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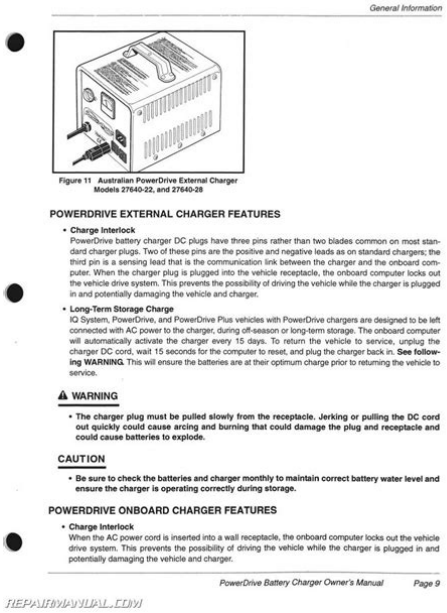

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Book Descriptions:

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During discharge, the chemical energy stored in the battery is converted into usable electrical energy. A leadacid motive power battery supplies direct current DC power to electric lift trucks, tractors and pallet trucks. This type of battery consists of a metal tray containing cells, connected in series. These batteries come in a wide variety of shapes, sizes, voltages and amperehour capacities. Each cell in a motive power battery contains positive and negative plates. All of the positive plates are joined in parallel to the positive post and strap, to form a positive group. The negative plates also are joined in parallel to the negative post and strap to form a negative group. These groups are separated and insulated from one another and they are immersed in a solution of sulfuric acid and water, called electrolyte. These groups of plates, separators, posts and straps are called an element and it is contained in an acidproof plastic jar. The cutaway illustration Fig. A1 shows the construction of an East Penn battery cell. Each positive plate consists of a leadalloy grid structure which is filled with a paste of active material, made from lead oxide. The active material is forced into the positive grid structure during manufacturing and is held firmly to the grid by a system of vertical and horizontal glass fiber mats, which reinforce and insulate the positive plate. A retainer and bottom shield encase each positive plate and mat assembly to help prevent short circuits. The negative plate also consists of a lead alloy grid structure that is filled with active material. But because negative plates undergo much less active material shedding, no reinforcing glass fiber mats are needed. Separators provide insulation between the positive and negative plates. The positive and negative plates are connected to their respective posts by positive and negative straps. COVER Heat sealed with lead insert bushing prevents leakage and voltagetoground.http://aulac.com.vn/userfiles/3-way-manual-globe-valve.xml

- **car battery charger service manual, 1.0.**

SEPARATOR GUARD White color increases visibility for fast electrolyte check. Solid insulating guard extends beneath the straps to prevent shorting between the plates and straps. ORING SEAL Accomodates positive plate growth without cover distortion and leakage. POST Special alloy for increased strength and conductivity. NEGATIVE PLATE Engineered to complement positive plate performance. POST PLATE STRAP Extra heavy to ensure a permanent connection between posts and plates. VERTICAL MAT Laminated construction comprised of uniformly spaced, fine glass tape that imbeds into the active material. Also features an interwoven glass fiber mat wrapped vertically around the positive plate ensuring optimum active material retention. POSITIVE GRID A nonporous lead alloy casting designed for maximum current carrying capacity, capable of many years of dependable service. Lead alloy is manufactured onsite and undergoes rigid testing before, during and after casting. ACTIVE MATERIAL Manufactured onsite to exacting specifications and uniformly applied under rigid laboratory control to ensure maximum efficiency throughout long battery life. HORIZONTAL MAT Made of glass fibers with an insoluble binder. Breaks up gas bubbles and increases positive plate insulation and performance. JAR Molded of high impactresistant material to remain leakfree under the roughest conditions. RETAINER A high porosity perforated envelope that encases positive plates and glass mats to prevent shorts and ensure maximum performance and life. BRIDGE Provides firm element support and ample sediment space. BOTTOM SHIELD Provides extra protection on bottom of positive plate to prevent shorting between plate and sediment. STEEL TRAY Heavy gauge with acidresistant protective coating. Steel covers furnished as required. Fig.http://mbitcity.ru/userfiles/3g+-mobile-broadband-wireless-n-router-mbrn3000-manual.xml

