

Traction Battery

SUPER ***LIFTTOP*** **ECO**

For battery forklift



LIFTTOP

Traction Battery SUPER <LIFTTOP> ECO

Battery forklift have replaced conventional forklift (i.e., internal-combustion engine type) as measures for the increasing demand on clean environments in various sites where forklift take an active role, such as factories, distribution centers, warehouses, ports and harbors, airports, etc. The batteries as a driving source of battery forklift are an outcome of integrating a number of superior technologies based on long-time practices and affluent experiences, and still advancing by inheriting these.

Now, we have newly adopted negative plate additives to enhance discharge properties at low temperatures, thereby our conventional traction batteries being reborn as SUPER <LIFTTOP> ECO.

Our Nabari Works, which manufactures batteries for electric vehicles, acquired certification of ISO 9001 quality management system, and have since been designing, developing, and manufacturing under the quality management system based on the certification standards. In addition, we have acquired certification of ISO 14001 environmental management system, and have since been engaged in production placing the importance on harmony with the environment.

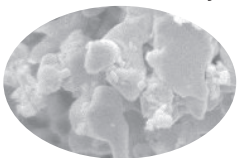
Discharge characteristic at low temperatures have been enhanced.

Features

- The reacting area has increased by about 20% in comparison with our conventional types.
The discharge capacity at low temperature has increased about 10% compared with our previous model.
- The active material density of the positive plate has been optimized.
The specification of well-balanced battery capacity and life performance has been realized.
- Low temperature characteristic have been enhanced, to accommodate the needs that are more versatile.

Comparison of negative-electrode active materials on SEM photographs

Conventional battery

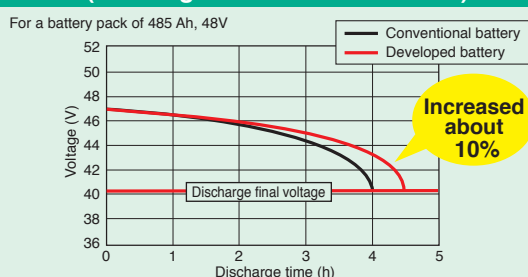
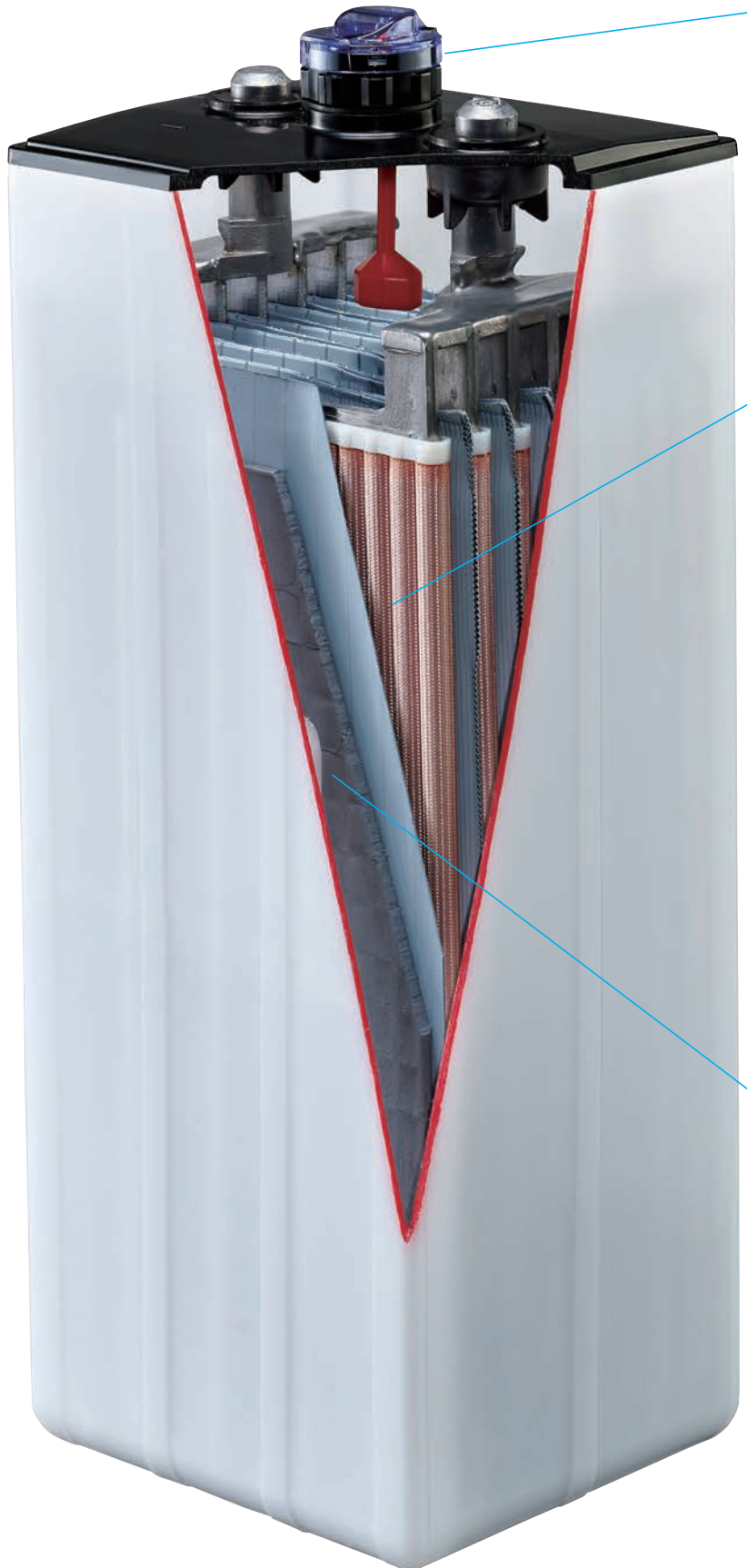


