TELEDYNE BATTERY PRODUCTS

COMPONENT MAINTENANCE MANUAL

LT Valve-Regulated Lead-Acid Batteries

Part Numbers Applicable to This CMM

7638-53	7639-25
7638-44	7407-28
7638-36	

PROPOSITION 65 WARNING

BATTERY POSTS, TERMINALS AND RELATED ACCESSORIES CONTAIN LEAD AND LEAD COMPOUNDS, CHEMICALS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER AND REPRODUCTIVE HARM. **WASH HANDS AFTER HANDLING.**

Document Number: Q01-2001 **Revision : C 1-20-17**

WARNING

THE SAFETY INSTRUCTIONS/PRECAUTIONS POSTED IN VARIOUS SECTIONS WITHIN THIS MANUAL MUST BE STRICTLY FOLLOWED.

ALWAYS WEAR SAFETY GLASSES AND ACID-RESISTANT GLOVES WHENEVER HANDLING BATTERIES ELECTROLYTE CONTAINS SULFURIC ACID, WHICH CAN PERMANENTLY DAMAGE EYES AND CAUSE SEVERE BURNS TO EXPOSED SKIN.

FOR LIMITATIONS, PROCEDURES AND PERFORMANCE INFORMATION NOT CONTAINED IN THIS SUPPLEMENT CONSULT THE BASIC PILOTS OPERATING HANDBOOK, AIRPLANE FLIGHT MANUAL, THE SPECIFIC STC OR THE BATTERY CONTINUOUS AIRWORTHINESS INSTRUCTIONS FOR THE APPLICATION.
THIS SERVICE MANUAL SHOULD NOT BE CONSTRUED AS THE FINAL AUTHORITY IN MAINTAINING YOUR SPECIFIC BATTERY. PLEASE CONSULT WITH TELEDYNE TECHNICAL SUPPORT FOR FURTHER INFORMATION.

CONTENTS

REVISIONS

Revision	Description of Change	Approved By	Date
NC	New document	JMR	5-8-09
A	Revised testing instructions	JMR	3-17-14
B	Added 7407-28 battery	JMR	2-8-16
C	Added 7638-36 and 7638-44 batteries	JMR	1-20-17

SCOPE

This manual provides Maintenance Procedures for Teledyne Battery Products' (TBP) 7000 Series LT Valve-Regulated Lead-Acid (LT VRLA) Aircraft Batteries, part numbers 7639-25, 7638-53, 7638-44, 7638-36 and 7407-28 manufactured under FAA Parts Manufacturer Approval number PQ1006NM for type certificated aircraft.

This manual has been written for the purpose of guidance only; consult Teledyne Battery Products (TBP) Technical Support for further information.

VALVE-REGULATED LEAD-ACID BATTERIES

3.1 DESCRIPTION

3.1.1. The 7000 series LT valve-regulated lead-acid (LT-VRLA) batteries are designed with an optimum lead alloy with tin and copper to provide the best possible electrode characteristics necessary for performance. These LT-VRLA batteries contain electrolyte absorbed in glass-mat separators, with no free electrolyte and are sometimes referred to as "sealed" or "recombinant-gas" batteries.

WARNING

ALL VRLA batteries contain sulfuric acid, which is highly corrosive and which can cause serious physical injury if it comes in contact with skin or if inhaled. It can also cause serious eye injury or blindness if it comes into contact with the eyes.

Caution must be exercised to avoid damage to the exterior case which could allow the contents to escape or come in physical contact with external materials or personnel.

If a battery case is found to be damaged, handle the battery with care and avoid contact with the skin. Inspect all areas adjacent to the battery for evidence of corrosion.

3.1.2. TBP valve-regulated lead-acid batteries have vent caps (with valves enclosed) that are sealed in place and cannot be accessed for maintenance. At no time must these vent caps be removed.

WARNING

During normal operation, the batteries will vent very small amounts of gases that must be vented away from the battery and aircraft. The venting mechanisms consist of nozzles (in the battery cover) and vent tubes that are designed to exhaust the battery compartment. Ensure that the vent tubes are not restricted or disabled in any way.

3.1.3. The electrolyte is contained in an absorptive glass-mat (AGM) separator that retains and immobilizes the electrolyte. These batteries can be operated in any orientation without spilling electrolyte.

3.1.4. The battery consists of six or twelve cells connected in series internally, for 12V or 24V batteries respectively. These cells are not replaceable.

3.1.5. Each cell is constructed of premium grade LT electrodes (plates) that are electrically isolated by AGM separators.

3.2 SPECIFICATION DEFINITION

3.2.1 TBP battery ratings are defined by a series of specifications:

3.2.1.1 **The One-Hour Rate**
This is the rate of discharge (current, A) a battery can endure for one hour with the battery voltage at or above 1.67 volts per cell, which is 10V for a 12V battery or 20V for a 24V battery.

The One-Hour Capacity, measured in Ampere Hours or Ah, is the product of the discharge rate (A) and time (in hours) to the specified end voltage.

3.2.1.2 **The Emergency Rate**
This is the rate of discharge (current, A) a battery can endure for thirty minutes with the battery voltage at or above 1.67 volts per cell, which is 10V for a 12V battery or 20V for a 24V battery.

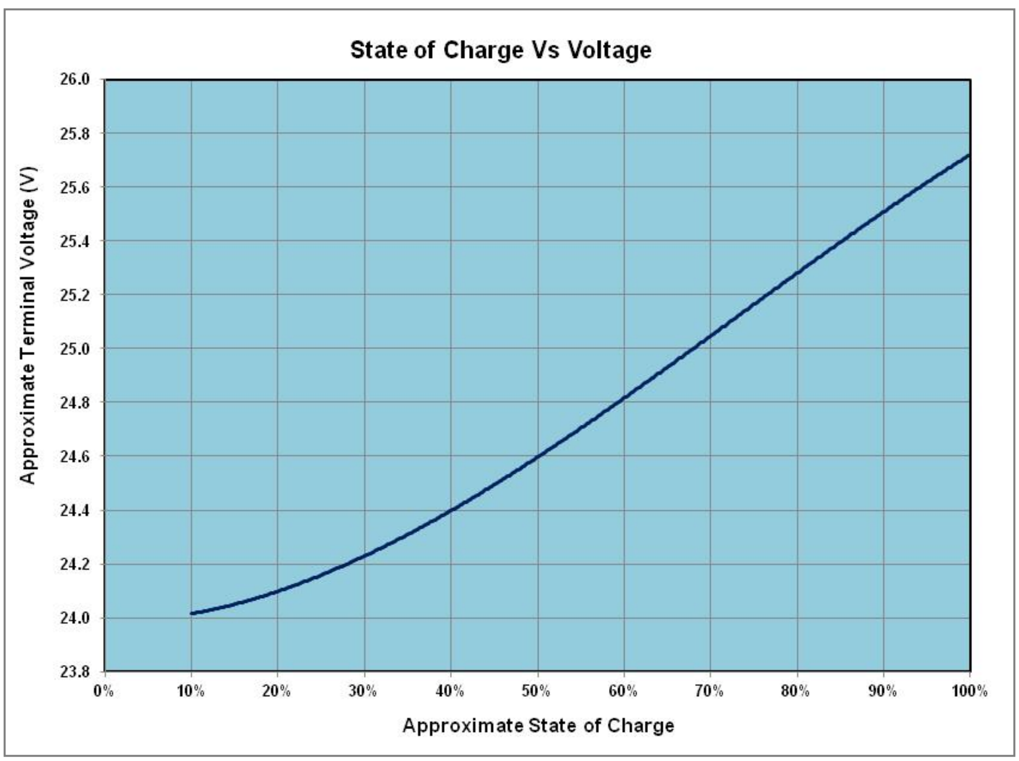
The Emergency Rate is the total essential load, measured in amperes, required to support the essential bus for thirty minutes.