A1 3 SEPARATOR Impervious to heat, acid and corrosion, deep channeled, microporous separators

provide insulation between positive and negative plates while allowing the free flow of electrolyte throughout the cell. ELECTROLYTE In ample volume to ensure top performance at all rates of discharge. The electrolyte has maximum sulfuric acid content and its temperature corrected specific gravity ranges should comply with the manufacturer’s recommended full charge specific gravity specifications See Table 11 . See Table 31 shown on page 14 Specific Gravity Temperature Corrections. However, a cell may have a voltage from 2.12 to 2.70 volts while being charged. A cell develops a voltage potential when two dissimilar metals are immersed in a suitable electrolyte. The two metals used in leadacid cells are lead peroxide PbO2 and sponge lead Pb, and the electrolyte is dilute sulfuric acid H2SO4. This combination of dissimilar metals and electrolyte results in a voltage potential of nominally two 2 volts per cell and their potential ability to deliver this voltage under varying load and for varying periods of time. When a battery is discharged, the internal components of each cell undergo chemical changes Figure I1. During the discharge cycle, the composition of the positive plates changes from lead peroxide PbO2 to lead sulfate PbSO4 and the negative plates from sponge lead Pb to lead sulfate PbSO4 The sulfate on both the positive and negative plates comes from the sulfuric acid in the electrolyte solution combining chemically with the active material of the plates. This chemical reaction reduces the sulfuric acid content in the electrolyte. The specific gravity of the electrolyte is reduced and approaches that of water 1.100. Cell voltage decreases during the discharge because the two 2 dissimilar metals PbO2 and Pb are becoming more similar PbSO4. Battery Ratings During charging, the discharging reaction is reversed and the chemical energy is restored.

The lead sulfate on the positive plates converts back to lead peroxide PbO2 and the lead sulfate on the negative plates converts back to sponge lead Pb. The released sulfate returns to the electrolyte solution, increasing the sulfuric acid content, which in turn increases the specific gravity. When these electrochemical reactions are complete, the cell is again fully charged. Fig. I1 A single leadacid cell does not have sufficient power to handle most requirements. However connecting a number of cells together in series results in a battery capable of supplying higher power demands. Battery Voltage The number of cells is determined by the required nominal operating voltage of the equipment. During charging, hydrogen gas is formed on the negative plates and oxygen is formed on the positive plates. Harmful if swallowed, inhaled, or in contact with skin. Acid causes severe skin burns and eye damage. May damage fertility or the unborn child if ingested or inhaled. May cause harm to breastfed children. May cause cancer if ingested or inhaled. Causes skin irritation, serious eye damage. Contact with internal components may cause irritation or severe burns. Causes damage to central nervous system, blood and kidneys through prolonged or repeated exposure if ingested or inhaled. Irritating to eyes, respiratory system, and skin. Extremely flammable gas hydrogen. Explosive, fire, blast or projection hazard. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wash thoroughly after handling. Do not eat drink or smoke when using this product. Use only outdoors or in a wellventilated area. Avoid contact with internal acid. Do NOT induce vomiting. IF INHALED Remove person to fresh air and keep comfortable for breathing. IF IN EYES Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Store locked up, in a wellventilated area, in accordance with local and national regulation.

Keep out of reach of children. See P.23 for full warranty information. Positive plate capacity is the ampere delivery for a fixed period of time usually six hours for a particular size positive plate. In the previous examples, the battery is an 18cell, D10013 plate unit. To determine the number of positive plates in each cell, subtract one from the total number of plates in the cell and divide by two. The use of a different type of positive plate, such as a D75 or D125, will respectively decrease or increase the amperehour capacity. 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. Batteries also contain other chemicals known to the State of

