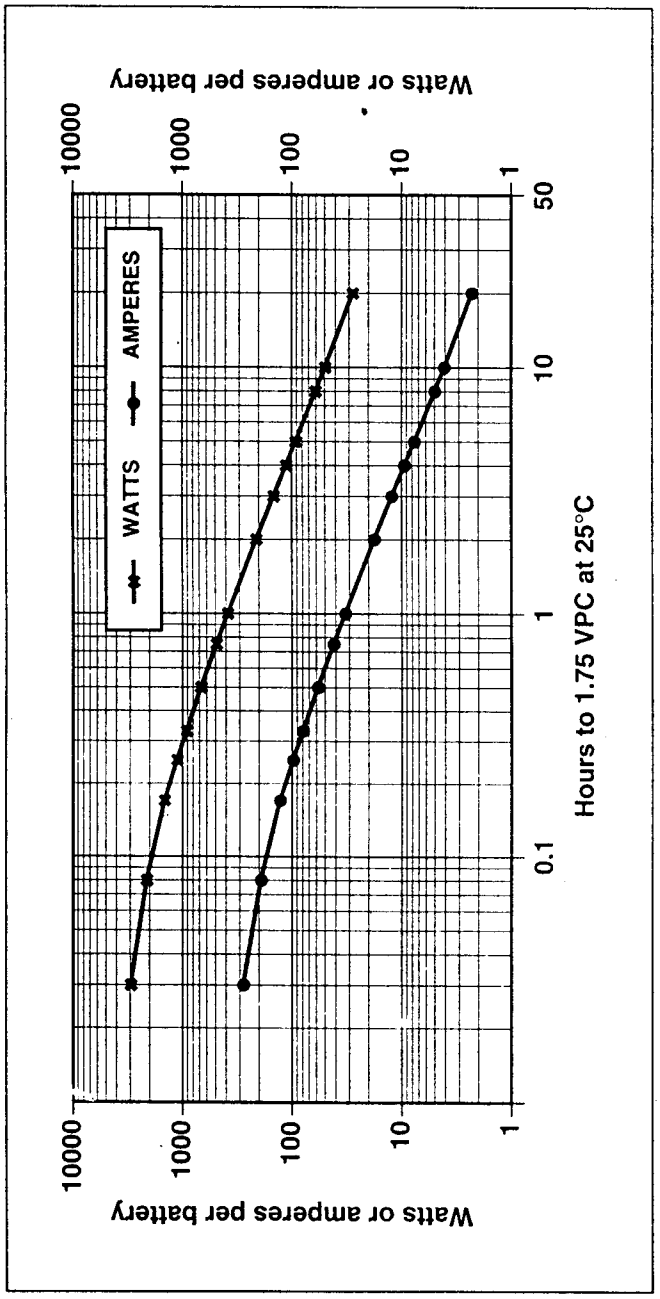


***Figure 4-10: 12HR40SX Discharge to 1.75 VPC***

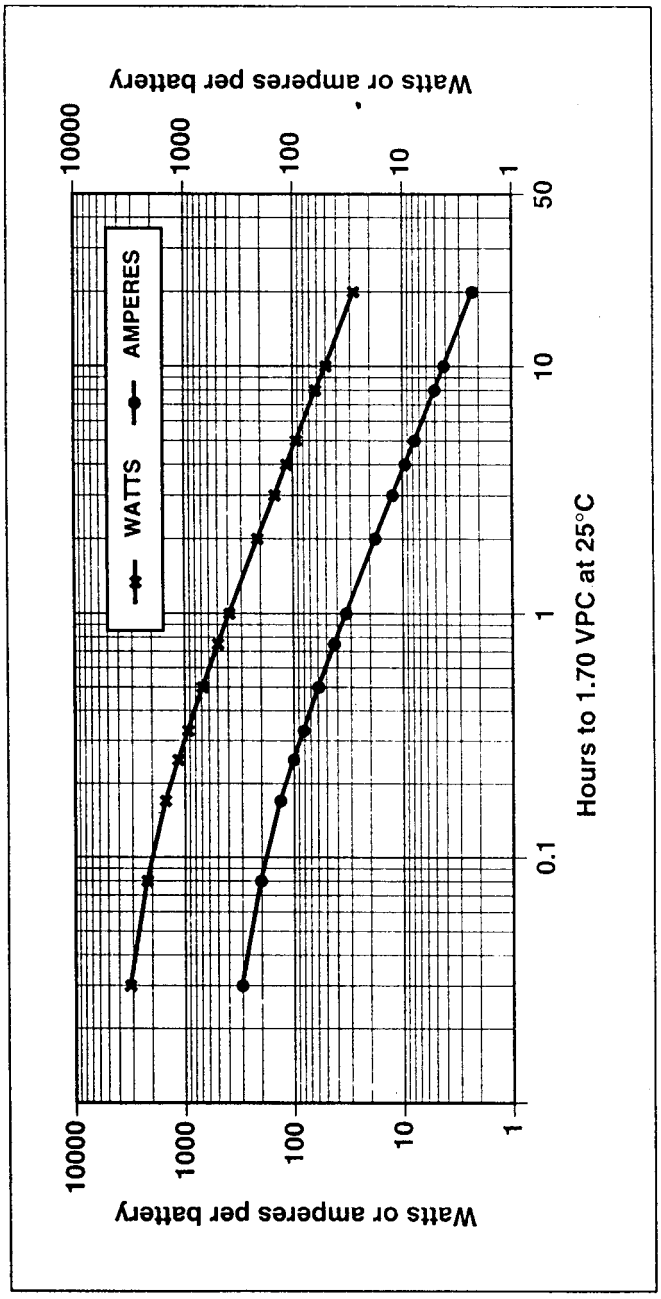


***Figure 4-11: 12HR40SX Discharge to 1.70 VPC***

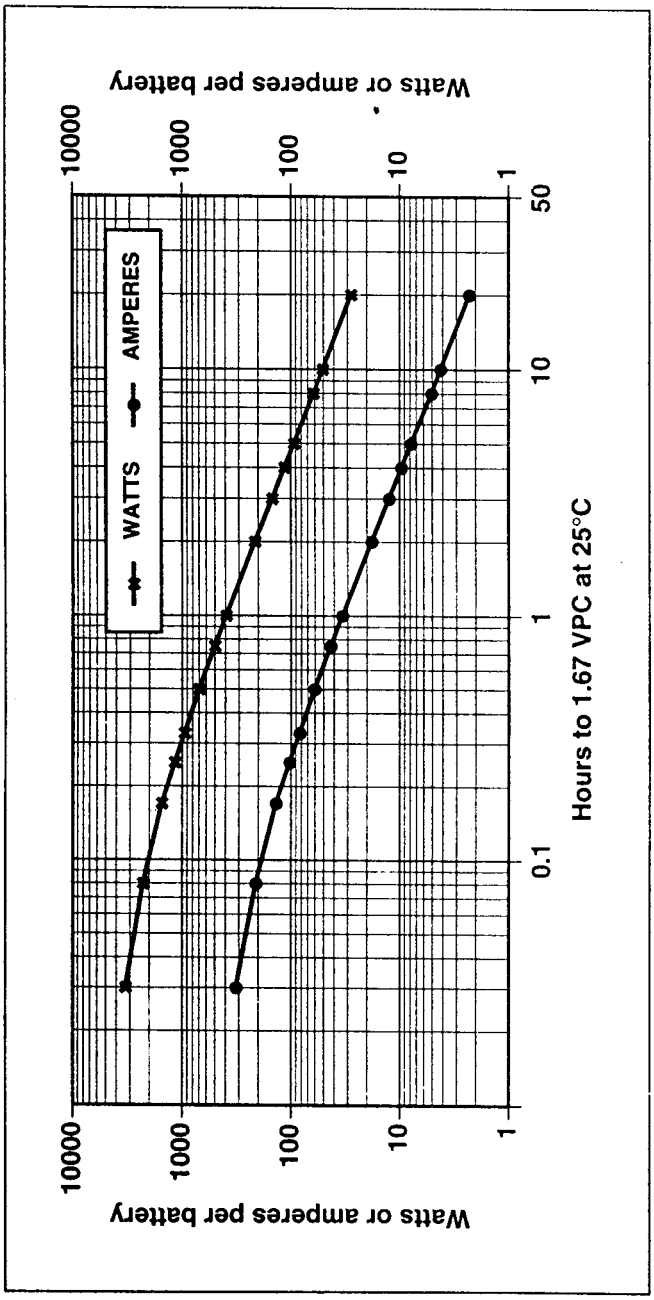


***Figure 4-12: 12HR40SX Discharge to 1.67 VPC***

# *Appendix A Installation and Maintenance Record*

**GE Critical Power HR Series Battery**

| City, State | Site Address | Equipment Type | Enclosure Type |
|---|---|---|---|
| | | | |