Developed battery



(Magnification: × 2000)

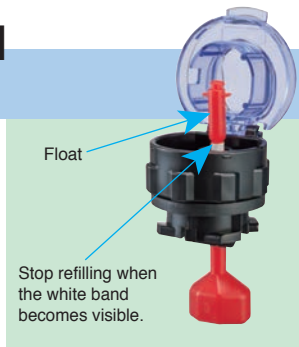
Comparison with the conventional battery (discharge test at 5°C for 5 hours)



Note The test results should be understood only as an example and do not guarantee the reproduction of identical results on all occasions.

Float mounted water plug

- The large diameter type facilitates water refilling.
- The float enables verification of the water level at a glance.
- Overflow prevention structure offers superior vibration-proof.



Positive plate

Glass tube

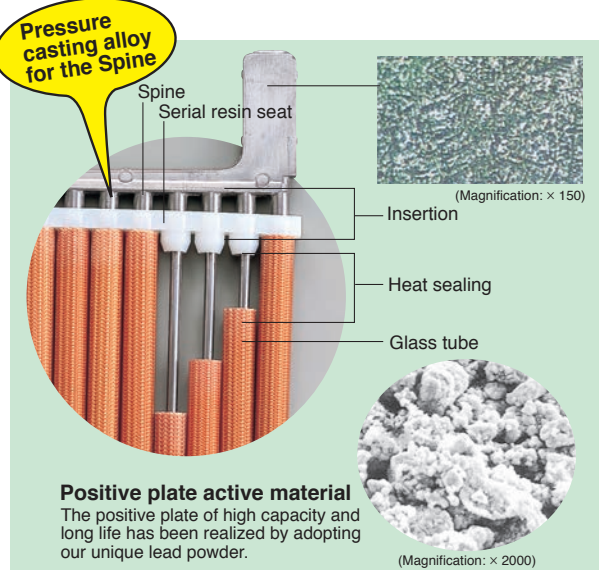
The glass tube used for the positive plate is made of special glass fibers having superior mechanical, electrical, and chemical properties, thereby contributing to the realization of long life.

Spine

The Spine comprising the conductor portion is fabricated by applying the pressure casting method, which we have practiced for a long time. This method enables the crystal architecture denser than that by the gravity casting method, thereby offering the enhanced durability in severe temperature environments.