3.2.1.3 **I_{pp}, Peak Power Current**: This is the discharge current delivered at 0.3 seconds while testing during a 15 second power discharge controlled to maintain a constant terminal voltage of half the nominal battery voltage (IEC 60952-1).

I_{pr}, Constant Voltage Current: This is the discharge current at the conclusion of a 15 second power discharge controlled to maintain a constant terminal voltage of half the nominal battery voltage (IEC 60952-1).

3.2.2 State of charge using voltage measurements should be used as a guide only. Figure 1 **(for a 24V battery)** indicates the relationship between Battery Open-Circuit Voltage (OCV) and % State-of-Charge (SOC). Please note that state-of-charge is not the same as available capacity (see GLOSSARY).

Figure 1



Note: Approximate Terminal Voltages would be half these values for a 12V battery

3.2.3. All valve-regulated batteries operate best in controlled temperatures. Excessive excursions above 100^{0}F can shorten the life of lead-acid batteries. The optimum operating temperature is around 80^{0}F.

Available capacity declines as the temperature drops. This decline is primarily related to the state of the electrolyte and easily recoverable once the battery has warmed up sufficiently.

SERVICE INSTRUCTIONS

4.1 SHIPMENT OF BATTERIES

4.1.1 The batteries are shipped conditioned and fully charged.

4.1.2 Each battery is identified with a unique serial number label and manufacturing date laser etched on the side opposite the positive terminal. Please use this manufacturing date for future reference.

4.2 INSPECTION FOR SHIPPING DAMAGE

4.2.1 Upon receipt, the packages must be examined for any shipping damage before they are placed in storage or use. If any damage is noted, contact the shipping company immediately.

4.2.2 Type verification can be performed by checking the serial number label on the packaging against the accompanying Certificate of Compliance or FAA Form 8130-3.

4.3 STORAGE REQUIREMENTS

4.3.1 TBPs 7000 series LT valve-regulated lead-acid batteries can be stored between -20^{0}F and +110^{0}F (store ideally at 80^{0}F). Storage at temperatures other than these, can lead to permanent damage.

Storage temperatures will determine inspection requirements.

4.3.2 TBPs 7000 series LT valve-regulated lead-acid batteries have a maximum of 24 months of inspection-free storage life, ONLY IF stored at temperatures between 40^{0}F to 80^{0}F.

Batteries maintained at lower temperatures should be reviewed in this category as well.

4.3.3 If stored between 95^{0}F (35^{0}C) to 110^{0}F (43^{0}C), the battery must be inspected on a monthly basis. It is not recommended to store any VRLA batteries at these temperatures for excessive periods of time (maximum 3 months storage). Prolonged storage at high temperatures (over 110^{0}F) will reduce battery life.
During these monthly inspections, the battery must be recharged per Section 5.2 and returned to storage. If stored at these temperatures longer than three months, there is a possibility of damaging the battery.

4.3.4 All batteries returned from service after initial use must be stored fully charged. The storage start date and battery voltage must be logged on the outer package or marked on the battery.

4.3.5 Long term storage at low temperatures (around 0^{0}F) will not detrimentally affect the life of the battery, provided the battery is at a reasonably high state of charge (over 80%) before placing in storage. The battery may be stored at lower temperatures, but will need to be warmed up to 0^{0}F (-18^{0}C) before use.

4.3.6 Please call TBP technical support if there are any questions regarding shelf life and recharge periods.

4.4 INITIAL INSPECTION

4.4.1 Visually inspect the battery to ensure there is no damage. Remove the protective cap over the terminal pins and ensure that the pins are clean and there is no corrosion. The pins have been installed with the correct torque at the factory and do not require any re-seating.

4.4.2 DO NOT remove the lid. The vents are ultrasonically sealed to the cover and cannot be removed for maintenance.

4.4.3 Inspect the open circuit voltage. Typical practice should be to recharge the battery at constant potential before placing into service. Review section 5 for all charging instructions.

For basic charging, constant potential is the preferred charging method. Deep-discharge recovery will usually require application of Constant-Voltage (Potential) and/or Constant-Current charging (see Sections 5.3 and 5.4). If there are any concerns while recharging, please call Tech Support at Teledyne Battery Products.

4.4.4 Charging should be terminated when the charge current drops to less than 0.5 ampere (may take up to 15 hours depending on the state-of-charge of the battery).

CHARGING

RECOMMENDATION
Charging should be conducted in a well-ventilated area at ambient conditions ranging from 65^{0}F to 80^{0}F.

5.1 OVERVIEW

5.1.1 Please review the charging method (constant-voltage or constant-current) before commencing. The preferred method is constant-voltage. Refer to Section 5.2 and 5.3.

5.1.2 Correct charging is very important and will affect the overall life of the battery. The charging process is not 100% efficient due to losses resulting from internal resistance and will typically require 10% to 20% more recharge than the amount of capacity removed during discharge.

5.1.3 Undercharging occurs when the battery is repeatedly subjected to time-limited charging; allowing residual lead sulfate to eventually increase in the plates, making it difficult to fully recharge the battery. In this case the battery will suffer a permanent loss of capacity.

5.1.4 Overcharging generally occurs when either constant-current charging is used without adequate control of total time on-charge or the voltage limit in constant-voltage charge is higher than the recommended range (see 5.2.4). Overcharging a battery will corrode the positive grids and break-down the water component in the electrolyte to hydrogen and oxygen (electrolysis). This is quite detrimental to the life of VRLA batteries since the water cannot be replaced.

5.2 STANDARD CONSTANT-VOLTAGE (OR CONSTANT POTENTIAL, CV OR CP)

5.2.1 These chargers are generally designed to provide a constant voltage source, with selectable initial current rates. Model variants provide selectable charge voltage and initial charge rates. Higher output current will reduce recharge time.

5.2.2 CP charging will result in a high initial charging current which will start dropping off when the voltage gradient between the charger and battery begins to decrease because the current in any circuit is directly proportional to the voltage gradient across that circuit.