**Installation Record**

| Battery ID # | Mfg. Date | Installation Date | OCV at Installation* | End Charge Voltage/Current | Boost Charge at Installation Y/N |
|---|---|---|---|---|---|
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* Measure and record open circuit voltage (OCV) for each battery at installation.

## GE Critical Power HR Series Battery

| City, State | Site Address | Equipment Type | Enclosure Type |
|---|---|---|---|
| | | | |

## Maintenance Record

| Date | Date | Date | Date | Date | Date | Date Removed from Service | Reason for Replacement |
|---|---|---|---|---|---|---|---|
| Temp | Temp | Temp | Temp | Temp | Temp | | |
| Battery Voltage/ Current | Battery Voltage/ Current | Battery Voltage/ Current | Battery Voltage/ Current | Battery Voltage/ Current | Battery Voltage/ Current | | |
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# *Appendix B Power Data*

The following tables display power data for the GE Critical Power 2000 HR Series Battery.

**Battery Discharge: Watts and Amperes for 12HR30SX and 12HR30ET at 77°F**

| **Battery Run Time** | Watts to 1.85 VPC | Amps to 1.85 VPC | Watts to 1.75 VPC | Amps to 1.75 VPC | Watts to 1.70 VPC | Amps to 1.70 VPC | Watts to 1.67 VPC | Amps to 1.67 VPC |
|---|---|---|---|---|---|---|---|---|
| 2 min | 1795 | 159.4 | 2141 | 200.9 | 2316 | 222.7 | 2419 | 235.8 |
| 5 min | 1273 | 111.4 | 1424 | 129.9 | 1493 | 138.5 | 1532 | 143.4 |
| 10 min | 876 | 75.8 | 947 | 84.7 | 979 | 88.6 | 995 | 90.7 |
| 15 min | 677 | 58.2 | 721 | 63.8 | 740 | 66.2 | 751 | 67.4 |
| 20 min | 555 | 47.5 | 587 | 51.5 | 600 | 53.2 | 607 | 54.1 |
| 30 min | 412 | 35.0 | 431 | 37.5 | 439 | 38.5 | 444 | 39.0 |
| 45 min | 299 | 25.3 | 311 | 26.9 | 317 | 27.5 | 319 | 27.8 |
| 1 hr | 236 | 19.9 | 245 | 21.0 | 248 | 21.4 | 251 | 21.7 |
| 2 hr | 130 | 10.8 | 134 | 11.3 | 136 | 11.5 | 137 | 11.7 |
| 3 hr | 90 | 7.5 | 93 | 7.8 | 94 | 8.0 | 95 | 8.0 |
| 4 hr | 69 | 5.7 | 71 | 6.0 | 72 | 6.1 | 73 | 6.1 |
| 5 hr | 56 | 4.7 | 58 | 4.9 | 59 | 4.9 | 59 | 5.0 |
| 8 hr | 37 | 3.0 | .7 | 3.1 | 38 | 3.2 | 38 | 3.2 |
| 10 hr | 29 | 2.4 | 31 | 2.5 | 31 | 2.6 | 31 | 2.6 |
| 20 hr | 16 | 1.3 | 16 | 1.3 | 16 | 1.3 | 16 | 1.4 |