Active material

Our unique lead powder is adopted for the positive-electrode active material, which takes on a role of accumulation of electricity in the positive plate, thereby contributing to the realization of high capacity and long life.



Positive plate active material

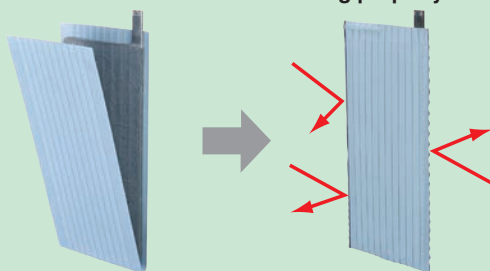
The positive plate of high capacity and long life has been realized by adopting our unique lead powder.

Negative plate

The negative plate is equipped with a clean separator made of polymer polyethylene, which elutes a significantly less amount of oil contained therein and thus results in less contamination of electrolyte.

The separator is laterally folded in two, and then ---

The circumference is adhered together to enhance the sealing property.



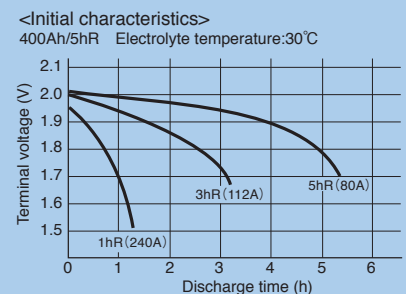
One example of the battery used for a forklift

As the battery for a forklift, a battery pack of 24 V or 48 V is installed thereon depending of the specification of the forklift.



Standard discharge characteristics (example)

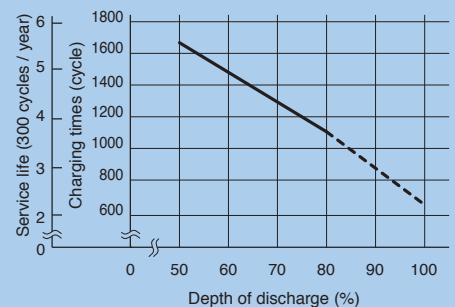
The battery capacity varies depending on the magnitude of discharge current. For example, the capacity at the 1 hour-rate discharge rate is reduced to about 60 to 65% of the 5 hour-rate discharge capacity (rating). In addition, discharge at large current may not only reduce an available quantity of electricity but also shorten the battery life.



Relation of depth of discharge and cycle life (example)

The cycle life of a battery is affected by driving conditions of a vehicle (daily discharge amount), vibration, heat, and the quality of daily maintenance. In particular, the discharge amount significantly affects the life, where repetitive, deep discharge tends to reduce the life.

Approx. 700 cycles (approx. 2 years) of 100% discharge
Approx. 1100 cycles (approx. 4 years) of 80% discharge
Characteristics in static tests in the laboratory.
Depth of discharge: 75%
Electrolyte temperature: 33-45°C
Charged capacity: 120% of discharged capacity



How to calculate the electricity rate (approximation)

$$\text{Electricity rate} = \frac{\text{Electric power unit price} \times \text{nominal voltage} \times \text{nominal capacity} \times \text{charge amount}}{\text{Efficiency of a charger} \times 1000}$$

Example: Calculation of electricity rate at 280 Ah/5hR, 48V

Electric power unit price: ¥28/kWh (Ask an electric power company.)
(Assumed unit price)

Nominal capacity: 280Ah/5hR

Nominal voltage: 48V

Charge amount: 120%

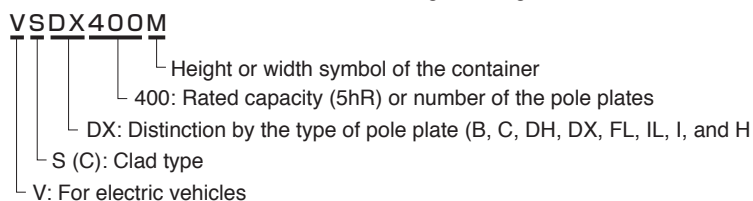
Efficiency of a charger: 0.85

$$\frac{28\text{¥/kWh} \times 280\text{Ah} \times 48\text{V} \times 1.2}{0.85 \times 1000} = \text{¥}530$$