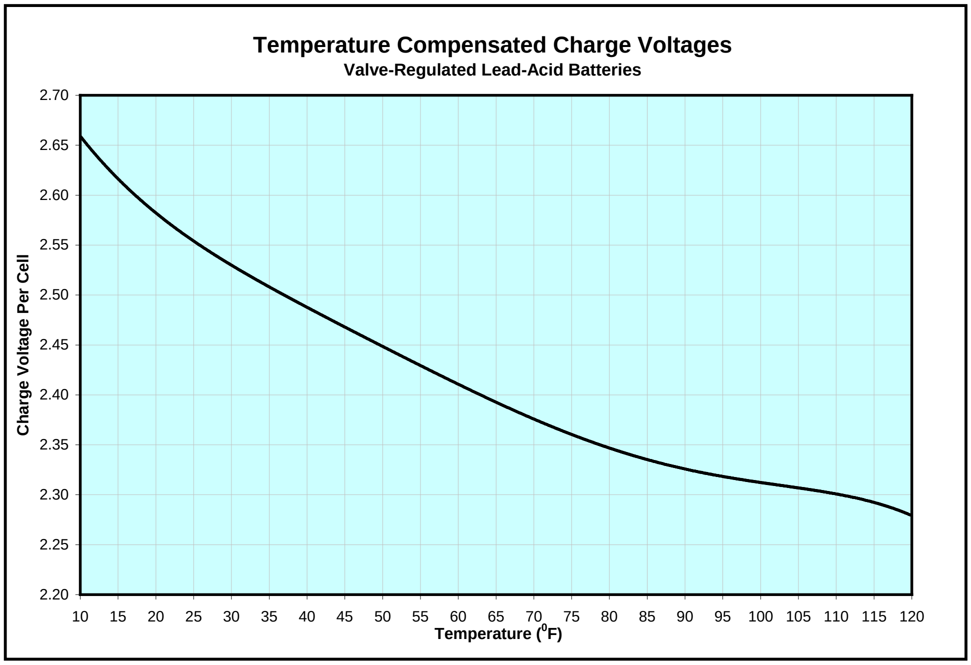
5.2.3 Typically, the charger will regulate to around 28.6V for 24V batteries. As the battery approaches the charger output voltage, charge current will drop below 0.5 amperes.

5.2.4 The battery must be connected to the charger with output voltage set between 28.6V ± 0.3V for 24V batteries and left on until the charge rate drops below 0.5 ampere. At this point, disconnect the charger from its power source first before disconnecting the battery from the charger – to eliminate any sparks.

Note: Unless the charger is of a type that turns off automatically, you must disconnect the charger and battery once the charge rate drops below 0.5 amperes.

5.2.5 Alternatively, constant-voltage charging can be temperature-compensated for better control. Note Figure 2 for Temperature Compensated Charge Voltages. This figure can be used for all 7000 series batteries.

Figure 2



5.3 STANDARD CONSTANT-CURRENT (CI)

5.3.1 These chargers must be capable of providing an output of ~ 33-35V (for 24V batteries) or ~16.5-17.5V (for 12V batteries) and ~ 4-8 amperes (with selector switch) and include a timer that can terminate charging when the required charge input is attained.

5.3.2 The ampere hours of energy restored is the product of charge current (in amperes) and the time (in hours).

5.3.3 During such charging, the on-charge battery voltage will reach 32V-33V for 24V batteries or 16-16.5V for 12V. This is standard for such a charge method. Please use charge rate and times as indicated in Sections 5.5, 6.4 and 6.5.

5.3.4 Since these chargers are designed to provide a constant current throughout the charging period, this method can lead to overcharging if not controlled. In order to control the charge input, these chargers must have a shut-off timer.

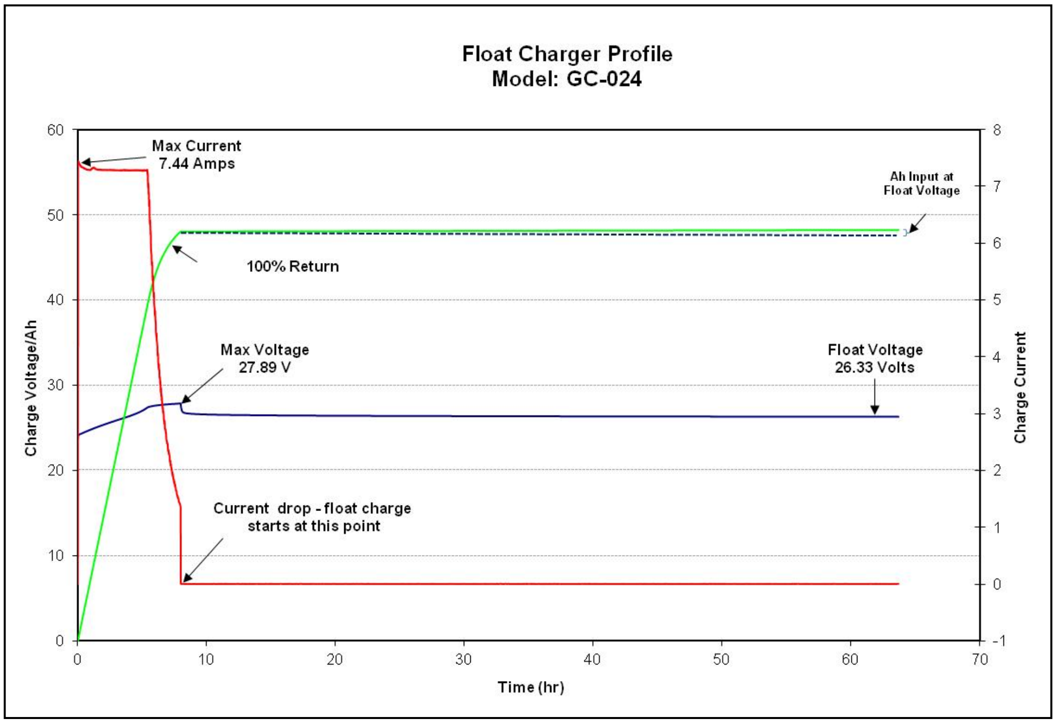
5.4 FLOAT CHARGING

5.4.1 This method of charging is essentially accomplished using a charger that can provide a constant potential charge at a lower voltage, typically around 26.4V.± 0.2V for 24V batteries or 13.5V ± 0.2V for 12V. See Figure 3 for charger performance.

5.4.2 Teledyne recommends using the GC-024 charger, which is a constant potential charger that will revert to a float charger after the battery has been charged at 28.5V ± 0.3V. Alternatively, TBP offers the GC-012 for 12V batteries as well.

5.4.3 The batteries may be kept on the float charger for up to six months at this voltage.

Figure 3



5.5 INITIAL CHARGING

5.5.1 All general charging will be accomplished using the Constant Potential charge regime, except when situations require specific charging treatment.