California to cause cancer.Do not disassemble or incinerate. Not recommended for inverted use. Follow product charging instructions. High Voltage Risk of shock. Do not touch uninsulated terminals or connectors. Keep Vent Caps Tightly in Place Manufactured by East Penn Manufacturing Co. 102 Deka Road, Lyon Station, PA 19536 6106826361 USA Lead Acid Battery Electrolyte Sulfuric Acid HYDROGEN GAS FROM THE BATTERY OR CELL CAN EXPLODE.Electrolyte weighing 1.2 times as much as the same volume of water has a specific gravity of 1.200. The full charge specific gravity of a cell is a matter of design and depends on several factors. The specific gravity must be high enough to contain the amount of sulfuric acid necessary to meet the chemical needs of a cell. If the sulfuric acid content is too high, damage may result to the cell. Since the acid content of the electrolyte decreases linearly as the cell is discharged, the decrease in specific gravity is directly proportionate to the amount of amperehours removed refer to Table 32, page 15.A cell having a full charge specific gravity of 1.290 and a final specific gravity of 1.140 will have a specific gravity drop of 150 points.

Example Assume the specific gravity is 1.190 at the end of the discharge. The amperehour capacity is the number of amperehours which can be delivered under specified conditions of temperature, rate of discharge, and final voltage. Basically, amperehours are determined by multiplying the number of amperes which the battery will deliver by the number of hours during which the current is flowing. The size and number of plates which make up the element then determine total cell or battery capacity. Due to the variety of job requirements batteries are produced with many different sizes of cells. The linear relation of specific gravity to state of discharge can be used in tests to determine power consumption or capacity required. Tests of this kind can be made to demonstrate that a lift truck may require a larger capacity battery to do the job, and can lead to the solution of a problem. Specific Gravity During Recharge The rise in specific gravity during recharge is not uniform or proportional to the amount charge returned in amperehours. During the early part of the charge, there is no gassing action to mix the electrolyte with the heavier acid being released from the plates. The heavier sulfuric acid will lay on the bottom. A hydrometer reading which draws electrolyte from the top of the cell does not indicate the true specific gravity or actual state of charge. During the gassing portion of the charge, the sulfuric acid mixes, and the specific gravity rises rapidly to full charge value. Kilowatt Hours KWH Battery capacity is also expressed in kilowatthours KWH, which is the product of ampere x time x average volts per cell during discharge. Since lead by itself would be too soft and flexible to make a grid, a certain amount of antimony is added to the grid to prevent it from sagging or warping. The grids are then cast by pouring the molten alloy into grid molds. Fig. I3 and life. The formed plates become darker and are individually inspected Fig. I4 and Fig.

I5 to be sure that each one is perfect. This is important because many other companies form their plates in the battery, or in groups of cells, resulting in temperature variation between plates, and they can’t individually inspect each one. Negative Grid Positive Grid Fig. I2 Due to the increased amount of chemical activity that takes place on the positive grids during charging and discharging, positive grids are more heavily constructed than negative grids Fig. I2. Apply Active Material After the grids have been cast, the lead oxide pastes are applied. The lead oxide applied to the negative grid contains an expander to produce sponge lead. The positive plate contains a puttylike mixture of lead, lead oxide, lead sulfate and water. Because proper pasting is critical to battery performance, East Penn uses highly sophisticated, computercontrolled pasting machines to consistently apply paste to exact thicknesses and weight. Fig. I4 Curing and Drying After the plates are pasted, they must be cured and dried in a rigidly controlled environment. This securely binds the active material to the grid and produces a smooth, uniform plate. The active material, now highly porous, allows the electrolyte to penetrate freely so it can produce maximum conductivity between the paste and the grid for high cell efficiency. Because the curing and drying process is so important to cell efficiency and battery life, East Penn has invested in humidity and temperaturecontrolled curing ovens Fig. I3,

which produce the highest quality plates in the industry. Plate Formation The cured plates must now undergo a formation charge, which transforms the previously inert material on the positive plates into lead peroxide and the material on the negative plates into sponge lead. The plates are lowered into a forming tank filled with dilute sulfuric acid, then temporarily connected to a lead bar, and given a computercontrolled forming charge.