Range and specification

Type	Rated capacity (5hR)	Outside dimensions (mm)				Weight when filled with liquid (In approx. kg)	Liquid amount (In approx. liter)
		Length (L)	Width (W)	Box height (h)	Total height (H)		
VSB4	160	90	158	320	352	11.6	2.8
VSB4Z	195	90	158	320	352	12.9	2.6
VSB5	200	109	158	320	352	14.2	3.4
VSB6	240	128	158	320	352	16.6	4.0
VSB7	280	148	158	320	352	19.2	4.7
VSB8	320	167	158	320	352	21.7	5.3
VSB400MZ	400	177	158	320	352	25.0	5.3
VSC3M	129	58	158	350	382	8.8	1.7
VSC4	172	90	158	350	382	11.7	2.6
VSC5	215	109	158	350	382	14.7	3.7
VSC6	258	128	158	350	382	17.2	4.4
VSC7	301	148	158	350	382	20.0	5.1
VSC344	344	148	158	350	382	21.3	4.9
*VSC10	430	206	158	350	382	28.4	7.1
*VSC12	516	244	158	350	382	33.4	8.5
VSDH390L	390	148	158	380	412	23.6	5.5
VSDH450L	450	148	158	380	412	25.1	5.2
VSDH480L	480	186	158	380	412	29.8	6.9
VSDH3M	164	58	158	395	427	10.3	1.8
VSDH4N	208	81	158	395	427	13.7	2.8
VSDH160A	160	90	158	395	427	12.9	3.6
VSDH250	250	90	158	395	427	16.0	3.0
VSDH480M	480	161	158	395	427	28.0	5.6
VSDH9	490	186	158	395	427	30.0	7.0
VSDH560	560	186	158	395	427	33.2	6.4
VSDX330	330	128	158	395	427	21.5	4.9
VSDX360	360	128	158	395	427	23.7	4.9
VSDX330M	330	144	158	395	427	23.0	5.8
VSDX400M	400	144	158	395	427	24.7	5.5
VSDX470M	470	144	158	395	427	26.4	5.2
VSDX450M	450	161	158	395	427	27.7	6.1
VSDX540M	540	161	158	395	427	29.4	5.8
VSDX560M	560	177	158	395	427	30.7	6.7
VSDX620	620	186	158	395	427	34.9	6.5
*VSDX690	690	206	158	395	427	38.6	7.3
VSDX165MH	165	58	158	410	442	10.9	1.9
VSDX485MH	485	144	158	410	442	26.6	5.3
VSDX545MH	545	161	158	410	442	29.7	5.8
VSDX565MH	565	177	158	410	442	31.0	6.8
VSDX600MH	600	177	158	410	442	32.7	6.5
*VSDX700H	700	206	158	410	442	38.9	7.4

Note) 1. Model Code and the numbers have the following meanings.



- The symbol "*" indicates a double pole type storage battery.
- Some designs and specifications may be changed without notice.
- The nominal voltage of a single cell is 2V.