5.5.2 When batteries are left on shelf for a longer period, they will have to be reviewed using open circuit voltage (OCV) as the primary guide, with the State of Charge Vs Voltage graph, Figure 1.

5.5.3 The requirement at initial installation is to ensure battery will provide 100% capacity. Inspect battery voltage and reference to Figure 1 to verify state of charge.

5.5.4 For various battery voltages, Table 1 provides the necessary charging and / or conditioning that would be required.

5.5.5 Please contact Teledyne Tech Support if there are any situations that are not clear.

Table 1
INITIAL CHARGING PROCESS

Battery Voltage (Open Circuit Voltage, OCV)	Process
<24V or <12V	Discharge the battery at the one-hour rate to 20V. Recharge at constant potential (CP) of 28.6V±0.4V or 14.25V ± 0.2V until the charge rate drops to 1A. Then charge at constant current (CC) of 1A for 12 hours. Discharge the battery at the one-hour rate to 20V (see Appendix A). The battery must achieve at least 100% (1 hr) of this rating. - If the battery passes, recharge it using CP and CC method - If not, repeat CP and CC charge followed by one more discharge. If the battery fails to meet capacity, call Teledyne Tech Support for further direction.
24V-25.5V or, 12V-12.75V	Discharge at one-hour rate to 20V (see Appendix A) – then recharge at constant potential of 28.6V±0.4V or 14.25V ± 0.2V until charge current drops to 0.5A or less. If the charge rate does not drop below required value, generally within 10-12 hours, conduct up to 2 additional capacity tests and verify that the charge rate drops to 0.5A or less.
> 25.5V or >12.75V	Charge at constant potential of 28.6V±0.4V or 14.25V ± 0.2V until charge rate (current) is equal to or less than 0.5A

ROUTINE MAINTENANCE

6.1 INSPECTION/SERVICE PERIOD

After initial installation, TBP requires a capacity check of the battery to be performed at 1,200±50 hours or 11±1 months, whichever comes first, with subsequent capacity checks performed every 600±50hours or 6±1 months. Please refer to aircraft manufacturer's guidelines for further clarification.

For all TSOA batteries, the initial capacity check will be performed at 1,800±50 hours or 18±1 months, whichever comes first, with subsequent checks every 9±1 months

WARNING

The battery must be removed from the installation and serviced in a well-ventilated designated area. During servicing, the battery will generate oxygen and hydrogen gases, which can be explosive under the right conditions.

6.1.1 Battery Integrity

Visually inspect the battery for any signs of cracks, corrosion, unusual terminal pin wear or discoloration on the pins.

WARNING

ALL VRLA batteries contain sulfuric acid, which is highly corrosive and which can cause serious physical injury if it comes in contact with skin or if inhaled. It can also cause serious eye injury or blindness if it comes into contact with the eyes.

Caution must be exercised to avoid damage to the exterior case which could allow the contents to escape or come in physical contact with external materials or personnel.

If a battery case is found to be damaged, handle the battery with care and avoid contact with the skin. Inspect all areas adjacent to the battery for evidence of corrosion.

6.2 CONTINUED AIRWORTHINESS REQUIREMENT – CAPACITY TESTING

In order to verify continued performance capabilities of the battery, the following inspection is to be performed:

6.2.1 Measure and record the battery voltage.

6.2.2 Charge the battery using Table 2.

Table 2
CHARGING PROCESS

Battery Voltage (Open Circuit Voltage, OCV)	Process
<24V or <12V	Discharge the battery at the one-hour rate to 20V. Recharge at constant potential (CP) of 28.6V±0.4V or 14.25V±0.2V until the charge rate drops to 1A. Then charge at constant current (CC) of 1A for 12 hours.
24V-25.5V or, 12V-12.75V	Discharge at one-hour rate to 20V (see Appendix A) – then recharge at constant potential of 28.6V±0.4V or 14.25V±0.2V until charge current drops equal to or less than 0.5A.
> 25.5V or >12.75V	Charge at constant potential of 28.6V±0.4V or 14.25V±0.2V until charge rate (current) is equal to or less than 0.5A

6.2.3 Allow the battery to rest for 1 hour before starting the discharge test.

6.2.4 The battery should be discharged at the one hour rate (see Table 3, Appendix A) to an end voltage of 1.67 volts per cell or 20 volts (per IEC 60952-1). Measure the time. The battery must achieve at least 80% of the rated time (or 48 minutes at the 1 hour rate).

If the first discharge time is less than 48 minutes, condition charge the battery per Section 6.3 and repeat the discharge test. This conditioning charge may be repeated once more, if needed, to ensure capacity is better than 80%.

6.2.5 If the second discharge fails to deliver at least 48 minutes, the battery should be rejected. Call TBP Technical Support for further details.

6.2.6 Once the battery has passed all required inspections and after it is fully recharged using constant-voltage charging methods, the battery is ready for installation.

6.3 RECONDITIONING BATTERY

6.3.1 Discharge the battery at the one hour rate, to the end voltage of 20V. If the battery is already below this voltage, skip this step.

6.3.2 Charge the battery at constant potential of 28.6V±0.4V or 14.2±0.3V, depending on nominal battery voltage until the charge rate drops to 1A, followed by a constant current charge at 1A for 12 hours.

6.3.3 Repeat the discharge test per Section 6.2.4, followed by a recharge per Section 6.3.2

6.3.4 The battery should achieve full capacity in 2 cycles. If it does not, reject the battery.

6.4 DEEP-DISCHARGE RECOVERY

6.4.1 Deep discharge is usually indicated by a battery voltage of less than 24 volts or 12 volts, depending on nominal battery voltage. A battery which has been deeply discharged can be recharged using constant-current charging techniques for best recovery.

6.4.2 Discharge the battery at the one hour rate (see Table 3) until the battery drops to 20V (24V batteries) or 10V (12V batteries).

6.4.3 Recharge the battery at a constant current charge rate of 1.0A for a total input (in ampere-hours) of 120% of the one-hour capacity, which is determined as follows:

For example, for a one-hour capacity of 25 Ah, the charge time is determined as follows:

1.2 (120% input) x 25Ah = 30 Ah (Ampere-hours) needed.

At the charge rate of 1.0 amperes, the total charge time would be:
30 Ah/1.0A = 30 hours.

6.4.4 After a pause of about 1 hour, discharge the battery at the one hour rate (see Table 3) until the battery drops to 20V or 10V, depending on battery nominal voltage. Depending on nominal battery voltage, record the time to 20V or 10V (while under load). If it is greater than 80% of specification (see Appendix A), recharge per Section 5.2 and return to use. If not, continue to Section 6.4.5.

6.4.5 Charge the battery at constant potential of 28.6V±0.4V or 14.2V±0.3V until the charge rate drops to 1A, followed by a constant current charge at 1A for 12 hours.