Individual plate formation allows the entire row of plates to be formed at uniform temperatures, which will enhance battery performance Fig. The small particles that are shed settle to the bottom of the cell. Both outside plates are negative, therefore the number of plates per cell is always an odd number, with each cell having one more negative then positive plate. The separators used to insulate the positive plate from the negative plate are grooved on one side and flat on the other Fig. I7. The grooved side faces the positive plate. The flat side faces the negative plate because the sponge lead of the negative plate would expand if it faced into the grooved side. In some cases, positive plates can be inserted into separator sleeves, which are two separators joined at the sides. When assembling the stack of plates and separators into an element, a post plate strap is welded onto the positive plate lugs and another one is welded onto the negative plate lugs. At the same time, positive and negative posts are welded onto the proper plate straps. A perforated plastic moss shield is placed on top of the assembled plates Fig. I8. The moss shield also protects the tops of the plates and separators and permits the gas bubbles to get up to the surface of the electrolyte. Positive Plate Wrapped Fig. The glass fibers imbed into the active material, strengthening in a way similar to reinforcing rods in concrete. A horizontal glass fiber mat is then wrapped around the plate to break up any gas bubbles and increase the plate’s insulation. The wrapped plate is then encased in a perforated plastic retainer envelope that firmly holds the glass wraps in contact with the plate while allowing the free flow of electrolyte to the plate. A bottom plate boot is added to prevent the sediment in the sediment chamber from contacting the bottom of the positive and negative plates and shorting out the cell.

Assembling An Element A group of positive and a group of negative plates are stacked with separators, inserted between each positive and negative Fig. I8 Finishing the Cell Assembly A finished cell consists of an element inserted into a highimpact plastic jar with a cover Fig. I9. Before the element goes into the jar, a sediment bridge is installed to give the element firm support and provide a place for sediment to settle. After the completed element is inserted into the jar, a high impact plastic cover is placed on top and heat sealed onto the jar. The cover’s positive and negative terminals have a lead post bushing attached and are welded firmly to the element’s posts. Each finished cell is air tested to ensure an air tight covertojar and posttobushing seal. Spacer material may be added between the cells and tray to assure a tight assembly. East Penn will assemble batteries with or without a hot asphalt based sealing compound that is poured in the channels between cells, per customer request. East Penn recommends that sealing compound be used because it prevents dirt and flushed electrolyte from draining between the cells and tray. This internal build up of corrosive material over time could cause cell or tray damage and result in voltage shorts to ground that adversely effect lift truck electrical controls. Once all the jars have been sealed into the tray, intercell connectors are attached Fig. I10. Electrolyte is then added to the cells and the battery is moved to the boosting room for a final charge. Battery Finishing and Shipping After the boost charge, the battery is sent to the finishing line, where cables and connectors are attached according to the buyer’s layout specifications Fig. I11. The battery is then weighed, thoroughly cleaned, and inspected. Actual battery service weight and the tray drawing number are stamped on the steel tray, and all battery identification labels, warning labels, plaques, and service stickers are affixed to the tray. Fig.

I10 The finished battery is wrapped in plastic and palletized. Shipping information and instructions are included with the battery before shipment and a “corrosive” label is attached to all wet

containing electrolyte shipments. All East Penn employees are extremely proud of the products that they produce. You can be assured that the highest quality materials and workmanship were used to manufacture your battery. Fig. I11 Fig. I9 8 SECTION II — BATTERY SAFETY Wearing Protective Clothing DANGER Contains Lead, Sulfuric Acid Electrolyte, Lead Compounds. When working on or near batteries, always wear proper protective clothes including a face shield, safety glasses, longsleeved shirt, acidresistant boots and gloves. Do not wear any metal jewelry because it can short circuit a battery and become extremely hot if it accidentally contacts exposed intercell connectors. Refer to detailed warnings, Section I, Page 5. 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. Keep Vent Caps Tightly in Place Manufactured by East Penn Manufacturing Co. 102 Deka Road, Lyon Station, PA 19536 6106826361 USA Chain hoists used to handle batteries should be equipped with a nonmetallic container or bucket to prevent the chains from dangling and possibly causing a short by coming in contact with exposed intercell connectors on the battery top. If no protection is available, cover the battery with a nonconducting insulating material such as plywood or heavy plastic. Lead Acid Battery Electrolyte Sulfuric Acid Only trained and authorized personnel should change, repair or charge batteries. When used properly, a leadacid motive power battery is a safe, dependable source of electrical power. However, if proper care and safety precautions aren't exercised when handling a battery, it can be an extremely dangerous piece of equipment.