Range and specification

Type	Rated capacity (5hR)	Outside dimensions (mm)				Weight when filled with liquid (In approx. kg)	Liquid amount (In approx. liter)
		Length (L)	Width (W)	Box height (h)	Total height (H)		
VSFL201M	201	58	158	490	522	12.7	2.3
VSFL268M	268	75	158	490	522	16.3	3.2
VSFL210A	210	90	158	490	522	16.0	4.6
VSFL280	280	90	158	490	522	17.8	4.2
VSFL320	320	90	158	490	522	19.7	3.9
VSFL5	335	109	158	490	522	21.5	5.2
VSFL390	390	109	158	490	522	23.5	4.8
VSFL6	402	128	158	490	522	25.4	6.1
VSFL545	545	148	158	490	522	31.2	6.8
*VSFL9ZD	670	186	158	490	522	39.5	8.7
*VSFL10	670	206	158	490	522	41.5	10.1
*VSFL11	737	225	158	490	522	45.3	11.0
*VSFL858	858	225	158	490	522	49.2	10.3
VSIL220ML	220	58	158	490	522	13.3	2.3
VSIL300NL	300	81	158	490	522	17.6	3.4
VSIL515L	515	128	158	490	522	28.7	5.5
VSIL545ML	545	144	158	490	522	32.5	6.3
VSIL730ML	730	177	158	490	522	40.1	7.7
*VSIL865L	865	206	158	490	522	47.6	8.9
*VSIL935L	935	225	158	490	522	51.5	9.8
VSIL225M	225	58	158	520	552	13.8	2.5
VSIL288M	288	75	158	520	552	17.7	3.4
VSIL280N	280	81	158	520	552	18.2	3.8
VSIL4	312	90	158	520	552	19.2	4.4
VSIL370	370	90	158	520	552	21.5	4.1
VSIL435	435	109	158	520	552	25.4	5.0
VSIL6	468	128	158	520	552	27.4	6.4
VSIL510	510	128	158	520	552	29.7	6.0
VSIL7	536	148	158	520	552	31.8	7.5
VSIL580	580	148	158	520	552	33.8	7.1
VSIL8	612	167	158	520	552	35.9	8.5
VSIL9	702	186	158	520	552	40.1	9.5
*VSIL10	780	206	158	520	552	44.8	10.6
*VSIL11	858	225	158	520	552	49.1	11.6
*VSIL12	936	244	158	520	552	53.1	12.5
VSI240M	240	58	158	520	552	14.4	2.4
VSI340N	340	81	158	520	552	19.1	3.7
VSI415	415	109	158	520	552	24.5	5.4
VSI470	470	109	158	520	552	26.7	4.9
VSI565	565	128	158	520	552	31.2	5.9
VSI645	645	148	158	520	552	35.5	6.9
VSI725M	725	161	158	520	552	39.2	7.4
*VSI845	845	186	158	520	552	47.1	8.4
*VSI925	925	206	158	520	552	51.5	9.5
*VSI1080	1080	244	158	520	552	60.3	11.4
VCH280M	280	57	158	700	732	19.6	3.1
VCH3	300	70	158	700	732	21.5	4.5
VCH360	360	70	158	700	732	24.9	3.9
VCH420	420	89	158	700	732	31.3	5.4
VCH600M	600	113	158	700	732	37.5	6.8

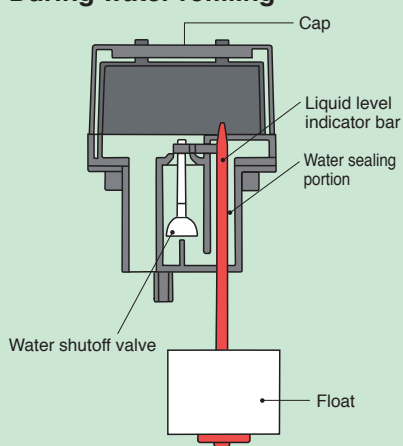
The water filling time has been significantly reduced. New Water Filling System 〈NEW QUICK FILLER〉

The water refilling time has been significantly reduced by expanding the feed water inlet (about half the refilling time of our conventional refilling device).

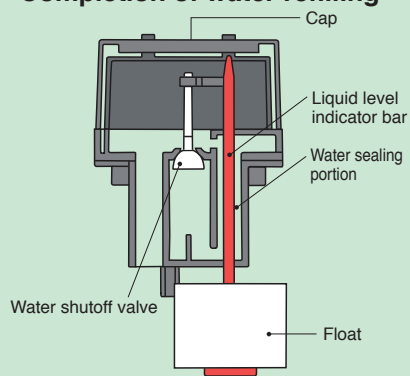


■ Structural diagram

During water refilling



Completion of water refilling



Water sealing structure for induced explosion prevention

A water sealing portion is provided for preventing entry of gas produced during charging into the water refilling hose in order to eliminate the hazard of induced explosion.