## Battery Discharge: Watts and Amperes for 12HR40SX at 77°F

| **Battery Run Time** | Watts to 1.85 VPC | Amps to 1.85 VPC | Watts to 1.75 VPC | Amps to 1.75 VPC | Watts to 1.70 VPC | Amps to 1.70 VPC | Watts to 1.67 VPC | Amps to 1.67 VPC |
|---|---|---|---|---|---|---|---|---|
| 2 min | 2581 | 231.2 | 2978 | 279.9 | 3188 | 306.1 | 3317 | 322.3 |
| 5 min | 1901 | 167.4 | 2130 | 193.0 | 2234 | 205.1 | 2291 | 212.0 |
| 10 min | 1338 | 116.1 | 1461 | 129.4 | 1513 | 135.3 | 1450 | 138.4 |
| 15 min | 1046 | 90.0 | 1124 | 98.5 | 1157 | 102.2 | 1173 | 104.1 |
| 20 min | 863 | 73.9 | 919 | 80.0 | 941 | 82.5 | 953 | 83.8 |
| 30 min | 646 | 54.9 | 678 | 58.5 | 691 | 60.0 | 698 | 60.8 |
| 45 min | 473 | 39.9 | 491 | 42.0 | 498 | 42.9 | 502 | 43.3 |
| 1 hr | 376 | 31.5 | 386 | 32.9 | 391 | 33.5 | 394 | 33.8 |
| 2 hr | 208 | 17.3 | 212 | 17.9 | 214 | 18.1 | 215 | 18.2 |
| 3 hr | 145 | 12.1 | 147 | 12.4 | 148 | 12.5 | 149 | 12.6 |
| 4 hr | 112 | 9.3 | 113 | 9.5 | 115 | 9.6 | 115 | 9.7 |
| 5 hr | 91 | 7.6 | 93 | 7.7 | 94 | 7.8 | 94 | 7.9 |
| 8 hr | 59 | 4.9 | 61 | 5.0 | 62 | 5.1 | 62 | 5.1 |
| 10 hr | 48 | 4.0 | 50 | 4.1 | 50 | 4.2 | 51 | 4.2 |
| 20 hr | 26 | 2.2 | 28 | 2.3 | 28 | 2.3 | 28 | 2.3 |

# *Appendix C Material Safety Data Sheets*

The following pages are the complete text of the Material Safety Data Sheets for the GE Critical Power HR Series battery.

**MATERIAL SAFETY DATA SHEET**

GE Critical Power

3000 Skyline Drive  Issue Date:  06/07/96

Mesquite, TX  75149  Issue Number:  1

Non-Emergency Telephone # 1-800-843-1797

Emergency Telephone # 800-424-9300 (CHEMTREC)

Use CHEMTREC only in the event of chemical emergencies involving a spill leak, fire, exposure, or accident involving chemicals.

## I. PRODUCT IDENTIFICATION.

Product Name:  BATTERY, GENESIS SEALED LEAD WP-93389

Chemical Name/Synonym:  WP-93389, SEALED, RECHARGEABLE, LEAD-ACID BATTERY

Product Code/Comcode:  407155399

HMDB Number:  11646

Label Codes

| | |
|---|---|
| Health: | 3-CORROSIVE |
| Fire: | 0-NON-FLAMMABLE |
| Reactivity: | 1-SLIGHTLY REACTIVE |

## II. HAZARDOUS INGREDIENTS.

Table 1:

| Component: | CAS# | % | TLV(ACGIH) | PEL(OSHA) |
|---|---|---|---|---|
| Non-Hazardous Ingredients | N/A | 23-26 | N/A | N/A |
| *Lead/Lead Oxide | 7439-92-1 | 68-71 | .15 MG/M3 | 50 UG/M3 |
| *Sulfuric acid | 7664-93-9 | 6-7 | 1 MGM3[1] | 1 MGM3[1] |

[1]STEL(ACGIH): 3 MG/M3 STEL(OSHA):N/A

N.D. = Not Determined N/A = Not Applicable

**Comments**: * These chemicals are subject to Section 313 Title III SARA reporting requirements.The data presented refer primarily to the acid electrolyte since this component poses the predominant immediate hazard associated with this product.

## III. PHYSICAL PROPERTIES.

Appearance/Odor: Acid electrolyte is clear with a strong acrid odor. Sealed battery has no odor.

Specific Gravity: N/A Vapor Density (Air=1): N/A

Boiling Point: N/A Melting Point: - N/A

Vapor-Pressure: (Air=1) N/A

Solubility in Water: N/A

Evaporation Rate N/A pH:N/A

% Volatiles by Volume:N/A

% Volatile Organic Carbon: N/A

## IV. HEALTH HAZARD SUMMARY.

Primary Routes of Exposure:

ORAL: SKIN: **X** EYE: **X** INHALATION: **X**

**Effects of Overexposure:** The electrolyte is corrosive to skin, eyes and mucous membranes. Repeated or prolonged inhalation of mists can cause inflammation of the upper respiratory tract and chronic bronchitis; pulmonary edema and death may occur from severe exposures.

