



## **TUBULAR-LM™ LOW MAINTENANCE MOTIVE POWER BATTERIES INSTALLATION AND OPERATING INSTRUCTIONS**

### **1. SAFETY**

- 1.1 Follow your company's Safety Instructions when working with or near industrial truck batteries. Observe the caution label affixed to the battery. Thoroughly familiarize yourself with industry and government guidelines (OSHA, ANSI) for charging, handling, and maintaining industrial batteries.
- 1.2 Assign battery and charger care to properly trained personnel.
- 1.3 This battery contains sulfuric acid electrolyte. Avoid contact with skin, eyes, or clothing. Wear rubber apron, gloves, boots, and goggles or face shield when handling, checking, filling, charging or repairing batteries.
- 1.4 Keep water readily available for flushing spilled electrolyte from eyes or skin. Use plain water only and obtain medical attention immediately. Special deluge showers and eye washbasins are required.
- 1.5 Batteries produce hydrogen and oxygen gas during charge. Keep open flames away. Do not check electrolyte level with a cigarette lighter or match. Use a flashlight or permanent lights. Switch on/off away from the top of the battery. Do not smoke or create sparks.
- 1.6 Lift batteries with a certified/approved hoist, crane, lift truck, or similar equipment. Move batteries with trucks, conveyors, or rollers. Be sure to place a rubber mat or similar insulating material across the tops of coverless batteries when handling. Make sure equipment is of ample strength and properly installed.

### **DO NOT USE CHAIN OR WIRE ROPE SLINGS.**

- 1.7 Never lay metal tools, such as wrenches or screwdrivers, on top of a battery.
- 1.8 Disconnect the battery from the truck when performing maintenance and repair on motor or electrical system.
- 1.9 Open or "break" the battery circuit before attempting repairs to the charging plug or receptacles.
- 1.10 Apply a strong neutralizer, such as baking soda or soda ash, when electrolyte is spilled on the floor. Check local regulations regarding the disposal of neutralized waste.

## 2. RECEIVING BATTERIES

Immediately upon receipt of shipment, examine the outside of the packing for signs of rough handling before accepting the battery from the carrier. Wet spots on the shipping pallet may be an indication of leaking jars broken in shipment.

If there is evidence of damage, the receipt should be signed and both copies (carrier's and receiving copies) marked "Shipment Received Damaged". The carrier should be called immediately and asked to make a "Carrier's Inspection for Damage Report".

If "concealed" damage is later detected, the carrier should be called immediately and requested to make a "Carrier's Inspection for Concealed Damage Report". After inspection by the carrier, arrangements should be made with the local GNB® Industrial Power representative to have the battery repaired before placing it in service.

**BEFORE PLACING BATTERIES IN SERVICE,  
REVIEW AND FOLLOW THE SAFETY GUIDELINES LISTED IN SECTION 1.**

## 3. PLACING IN SERVICE

Verify that the battery weight meets or exceeds the minimum truck weight requirements. Allow the battery to cool or warm to room temperature before charging or adding water. Make sure the battery charger is properly matched to the battery. Use a charger with automatic charger termination controls. **GNB recommends the use of an SCR charger with an I-E-I charging profile in order to achieve a minimum 45-day watering interval. To achieve a minimum 90-day watering interval, GNB requires the use of a GNB® SCR charger with a Tubular-LM™ charging profile.**

Open the vent caps from each cell and check to see that the electrolyte level is above the plate separators. If it is obvious that the electrolyte has spilled out of any cells, replace it with electrolyte of the same specific gravity as found in the other cells of the battery (1.280 – 1.290). Close the vent caps and give the battery a freshening charge until there is no increase in specific gravity for three hydrometer readings taken at one-hour intervals.

During shipment of the battery, low temperatures and/or normal shock and vibration often results in a drop in the electrolyte level. If the level is below the plate separators, recheck it after 3 hours of charging. If the level remains below the plate separators, add water or electrolyte to the proper level at the end of charging.

Following the first 90 days of service, the battery should reach its normal operating specific gravity of 1.295 to 1.345 at 77° F (25° C).