6.4.6 Discharge the battery at the one hour rate (see Table 3) until the battery drops to 20V or 10V, depending on nominal battery voltage. The battery should be at least 80% of capacity. If the battery is lower than 80%, repeat step 6.4.6 one more time. If the battery does not provide more than 80% of the rated specification, it should be rejected.

6.4.7 Avoid subjecting a battery to frequent deep discharges as this can reduce the useful life of the battery.

6.5 MONITORING BATTERIES IN LONG-TERM STORAGE

After storage or before installation on aircraft, follow the guidelines below. Refer to Section 4.3.

6.5.1 If the batteries are stored for two years at recommended temperatures, the batteries can be recharged at constant current of 1A for 120% of the one hour capacity (see Appendix A for specifications). If it is a 25Ah battery, recharge at 1A for:

1.2x25Ah/1A = 30 hours.

6.5.2 Conduct a capacity check per Section 6.2. Repeat cycle starting with recharge per 6.3.2. The battery should be at capacity by the end of the second cycle. Call Teledyne Tech Support if is not at capacity.

6.6 INSPECTION OF CONNECTORS

6.6.1 Before connecting battery to aircraft, ensure the connector sockets have not worn or become loose. Use go-no-go gauge, part number 3600-51, obtained from Teledyne.

6.6.2 Inspect the connector for any cracks – replace if cracked.

6.6.3 Verify the cables are not worn / corroded. Replace if they are worn / corroded.

UNSCHEDULED REMOVALS

7.1 Unscheduled removals may be required when the battery has been inadvertently discharged or has a premature failure. Recharging the battery using Constant Potential method described in 5.2 should be attempted. Perform a capacity check as outlined in 6.2. If the battery fails to provide specified capacity as noted in Table 3, Appendix A, it should be rejected.

7.2 In lieu of the capacity test set forth above, testing on an installed battery may be performed during the 400-hour maintenance check, or the periodic maintenance interval performed by the service center. This test entails a battery OCV check which is compared to the graph in Figure 1. If the voltage is below 75% state-of-charge, the battery should be pulled out for servicing as outlined in Section 6.

8. LT VRLA TROUBLE-SHOOTING GUIDE

PROBLEM	CAUSE	RECOMMENDATIONS
Battery has low capacity	Battery is at end of life.	Replace battery.
	Battery has not been charged correctly	Refer to Section 5 for charging options
Will not come up to full charge.	Aircraft charging voltage may be lower than required for application.	Contact Aircraft Technical Support for assistance.
Will not hold charge.	Flight legs too short to charge the battery sufficiently.	Remove the battery from the aircraft and recharge when necessary.
	Battery held at high ambient temperatures	Remove battery from aircraft, recharge as required.
	Equipment left on accidentally, battery is discharged.	Recharge per Section 5; if deeply discharged, follow Section 6.3.
	Loose connections; corrosion	Clean and neutralize connections; tighten all connections
	Quick disconnect worn beyond tolerance.	Check Cannon or Elcon type connectors for good contact (see 7.2) with Teledyne Go-NoGo gauge part number 3600-51.
	Battery could be shorting under load.	Perform airworthiness test per Section 6.2
	Battery could be self-discharging due to low state of charge. Sulfation can build up – based on repeated undercharge situations – or Excessive sulfation build-up caused by leaving the battery in a discharged state for an extended period of time.	Recharge per Section 5; if deeply discharged, follow Section 6.3.
	Possible excessive use of starter and other electrical equipment.	Remove and recharge the battery; reduce equipment load or use an approved higher capacity battery.
Battery life too short.	Application.	Ensure that battery selection is correct for the application. Infrequent flying will lead to gradual discharge of battery, especially if the breaks between flying are over three weeks. Please review directions under Managing Periods of Non-Use under SERVICE. Ensure battery is not subjected to excessive vibration or high temperatures in service.
	Charging variations such as overcharging or chronic undercharging brought about by short flights.	Overcharging could be eliminated by inspecting and correcting charge voltages. Excessive undercharging (very short flights) should be compensated by periodic charging of battery.

TRANSPORTATION

9.1 TBP LT VRLA batteries are classified as “Nonspillable” and are exempted from all other requirements of 49 CFR, Chapter 1, Subchapter C, Parts 106 – 180, as determined in:

a) US Department of Transportation’s 49CFR, Chapter 1, Part 173.159, paragraph “d”
b) IATA/ICAO Packing Instructions 806, Provision A67

RECYCLING

10.1 MATERIAL SAFETY DATA SHEETS

10.1.1 The MSDSs can be downloaded as needed from the TBP website: www.gillbatteries.com

10.2 RECYCLER LOCATIONS

10.2.1 All parts of spent lead-acid batteries are recyclable. Generally, batteries are collected by retailers and wholesalers who send large quantities to battery recyclers for reclamation. Battery recyclers are permitted hazardous waste treatment recycling facilities. If you have just a few batteries you should contact your local battery retailers or wholesalers.

10.2.2 Recycler in California:

RSR Quemetco, Inc.
720 South 7th Avenue
City of Industry, CA 91745
(800)527-9452

10.2.3 The California Department of Toxic Substances Control publishes an annual listing of commercial hazardous waste recyclers, which also includes facilities outside of California. A copy of this publication, the "Directory of Industrial Recyclers" may be obtained by calling (916) 324-2423, or writing to the:

California Waste Exchange Resource Recovery Unit
Hazardous Waste Management Program
Department of Toxic Substances Control
P.O. Box 806
Sacramento, CA 95812-0806

10.2.4 **Nation-wide Recycling:**

Most retailers, auto parts stores or service outlets that sell new lead-acid batteries will accept a small number (one or two) of spent lead-acid batteries for recycling. If you have a larger quantity to be recycled, call to verify that your chosen outlet can handle a larger quantity of old batteries.