Early symptoms of lead intoxication include a persistent metallic taste, anorexia, constipation, and severe abdominal pain.

Continued exposures may result in muscle weakness and fatigue, nervous system damage, tremors, pallor of face, anemia and kidney damage.

No chemical exposure is expected under normal conditions of use.

**Listed as a Carcinogen or Potential Carcinogen By the following Agencies?**

NTP: **NO** LARC: **YES** OSHA: **NO**

**Toxicity Study Information (for Environment & Safety Professionals):**

Only select registry of toxic effects of chemical substances (RTECS) data are presented here; consult latest issue for more information.

LEAD - TCLO: 10 UG/M3, human, inhalation; TDLO: 450 MG/KG/YR, human, oral. Reported to cause chromosomal aberrations in human and animal cells. Causes reproductive and developmental effects in experimental animals.

According to the International Agency For Research On Cancer (IARC) Monography Supplement (1987), there is inadequate evidence for carcinogenicity of lead in humans. Lead and inorganic lead compounds are classified as Group 2B carcinogens by IARC. OSHA regulated (29 CFR 1910.1025).

## V. FIRST AID PROCEDURES.

**Eye:** In case of contact, flush with plenty of water for at least 15 minutes. Obtain medical attention immediately.

**Skin:** In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse.

**Inhalation: If inhaled, remove to fresh air.** Give artificial respiration if breathing has stopped. If breathing is difficult, give oxygen. Contact physician immediately.

**Ingestion:** If swallowed**,** do not induce vomiting. Ingest large amounts of milk or water. Obtain medical attention immediately.

**Notes to Physician:** None

## VI. FIRE AND EXPLOSION HAZARD DATA.

**Flash Point:** N/A
Autoignition Temp: N/A

**Flammable Limits:** LEL: N/A % UEL: N/A %

**Extinguishing Media:** Carbon Dioxide, Dry Chemical, or Foam.

**Special Fire-fighting Procedures:** Fire fighters should wear self-contained breathing apparatus and protective clothing to avoid corrosive and toxic mists, vapors, and possibly lead fumes. Cool battery exterior with water to prevent rupture.

**Unusual fire and explosion hazards:** Sulfuric acid, especially when diluted with water, can react with metals to produce flammable hydrogen gas. Remove all sources of ignition.

## VII. REACTIVITY DATA.

**Stability:** Stable

**Conditions to Avoid:**Avoid shorting. Use approved charging methods.

**Incompatibility (Materials to Avoid):**Strong alkaline materials, materials that react with a strong oxidizer.

**Hazardous Decomposition**

**Products:** Thermal decomposition will produce toxic sulfur oxides and lead fumes.

**Hazardous Polymerization:** Will not occur

**Conditions to Avoid:** NONE

## VIII. SPECIAL PROTECTION INFORMATION.

Ventilation: General ventilation should be adequate under normal conditions of use.

Respiratory Protection: Respirators are not required under normal conditions of use.

Protective Gloves: Protective gloves are not required under normal operating conditions.

Eye Protection: Eye protection is not required under normal operating conditions.

Other Clothing and/or Equipment: Not required under normal operating conditions

## IX. ENVIRONMENTAL INFORMATION.

**Steps to be Taken in Case Material is Released or Spilled:** Cover spill with clay absorbent. Neutralize with sodium bicarbonate (baking soda). Alternatively sand, ashes, or gravel can be used to cover spill and soda ash or lime can be used to neutralize. Place in acid resistant container.

**Waste Disposal Method:** Batteries and electrolyte must be disposed of in accordance with RCRA regulations. Recycling lead and plastic contained in this product is suggested. Dispose of in accordance with local, state, and federal rules and regulations.

**TSCA Status:** All components appear on TSCA chemical substance inventory.

**DOT Information**: No assigned UN number. Battery has been tested and determined to be in compliance with DOT HMR 49 non-hazardous materials, ICAO, IATA, and special provision A67 and therefore are unregulated and classified as "nonspillable wet electric storage batteries".