**IF BATTERIES ARE NOT IN REGULAR USE, KEEP THEM CHARGED.  
CHECK THE SPECIFIC GRAVITIES MONTHLY AND GIVE THE BATTERY A FRESHENING  
CHARGE (3 OR 4 HOURS AT THE FINISH RATE) IF THE GRAVITIES HAVE FALLEN 0.030  
OR MORE; OTHERWISE GIVE A FRESHENING CHARGE EVERY THREE MONTHS.**

## 4. OPERATION

Batteries are rated in ampere-hours (Ahr) and are selected to perform a specific workload within an established period of time. Increasing the workload or time period could result in over discharging, thus shortening battery life. Limit discharging of the battery (to 80% or less) so that specific gravities do not go below 1.180. If truck operation results in only partial discharges (40% or less) and specific gravities are 1.250 or more at the end of the shift, recharging may be deferred and the battery used for another shift, providing the workload is not expected to increase. Hydrometer readings and experience will determine the frequency of charge intervals under these circumstances.

A battery should always be recharged immediately following a complete discharge. Never allow it to remain in a discharged condition; otherwise, permanent damage may result. A battery is designed to be operated as follows:

- 8 hours discharge
- 8 hours charge
- 8 hours cool-down

Tubular-LM™ Low Maintenance batteries are designed and built to deliver 80% of their rated capacity at 77 °F (25 °C) each cycle.

## 5. TEMPERATURE

In the operation of motive power lead acid batteries, the electrolyte temperature must not exceed 110 °F (43 °C). If the battery is continuously operated at or above this temperature, the service life of the battery will be severely diminished. Under normal operating conditions, battery electrolyte temperature should be maintained between 60-100 °F (15-38 °C). Following charging, the battery should be allowed to cool-down or rest approximately 8 hours prior to another discharge cycle.

If a battery is ever hot to the touch, allow it to cool to room temperature before charging or discharging. If a battery consistently operates at high temperatures greater than 100 °F (38 °C), contact your local GNB representative for service.

## 6. CHARGING

When recharging a fully discharged battery, the starting charge rate will be 3 times higher than the finish charge rate. The charge rate should taper down to the finish rate by the time the battery is 85% charged and may be even lower when fully charged. High "on charge" temperatures or frequent need for water additions are indications of overcharging. Short running times and/or low end-of-charge specific gravities may indicate inadequate recharge. Consult your local GNB representative on specific charging problems.

The ampere-hour rating of the charger applied to the battery should be within 10% of the ampere-hour rating of the battery.

**DO NOT INTERMITTENTLY CHARGE, "OPPORTUNITY CHARGE",  
OR SHORT CYCLE THIS BATTERY.**

## 7. CONNECTIONS

The battery cells are connected in series using welded lead connectors.

## 8. MAINTENANCE

**KEEP RECORDS...** Showing charging and equalization dates and times. After each watering (and subsequent equalization), record the specific gravity, temperature, and open circuit voltages for each cell of the battery. These records are required to maintain your warranty.

**TEMPERATURE...** Under normal operating conditions, the electrolyte temperature should be between 60-100 °F (15-38 °C). Operating temperatures above 100 °F will reduce the battery's service life. Operating temperatures below 60 °F result in less capacity and special charging is required.

### WATER ADDITIONS...

**When using any SCR charger with an I-E-I charging profile...**After each 45 calendar days of operation to 80% DOD at 5-days per week or when the specific gravity in the cells reaches 1.335 to 1.345, add water at the end of the charging period (when the battery is fully charged and the charger has tapered to its finish rate). See Section 9.

**When using a GNB® SCR200 charger with a Tubular-LM™ charging profile...**After each 90 calendar days of operation to 80% DOD at 5-days per week or when the specific gravity in the cells reaches 1.335 to 1.345, add water at the end of the charging period (when the battery is fully charged and the charger has tapered to its finish rate). See Section 9.

**EQUALIZE...** After every 10 duty cycles to 80% DOD or bi-weekly, if operating at 5 duty cycles per week, and after each water addition.

**DEPTH OF DISCHARGE...** Do not discharge the battery beyond 80% of the rated ampere-hour capacity. Over discharging shortens the battery life and voids the warranty.