There are four hazardous elements in a leadacid battery sulfuric acid, explosive gases, electricity, and weight. Hazardous Elements Sulfuric Acid The electrolyte in a leadacid storage battery is a diluted solution of sulfuric acid and water. Although the acid content in the solution is only about 37%, it's still a strong corrosive agent and can burn skin and eyes and eat holes in many types of fabric. See Wearing Protective Clothing. Specific Gravity Reading 1.280 1.290 1.325 % Acid Content by Weight Fig. II1 37.40 38.55 42.50 Always use the proper lifting equipment to reduce the risk of tray damage, shorting and possible injury. A wood insulated battery lifting beam used with an overhead hoist is the safest way to move a battery Fig. II1. An insulated lifting beam, with hooks that fit properly into the lifting ears in the tray, can be used with almost any type of overhead hoist. Be sure the lifting hooks align perfectly with the battery lifting ears. Misaligned hooks can cause battery lifting ear damage and could disengage while the battery is being lifted. Explosive Gases When a leadacid battery is being charged, it produces an explosive mixture of hydrogen and oxygen gases. Make sure that all vent caps are unclogged and securely attached so that any gas is safely vented from the battery. Never smoke, use an open flame or create an arc or sparks on or near a battery without first eliminating explosive gases from the cells you're working on. See Gas Purging — Section VI. Using the Battery as a Counterbalance Electricity An electric shock hazard exists for persons who contact live parts of batteries when the voltage is over 50 volts. The higher the voltage, the greater the electric shock hazard. In addition, metallic objects coming in contact with exposed cell connectors will cause a short and can become very hot. Even shorts involving a single cell can become hot enough to cause severe burns.

In order for most lift trucks to operate safely, the battery is used to counterbalance the carried load. Therefore, a new or different battery must fall within the recommended battery weight range. This battery weight information is found on the nameplate of the truck. A battery's service weight is usually stamped on the tray near one of the lifting holes. A battery that's too heavy or too light can change the truck's center of gravity and cause it to be unstable. It's the user's responsibility to be sure that this weight is in the proper range. Weight The average lift truck battery weighs more than 2,000 pounds. Obviously it can cause serious injury if it isn't handled carefully during installation, removal or transport. Use proper lifting equipment and techniques at all times. 9 SECTION II — BATTERY SAFETY cont. CHARGING BATTERIES HANDLING ACID All plants should have designated charging areas, especially if they change batteries at the end of each shift.These areas

should have proper battery handling equipment including overhead hoists, lifting beams, battery racks and cranes, and the area must be well ventilated. Use a carboy tinter or safety siphon when removing acid from a carboy container. The venting device in a carboy prevents splashing. Carboys should be stored in a cool place away from direct sunlight. Note Use proper eye protection, protective clothing and equipment. Racks used in the charging area must be insulated to prevent any sparking. The battery rack supports must also be suitably insulated or made of nonconducting material. Mix electrolyte in a heat and acidresistant container. Always pour acid into water. Never pour water into acid because a violent chemical reaction can occur. Pour the acid slowly and stir the mixture so the acid doesn't settle on the bottom. Charging Areas — Proper Equipment Pouring Acid Mixing Electrolyte A source of running water nearby is desirable and a water hose at the filling operation is recommended.