## X. SPECIAL PRECAUTIONS.

**Storage and Handling Requirements:**

Store batteries in a cool, dry, well ventilated area. Avoid temperature extremes above 80° C and -40° C. Protect batteries from physical damage. Do not puncture battery case. Lead acid cells have enormous circuit capability. Extreme care shoul be excercised to avoid shorting of cell terminals. When working around cells, remove rings, wrist watches, necklaces, metal bracelets, belt buckles, etc. Remove all sources of ignition.

**Storage And Handling:**

Store batteries in a cool, dry, well ventilated area. Protect batteries from physical damage. All lead/acid cells have enormous circuit capability. Extreme care should be exercised to avoid shorting of cell terminals. When working around cells remove rings, wrist watches, necklaces, metal bracelets, belt buckles, etc.

N.D. = Not Determined N/A = Not Applicable

While information in this fact sheet has been compiled from reference materials and other sources believed to be reliable, its accuracy and completeness is not gauranteed, nor is any responsibility assumed or implied for any loss or damage resulting from inaccuracies or ommissions. Any specific evaluation will involve professional judgement by the user's industrial hygiene professional.

**MATERIAL SAFETY DATA SHEET**

GE Critical Power

3000 Skyline Drive Issue Date: 04/04/94

Mesquite, TX 75149 Issue Number: 1

Non-Emergency Telephone # 1-800-843-1797

Emergency Telephone # 312-733-6100 (SANCHEM)

## I. PRODUCT IDENTIFICATION

Product Name: NO-OX-ID "A"

### II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

According to current U.S. Dept. of Labor Standards, this material contains no toxic or hazardous chemicals.

## III. PHYSICAL/CHEMICAL CHARACTERISTICS

| | |
|---|---|
| Boiling Point | 450°F |
| Specific Gravity | 0.86 |
| Vapor Pressure | N/A |
| Melting Point | 140° - 150°F |
| Vapor Density | N/A |
| Evaporation Rate | N/A |
| Solubility in Water | Insoluble |
| Appearance and Odor | Dark brown firm grease, odorless |

## IV. FIRE AND EXPLOSION HAZARD DATA

| | |
|---|---|
| Flash Point (Method Used) | 450°F, 232°C (C.O.C.) |
| Flammable Limits | LEL 0.9UEL 6.0 |
| Extinguishing Media | Dry chemical, sand or foam |
| Special Fire-fighting Procedures | None |
| Unusual Fire and Explosion Hazards | None |

## V. REACTIVITY DATA

| | | |
|---|---|---|
| Stability: | Unstable | Stable **X** |

Conditions to Avoid: Open flame or excessive heat, strong oxidizing materials

Incompatibility (Materials to Avoid)
Strong oxidizers

Hazardous Decomposition or By-products
None

| | |
|---|---|
| Hazardous Polymerization | May Occur<br>Will Not Occur **X** |

## VI. HEALTH HAZARD DATA

Routes of Entry:

| | |
|---|---|
| Inhalation | N/A |
| Skin | Wash well with soap and water |
| Ingestion | Induce vomiting, consult physician |

Health Hazards (Acute and Chronic) N/A

Carcinogenicity

| | |
|---|---|
| NTP | No |
| IARC Monographs | No |
| OSHA Regulated | No |

Signs and Symptoms of Exposure
May cause minor skin irritation

Medical Conditions Generally Aggravated by Exposure
None Known

Emergency and First Aid Procedures
Wash with soap and water, if ingested induce vomiting

## VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps To Be Taken In Case Material Is Released Or Spilled
Scoop up and store in sealed drums for disposal, wash down area with soap and water

Steps To Be Taken In Handling and Storage
Do not store near oxidizers. Store in cool dry area away from open flames and heat

Other Precautions None

## VIII. CONTROL MEASURES

| | |
|---|---|
| Respiratory Protection | None |
| Ventilation | N/A |
| | Local ExhaustN/A |
| | Mechanical (General)N/A |
| | SpecialN/A |
| | OtherN/A |
| Protective Gloves | Rubber |
| Eye Protection | Goggles |
| Hygienic Practices | ‘Wash hands before eating |