**CLEANING...** Keep the top of the battery clean and dry. See Section 9.

### PREVENTIVE MAINTENANCE SCHEDULE... (based on five 80% DOD duty cycles per week)

<b>BI-WEEKLY</b>	Equalize charge the battery.
<b>EVERY 45- OR 90-DAYS**</b>	Check cell electrolyte levels and add water to each cell.
	Record cell electrolyte specific gravities, temperatures, and open circuit voltages after watering and equalization.
	Inspect the cables and charging plugs.
	Clean the top of the cells.
<b>ANNUALLY</b>	Inspect the charger. Confirm proper output voltage and current. Check for external damage, frayed or cut cables, or worn connectors.
	Clean the exterior of the battery.

\*\* 45-days when using any SCR charger with an I-E-I charging profile  
90-days when using a GNB® SCR200 charger with a Tubular-LM™ charging profile

## TROUBLE SIGNS...

The battery temperature rises more than 25 °F (14 °C) during a normal charge.

The cell open circuit voltages vary by 0.15 volts or more and cell specific gravities vary by 0.020 or more after equalizing.

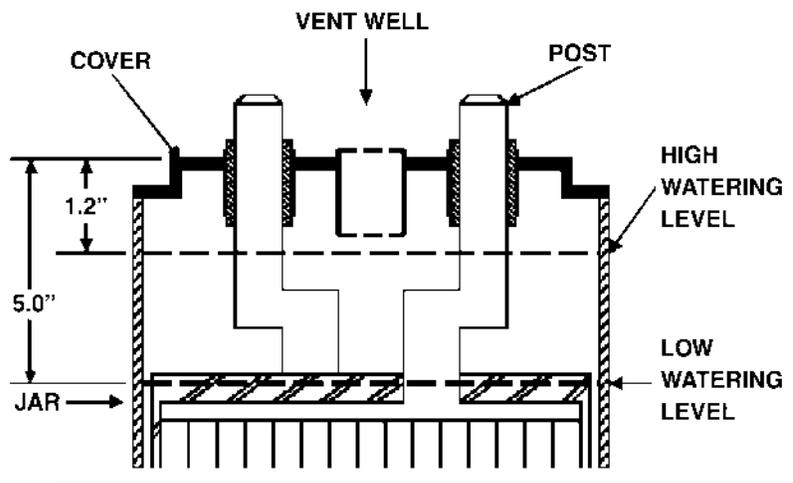
The top of the battery is always wet or one cell requires excessive watering.

## 9. MAINTENANCE CLEANING

The top of the battery should be kept clean and dry. Keep the vent caps in place during use and charging. Remove the vent cap only to observe electrolyte levels, make water additions, take temperatures, or take specific gravity readings with a hydrometer. If the battery requires cleaning, contact your local GNB servicing representative. The solution used to clean and neutralize the outside of the batteries should be disposed of in an environmentally safe manner.