The floors in battery and charging rooms should have an acidresistant coating and be sloped toward a sump. They should always be washed with clean water after an acid spill. The spill should be neutralized with a noncorrosive, water based neutralizing chemical that is user safe and environmentally compliant. When using high specific gravity acid above 1.400, take special precautions because it can be extremely dangerous. Note Use proper eye protection, protective clothing and equipment. Store acid and electrolyte solutions in covered containers made of lead, glass or acidresistant plastic. Keep the containers in a cool, dry area away from direct sunlight. Handoperated fire extinguishes should be available in all charging areas even if the areas are equipped with automatic sprinkler systems. For information on extinguisher class, size and mounting locations, consult local fire authorities or your insurance carrier. Important only the most experienced battery technicians should be allowed access to sulfuric acid and allowed to add acid for cell equalization purposes. Charging Areas — Proper Ventilation First Aid for Acid Splash The charging area must be properly ventilated, either naturally or with a ventilation system. When installing a ventilation system, a number of factors must be considered, including the number and size of batteries being charged at one time and the size, height and airtightness of the room Eyes Flush immediately with gently running water for at least 15 minutes, then see a doctor as quickly as possible. For contact lens wearers, remove the lens before the eyes are flushed. A buffering or neutralizing agent shouldn't be used in the eyes without the approval of medical or safety personnel. Ventilation is considered satisfactory if the hydrogen concentration doesn't exceed 2% in any one location. Concentrations of more than 4% are explosive and dangerous.

A number of instruments, such as combustible gas indicators and flammable vapor indicators, are available for continuous automatic analysis of hydrogen content in the air. Skin Wash affected area under running water and apply a chemical burn treatment. Severe burns require immediate medical attention. Clothing If large areas of clothing have been splashed or soaked, the clothing must be removed and the acid must be neutralized with a noncorrosive, water based neutralizing chemical that is user safe and environmentally compliant and then rinsed under running water. If the clothing is rinsed quickly enough, the chances of damage to the material are lessened. Always keep tray covers and truck compartment covers open when charging a battery. This helps cool the battery and disperse the gases. Always turn the charger OFF before connecting or disconnecting a battery. Live leads can cause arcing and sparking, which could cause an explosion if battery gases are present. In addition, the contact surfaces of the plugs or connectors will become pitted over time. Sparks, Open Flames Because of the explosive gas mixtures generated while charging batteries, anything that could ignite the gas, such as sparks, open flames, an electrical arc, smoking, etc., must be prohibited in the charging areas. To serve as a prominent reminder, "NO SMOKING" signs should be posted in all charging areas. 10 SECTION II — BATTERY SAFETY cont. Eye Wash and Emergency Shower Facilities 2. A deluge shower Fig. II3 should be used where high specific gravity acid above 1.400 is handled. The shower uses a handle or foot treadle to turn on a powerful water stream that can wash acid from skin and clothes. Emergency eye wash and acid neutralization facilities should be located

in the immediate work area for easy access. The three most popular types of eye wash and acid neutralizing equipment are the chemical burn station, deluge shower, and eye wash fountain. Fig. II4 3. An eye wash fountain Fig.

This device produces two streams of water so that both eyes can be flushed simultaneously. Fig. II2 1. A chemical burn station Fig. II2 is used in smaller battery charging and repair areas. The station consists of a wallmounted plastic squeeze bottle that contains a buffering solution for treating acid burns on skin, eyes and clothing. This inexpensive equipment should be used only where acid with a specific gravity lower than 1.400 is used. A buffering or neutralizing agent shouldn’t be used in the eyes without the approval of medical or safety personnel. Neutralizing Acid and Electrolyte For cleaning batteries, noncorrosive, water based battery cleaning products are all that should be used. For user safety and environmental regulatory compliance, the cleaning liquid should contain no hazardous chemical ingredients. Even some products labeled “Battery Cleaner” must be avoided because of hazardous ingredients and damage to batteries and related equipment. Acid spills are common in battery rooms. When acid spills occur it is critical to minimize 1. Health and safety risk to personnel and the environment. 2. Damage to batteries, equipment, and surrounding surfaces. 3. Time to neutralize, absorb, and cleanup. 4. Disposal costs of waste materials. 5. Regulatory compliance risks and fines. Neutralizing acid absorbers and spill kits have the performance attributes required when dealing with acid spills. The ph neutral dry and nonhazardous waste is easy to sweepup and dispose as nonhazardous waste. Fig. II3 11 SECTION II — BATTERY SAFETY cont. Repairing Batteries 5. To prevent possible short circuits, use insulated tools whenever you are working on a battery. If possible, cover the terminals and connectors with an insulating material such as plywood or heavy plastic, if the battery being worked on does not have intercell connector and terminal shrouds installed. Keep in mind several safety points when repairing batteries 1.