Automatic water stopping structure

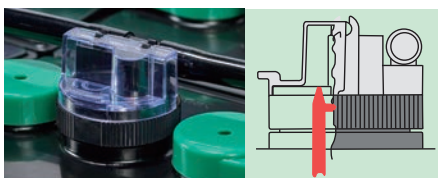
The water shutoff valve rises when water reaches the appropriate level, and stops water refilling automatically.

Opening/closing the cap is unnecessary during water refilling operation

The user only needs to snap-connect the couplings of the hoses on the tank and battery sides and open the faucet. Water is fed into all cells.

The liquid level is easily visible. Maintenance is also easy.

The liquid level is identifiable at a glance, thanks to the large level display. In addition, the large hole for measuring the specific gravity enables quick measurement of the specific gravity.



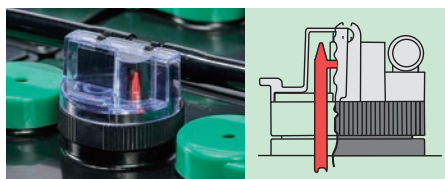
Liquid level checking: The fallen liquid level indicator bar (red color) indicates that water must be refilled.



Refilling preparation: Snap-connect the couplings of the hoses on the tank and battery sides and open the faucet.



Start of water refilling: Opening the faucet automatically starts refilling water into all batteries (be sure to open the faucet fully).



Completion of water refilling: Refilling water is complete when the liquid level indicator bar rises to the upper limit. Close the faucet and disconnect the coupling.



Float mounted water plug

Easy water filling

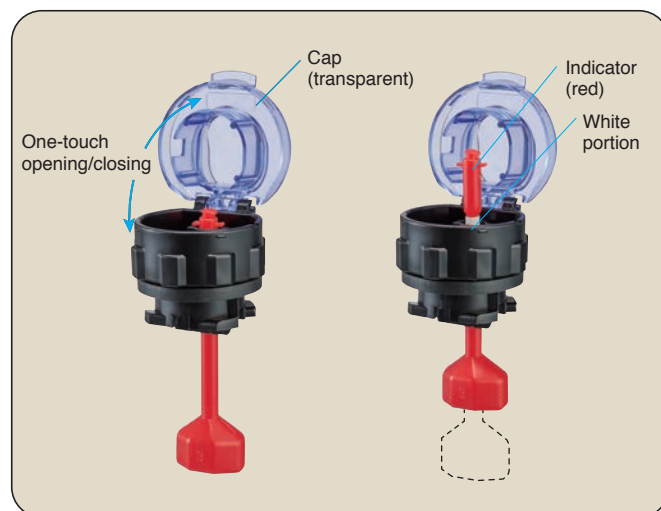
The spout wide and it is easy to fill water.

Excessive refilling prevented

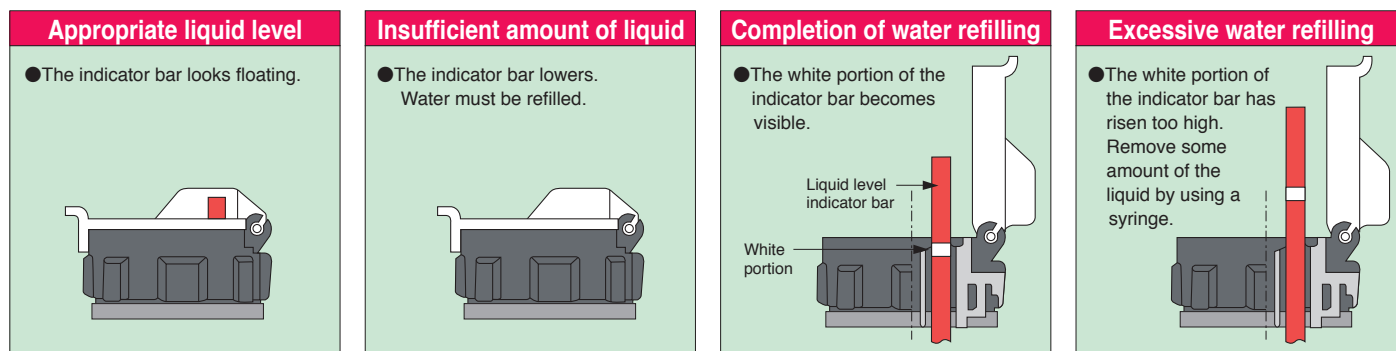
As the appropriate liquid level is displayed as an indicator band, an appropriate amount of liquid is understood at a glance, thereby preventing excessive refilling.