## 10. WATER ADDITIONS

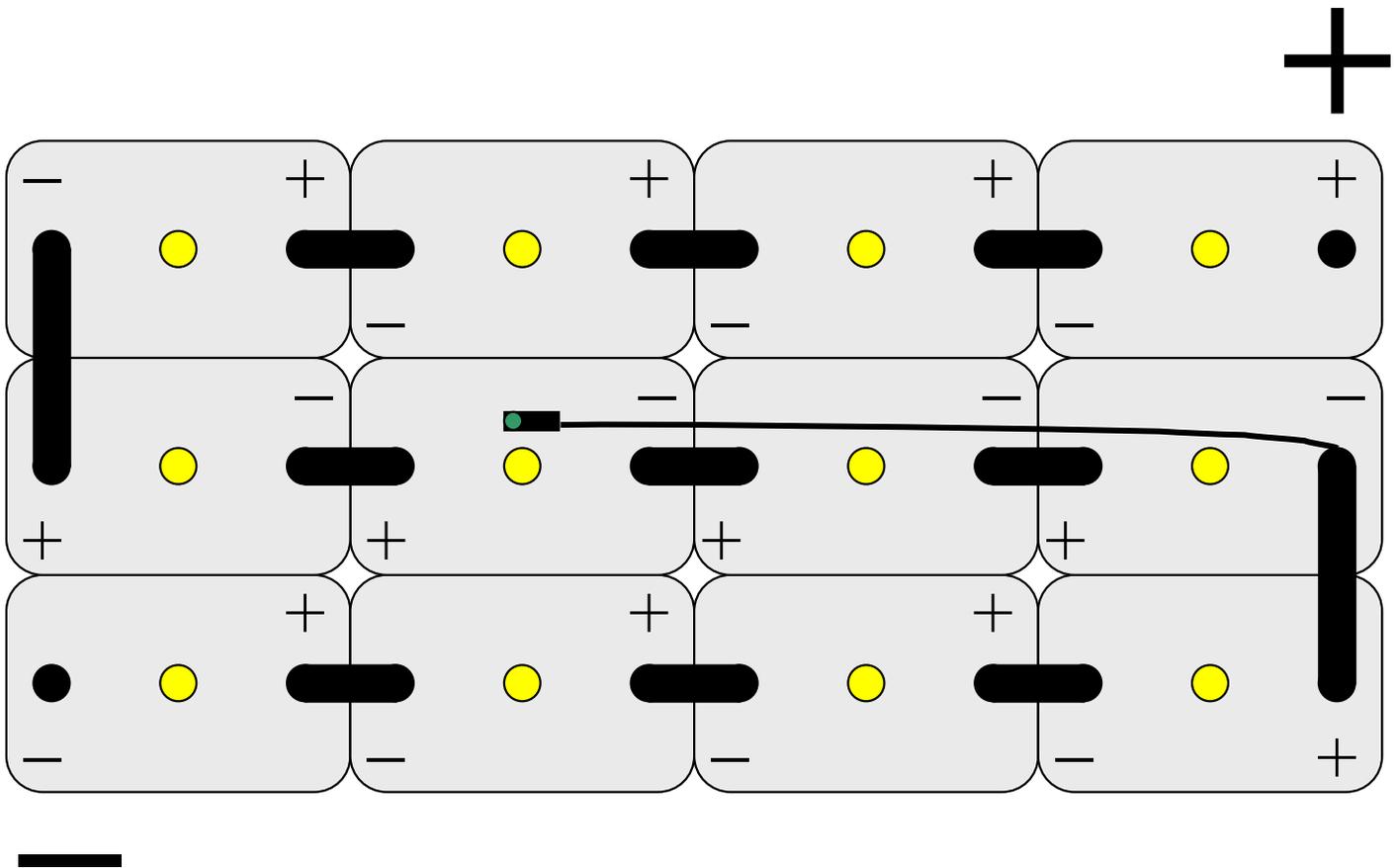
Maintain electrolyte levels above the plate separators, but no higher than 1/8" from the bottom of the vent well. Check the electrolyte level quarterly, or as necessary depending on battery use prior to charging. If the level is not visible (below the plate separators), add just enough water to cover them and then proceed with charging the battery. Otherwise, defer watering the battery until the end of the charging period when the battery is fully charged and the charger has tapered to its finish rate. At that time, add enough water to bring the electrolyte level to 1.2" of the top of the cover. Always use distilled water or water that is known to be free of abnormally high amounts of impurities. Contact your local GNB if you are not sure of your water quality.



**BATTERIES MUST BE VISUALLY INSPECTED PER THE ABOVE SCHEDULE EVEN WITH THE USE OF A WATERING SYSTEM.**

The GOLD and PLATINUM options for Tubular-LM™ Low Maintenance batteries are equipped with an electrolyte level sensor and a single point watering system.

The acid resistant, electrolyte level sensor is installed in a central cell of the battery by the GNB manufacturing facility or distribution center prior to battery shipment. The sensor lead wire is attached to the negative post of the second cell away from the sensor towards the battery negative terminal. See the following diagram for a 12-cell battery example.



When the light of the sensor is ON and FLASHING, the electrolyte level is within the recommended operating range. When the light of the sensor is OFF, water addition to the battery cells is needed.

Operation of the sensor and lead wire connections should be checked quarterly. Sensor operation can easily be checked by lifting it out of the cell. If the light goes OFF, the sensor is functional and can be reinserted. When the sensor is removed from the cell, if the light continues to FLASH, check the lead wire connections. If, after confirming the lead wire connections, the light continues to FLASH while out of the cell, replace the electrolyte level sensor.

The single point watering system, manufactured by Battery Watering Technologies (BWT), provides a quick, efficient method for adding water to flooded lead-acid batteries. The system fills all cells to the proper height with one simple and convenient connection.



Figure 1

The BWT watering plug assembly – plug, float and gasket (see Figure 1) – is the heart of the system. It controls the watering of each battery cell to the recommended shut-off level. This is a minimum of 1/8" below the vent well at the end of recharge.