For additional information, please use the following web address to locate nation-wide recycling facilities: www.batterycouncil.org

10.3 INTERNATIONAL RECYCLING RESOURCES

10.3.1 British Battery Manufacturers Association
26 Grosvenor Gardens
London SW1W 0GT
Direct Tel: +44 (0) 207 838 4800
Direct Fax: +44 (0) 207 838 4801

10.3.2 SNAM (Societe Nouvelle d'Affinage des Metaux)
Rue de la Garenne
St Quentin Sallavier
38297 La Verpilliere Cedex
France
Telephone: 00 33 74 945 985

10.3.3 You can also locate a recycling facility through the following Call2Recycle (a program of Rechargeable Battery Recycling Corporation – RBRC) website: http://www.call2recycle.org/

GLOSSARY

Active material	The formed (charged) material on the positive and negative electrodes (plates).
AGM	Absorptive Glass Mat, a non-woven fiberglass separator that holds the electrolyte.
Ah	Ampere-hour; the standard designation of capacity units for batteries.
CFR	Code of Federal Regulations.
Charge Balance	Net amount of charge "lost"
Electrolyte	The liquid added to a battery that is capable of conducting ions between the two electrodes.
Electrolysis	Decomposition of an electrolyte by the action of an electric current flowing through the electrodes (positive and negative plates).
IATA	International Air Transport Association.
ICAO	International Civil Aviation Organization.
IEC	International Electrotechnical Commission.
I_{pp}	Peak current delivered at 0.3 seconds into a 15 second controlled discharge at a constant terminal voltage of half the nominal battery voltage.
I_{pr}	Discharge current at the conclusion of a 15 second controlled discharge at a constant terminal voltage of half the nominal battery voltage
Nonspillable	Refers to the ability of the battery to retain the electrolyte when subjected to tests identified under US DOT Reg 49 CFR, Part 173.159, paragraph "d".
OCV	Open Circuit Voltage; measured with no loads connected to the battery.
Passivation	Refers to the oxidation of the negative electrode.
Recombination	The process by which oxygen combines (reacts) with the negative active material.
Sponge lead	Fully charged negative plates convert to a very porous pure lead material, often referred as sponge lead since it resembles a sponge under high magnification.
State of Charge	The state-of-charge is the ratio between the difference of the rated capacity and the charge balance to the rated capacity.
Sulfation	The product of discharge, lead sulfate, formed on both positive and negative plates.
Venting	Means for a battery to release the gases it generates during charging.

APPENDIX A

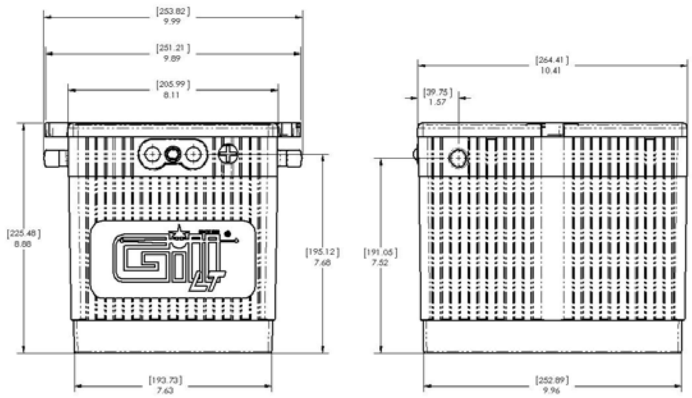
Table 3
VRLA Battery Capacities

Type	Battery Voltage (V)	1 Hour Rate (A)	30 Minute Rate (A)
7639-25	24	25	45
7638-53	24	53	80
7638-44	24	44	70
7638-36	24	36	63
7407-28	24	28	45

APPENDIX B

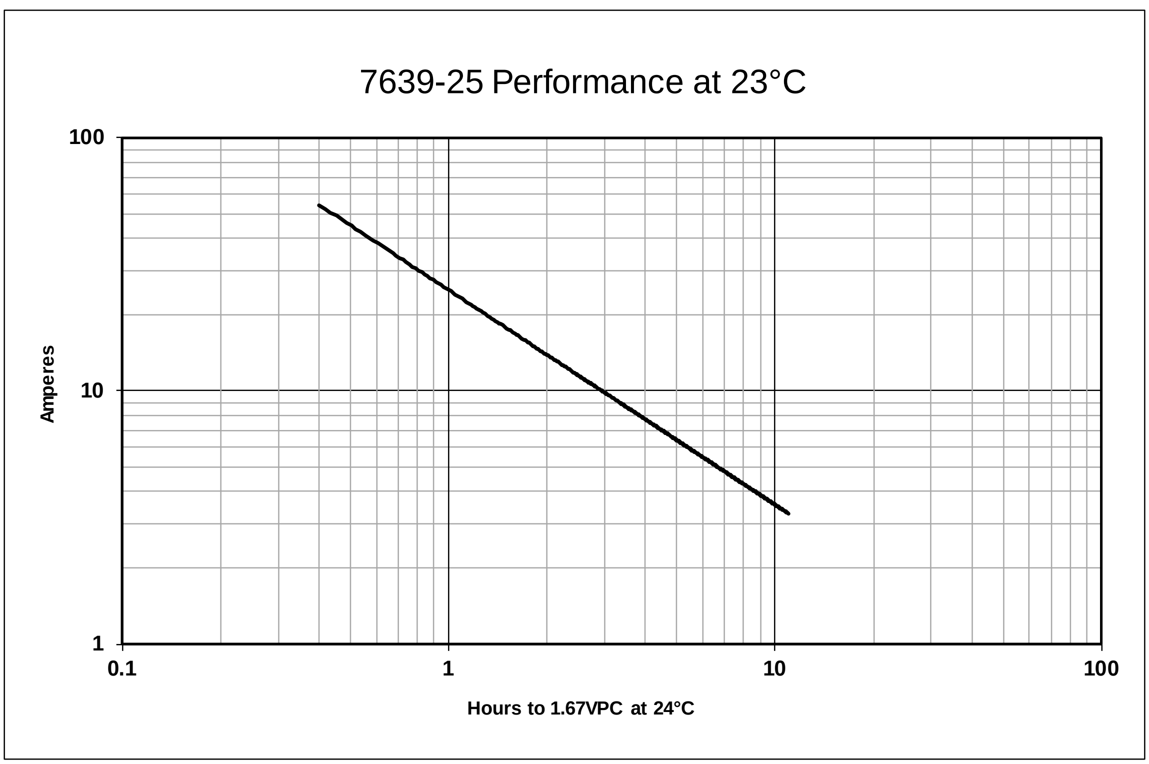
VRLA Battery Specifications and Performance Curves

1) 7639-25
2) 7638-53
3) 7638-44
4) 7638-36
5) 7407-28

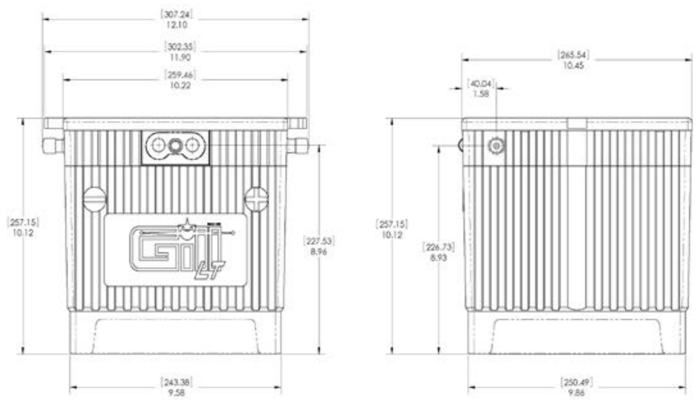


Specifications

Ratings	Electrical Performance at Various Temperatures								Battery Weight (lb)
	30 min. (@ 23°C 1.67 Volts per cell)	1 hr (@ 23°C 1.67 Volts per cell)	Ipp @ 23°C (A)	Ipr @ 23°C (A)	Ipp @ -18°C (A)	Ipr @ -18°C (A)	Ipp @ -30°C (A)	Ipr @ -30°C (A)	
Watts	900	500							59
Amps	45	25	1,503	1,002	1,104	734	793	596	
Capacity (Ah)	23	25							
Energy (Wh)	450	500							