Easy replacement

Installation and removal of the float mounted plug is easy, thanks to the use of the quarter turn method.



The liquid level is obvious at a glance, so the level can be accurately managed.



- When insufficient amount of liquid is observed, refill water to the level equivalent to the completion of water refilling.
- Care should be taken that the water refill cap might be damaged in case a person steps on or an object drops thereon

Liquid level meter <SUPER DELSIGN>

Easy-to-see warning display

The green lamp is normally lit. The red lamp goes on to alert the timing of water refilling.

One-touch mounting on the side surface of the iron box

Adhesive is provided on the backside of the panel. Tear off the seal to mount the level meter with ease.

Mounting the sensor and the power source is also easy.

Simply mount the sensor provided inside the water refill faucet. Solder the power source on the lead connector.



Note: The liquid level sensor detects the level of only one cell and does not indicate the liquid level of the entire assembled batteries.

Sugoraku Water Feeder

This is a "pressure-accumulation type water feeder" using compression of the air. You can replenish water to the float mounted water plug while you keep the device on the floor.



Products for maintenance



Thermometer / -20~100°C



Syringe / 180mℓ



Collector bin / 2ℓ



Suction gravimeter / 1,100~1,350



Funnel: Bore diameter of $\phi 10$

Precautions for maintenance and handling

Classification of harm and damage

 Danger	Degree of harm in which improper handling may cause death or serious injury to the user and in which the degree of urgency is high.
 Warnings	Degree of harm in which possibility of improper handling causing death or serious injury to the user is expected. When minor injuries or property damage happen frequently.
 Cautions	Degree of harm or damage in which improper handling is expected to cause injury to the user or damage to properties.

Graphic symbol and meaning

 No fire	Do not bring the battery near fire or cause it to short circuit or spark. Doing so may cause ignition-induced explosion.	 No children	Do not let those without full understanding on the handling and danger of the battery (children, etc.) to touch it.
 Caution for rupture and explosion	The battery generates hydrogen gas which may cause ignition-induced explosion if handled improperly.	 Caution for battery electrolyte	Electrolytic solution of the battery is dilute sulfuric acid, which can cause blindness and burns if it gets in to your eyes or on your skin.
 Caution for electric shock	At voltage of 42V or higher, direct contact to a conductive part by human body may cause electric shock.	 Caution for static electricity	Cleaning the battery with dry cloth or handling it when your body is electrically charged may cause a spark of static electricity that may cause ignition-induced explosion.
 Caution for ignition	Improper use of the battery may cause it to ignite.	 Careful reading of the instructions	Read the operating instructions carefully before using the battery to ensure proper use.
 Wearing glasses	To protect your body from explosion or diluted sulfuric acid, wear protective goggles and rubber gloves when handling the battery.		

Danger

 No fire	<ul style="list-style-type: none"> Do not use or charge the battery in a sealed or poorly ventilated place. The battery generates hydrogen gas which may cause ignition-induced explosion. Keep fire away from the battery. The battery generates hydrogen gas, and making it short-circuited or spark or bringing a flame of cigarette near it may cause ignition-induced explosion.
 Caution for rupture and explosion	<ul style="list-style-type: none"> Do not install the battery near a heating element (such as transformer) or something that generates a spark (such as welding machine, grinder, switch, and fuse). The battery generates hydrogen gas which may cause ignition-induced explosion.
 Caution for static electricity	<ul style="list-style-type: none"> Do not short-circuit the terminals of the battery with things such as tools for removing and tightening bolts and nuts. Generated sparks may cause burns or ignition-induced explosion. Do not use the battery (i.e., the fork lift) with its liquid level below the minimum level. It may overheat, or if its internal parts have been deteriorated, short circuit inside may cause an explosion.
 Caution for battery electrolyte	<ul style="list-style-type: none"> Do not use dry cloth or feather duster to clean the surface and connecting parts of the battery. The battery generates hydrogen gas which may cause ignition-induced explosion by static electricity. Clean top surface of the battery with a cloth moist with water. When electrolytic solution (dilute sulfuric acid) gets into your eyes, immediately wash the eyes with a large amount of clean water such as tap water, and immediately seek medical attention. It may cause blindness.