During watering, the rising electrolyte level causes the float to rise. As the float rises, a self-contained mechanical linkage closes a poppet valve inside the plug. Once closed, system pressure keeps the valve closed for the duration of the filling cycle. The installed system is designed to bleed off this pressure gradually once the quick-disconnect is disconnected.

During watering, the water flows from the filter/regulator unit or tank unit, through the visual flow indicator (water wheel), quick-disconnect coupler, in-line filter, and in to the plugs.

## SYSTEM REQUIREMENTS

- a) **Filtration:** The supply water should be filtered to ensure proper long-term operation. Experience has shown that municipal water supplies typically contain unacceptable amounts of particles and debris. A 20-micron (or finer) filter is recommended.

NOTE: This is in addition to the auxiliary 100-micron BWT filter pre-packed with the system.

- b) **Pressure:** Minimum height of water reservoir must be ten feet. For municipal water supply lines, a pressure regulator is required. Recommended static system pressure is 15 psi. Excessive pressure can cause plugs to snap shut prematurely. Insufficient pressure will cause the cells to fill more slowly.

- c) **Fill Time:** The filling system should only be connected long enough for the cells to fill (usually 1 to 3 minutes). When the flow indicator stops spinning, the cells are full and the quick-disconnect should be disconnected.

CAUTION: For systems where a timer control is used, BFS recommends filling for two minutes.

- d) **Float Clearance:** Adequate clearance (T1), per Figure 2a/b/c is required for proper action.

- e) **Water Quality:** Use only water that meets the following analysis:

Total solids	less than 125 ppm
Fixed solids	less than 75 ppm
Organic and volatile material	less than 50 ppm
Iron	less than 4 ppm

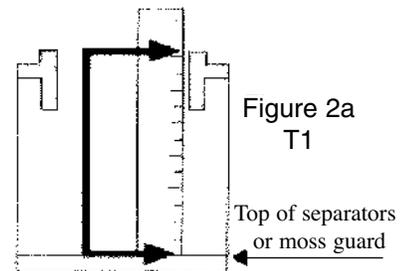


Figure 2a  
T1

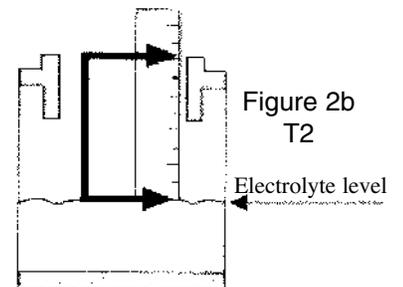


Figure 2b  
T2

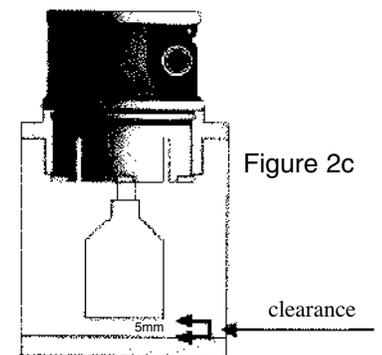


Figure 2c

Manganese	less than 0.007 ppm
Nitrates (as NO <sub>3</sub> )	less than 10 ppm
Nitrites (as NO <sub>2</sub> )	less than 5 ppm
Ammonia (as NH <sub>4</sub> )	less than 5 ppm
Chlorides	less than 25 ppm

### **Before watering**

- **Make sure that the battery is disconnected from all charging equipment.**
- **Make sure that the battery is properly cleaned.**
- **Make sure that you are working with safety glasses.**

### **Water only after charging.**

## **11. SERVICE AND PARTS**

Your local GNB sales representative has more information regarding the full range of maintenance and repair service available. GNB can also supply all of your battery, charger, and accessory device replacement part needs. For more information in the U.S.A. and Canada, call 1-888-563-6300. All others, please contact your local GNB battery sales representative.

## **12. RECYCLING**

U.S. Federal and State Regulations require that lead acid batteries be handled and disposed of in compliance with strict guidelines. GNB offers disposal service for lead acid batteries. Call 1-888-438-5865 to arrange a pick-up or to get additional information.

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### **GNB Industrial Power**

USA – Tel: 877.462.4636

Canada – Tel: 800.268.2698

[www.gnb.com](http://www.gnb.com)

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