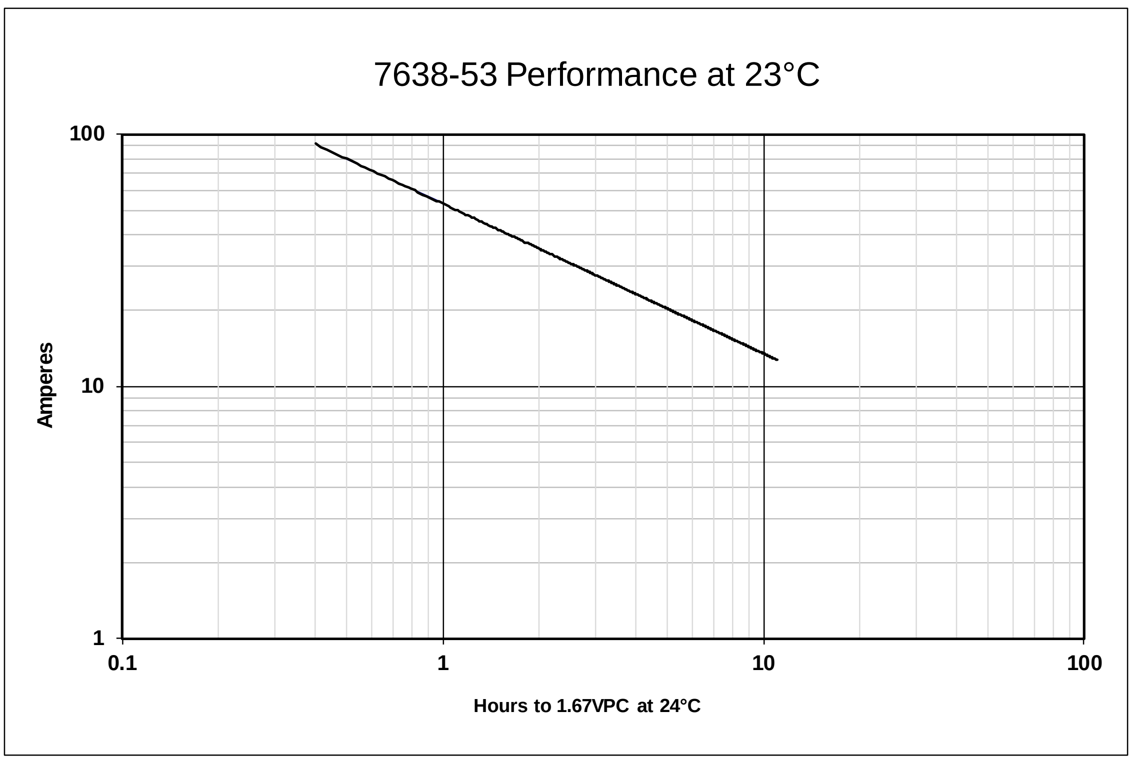


Premium LT Valve Regulated Lead Acid Aircraft Batteries By TELEDYNE BATTERY PRODUCTS

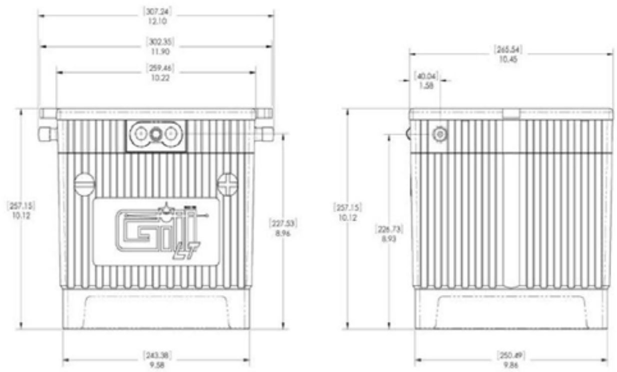


Specifications

Ratings	Electrical Performance at Various Temperatures								Battery Weight (lb)
	30 min. (@ 23°C 1.67 Volts per cell)	1 hr (@ 23°C 1.67 Volts per cell)	Ipp @ 23°C (A)	Ipr @ 23°C (A)	Ipp @ -18°C (A)	Ipr @ -18°C (A)	Ipp @ -30°C (A)	Ipr @ -30°C (A)	
Watts	1,600	1,060							93
Amps	80	53	1,857	1,247	1,500	1,110	1,129	860	
Capacity (Ah)	40	53							
Energy (Wh)	800	1,060							

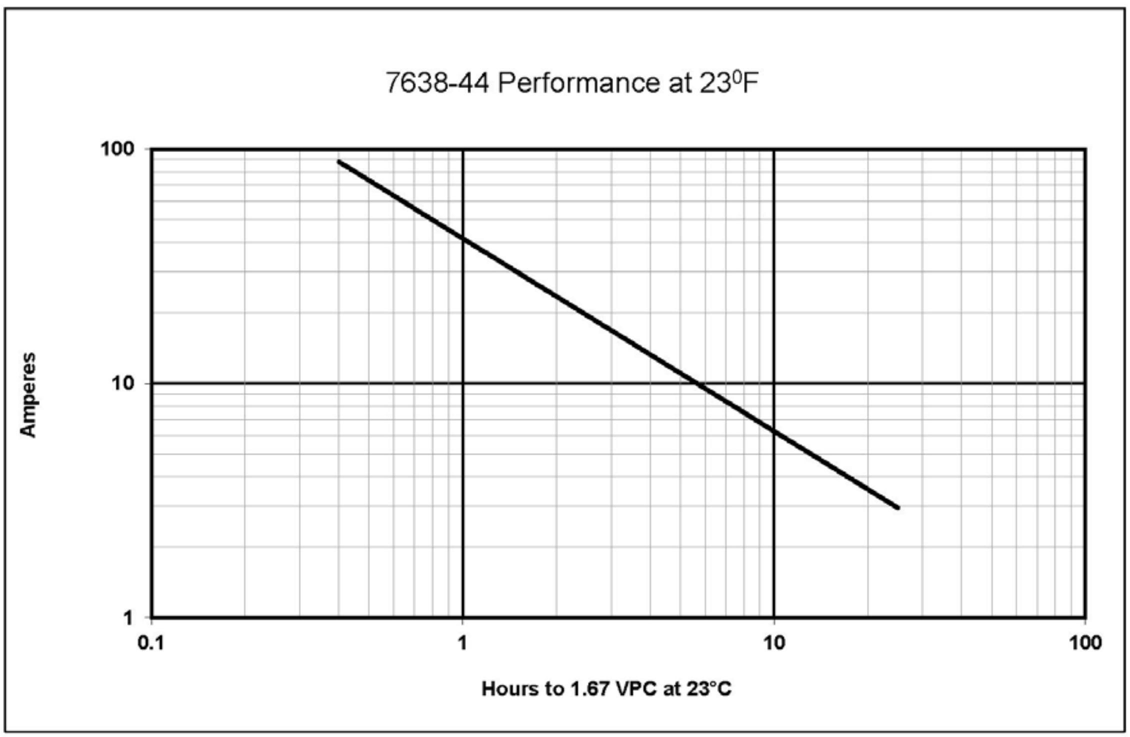


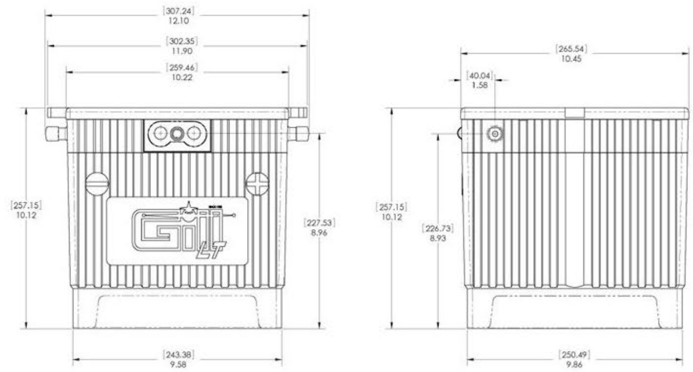
Premium LT Valve Regulated Lead Acid Aircraft Batteries By TELEDYNE BATTERY PRODUCTS



Specifications

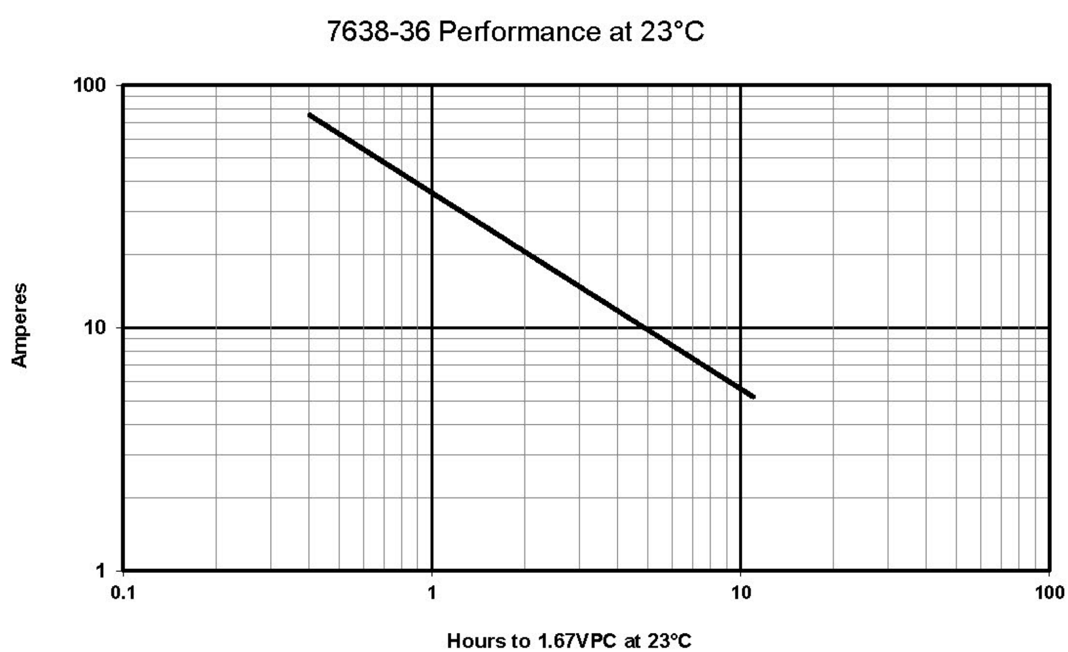
Ratings	Electrical Performance at Various Temperatures								Battery Weight (lb)
	30 min. (@ 23°C 1.67 Volts per cell)	1 hr (@ 23°C 1.67 Volts per cell)	Ipp @ 23°C (A)	Ipr @ 23°C (A)	Ipp @ -18°C (A)	Ipr @ -18°C (A)	Ipp @ -30°C (A)	Ipr @ -30°C (A)	
Watts	1,400	880							86
Amps	70	44	1,857	1,247	1,677	1,051	1,411	948	
Capacity (Ah)	35	44							
Energy (Wh)	700	880							

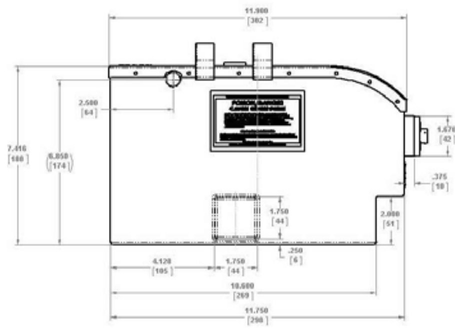


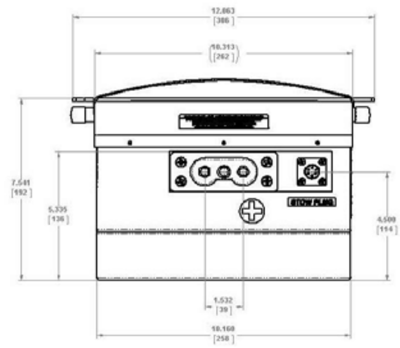


Specifications

Ratings	Electrical Performance at Various Temperatures								Battery Weight (lb)
	30 min. (@ 23°C 1.67 Volts per cell)	1 hr (@ 23°C 1.67 Volts per cell)	Ipp @ 23°C (A)	Ipr @ 23°C (A)	Ipp @ -18°C (A)	Ipr @ -18°C (A)	Ipp @ -30°C (A)	Ipr @ -30°C (A)	
Watts	1,260	720							84
Amps	63	36	1,958	1,408	1,492	1,128	1,156	741	
Capacity (Ah)	32	36							
Energy (Wh)	630	720							







Specifications

Ratings	Electrical Performance at Various Temperatures								Battery Weight (lb)
	30 min. (@ 23°C 1.67 Volts per cell)	1 hr (@ 23°C 1.67 Volts per cell)	Ipp @ 23°C (A)	Ipr @ 23°C (A)	Ipp @ -18°C (A)	Ipr @ -18°C (A)	Ipp @ -30°C (A)	Ipr @ -30°C (A)	
Watts	900	560							66
Amps	45	28	1,599	1,088	1,100	840	850	600	
Capacity (Ah)	18	28							
Energy (Wh)	450	560