Warnings



Caution for rupture and explosion



No children



Wearing glasses



Caution for battery electrolyte



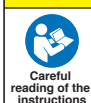
No fire



Caution for static electricity

- Do not store the battery in poorly ventilated place or a place with fire. Doing so may accumulate hydrogen gas which may cause an explosion.
- Charge the battery with the charger dedicated for it or the one that matches its rated capacity and voltage. Do not charge it with anything other than those as it may not fully charge the battery or cause liquid leakage, heat generation, or electric leakage.
- Those who have not fully learned how to handle the battery and of its danger should not mount or install it. Doing so may cause injury or damage to the storage battery.
- Do not allow anyone who is not familiar with handling of the battery (children, etc.) to touch it. Electrolyte (dilute sulfuric acid) inside the storage battery may cause blindness and burns.
- Do not drop the battery in a fire. Do not heat it. Doing so may cause liquid leakage, smoke, or explosion.
- Do not connect the terminals of the battery mistaking the positive and negative poles. Doing so may cause heat generation, ignition, smoke, or ignition-induced explosion.
- Do not discharge the battery with current exceeding the rated capacity. Its internal parts may melt and cause an explosion.
- Before checking or cleaning the battery, remove static electricity from your body by touching a metal part away from the battery or by other means. Touching the battery with charged body may generate a spark, which may cause ignition-induced explosion.
- Do not use the battery or leave it as it is with dirt or foreign material stuck on its surface or connecting parts. Doing so may cause ignition-induced explosion or fire by electric leakage. Remove dirt and foreign material with a cloth moist with water or the like to keep the battery clean and dry at all times.
- When electrolytic solution of the battery (dilute sulfuric acid) gets on your skin, body, or clothes, immediately wash it off with plenty of water, and then thoroughly wash it with soap. It may cause burns.
- If the electrolytic solution (dilute sulfuric acid) gets into your mouth or if you swallowed it by mistake, immediately gargle with a large amount of drinking water, and then drink plenty of drinking water or milk. Then, seek medical attention immediately. It may cause burns inside the mouth.
- Do not disassemble or repair the battery. Doing so may cause ignition-induced explosion and injury.

Cautions



Careful reading of the instructions



Caution for electric shock



No fire



Caution for rupture and explosion



Caution for battery electrolyte

- Follow the operating instructions of the device manufacturer for handling of batch water feeder, battery level warning device, and other devices.
- Do not wet the battery with rainwater or seawater. Doing so may damage the battery or cause a fire.
- When charging the battery, do not let the charging conditions to exceed what specified in the operating instructions of the specified charger. It may cause heat generation and liquid leakage.
- The battery shall not be inspected or handled by anyone other than a person with full understanding on how to handle it in inspection and maintenance, an expert, or a service shop personnel. It may cause electric shock or injury.
- Do not install the battery near a heating element (such as transformer) or something that generates a spark (such as welding machine, grinder, switch, and fuse). The battery generates hydrogen gas which may cause ignition-induced explosion.
- We are working on securing effective use of resources as well as preservation and maintenance of the environments by recycling the material of the spent batteries (re-using lead, plastic, etc. as raw materials). When disposing of a spent battery, use the disposal service provider in accordance with the law on waste disposal and environmental laws. If you have any questions, please contact the distributor or us.

When placing an order:

Please kindly inform us the following when you place a purchasing order:

- About the battery forklift or battery carrier
 - (1) Manufacturer name, (2) Model, and (3) Weight (tonnage)
- About the battery (if you currently use one)
 - (1) Manufacturer name, (2) Model, (3) Capacity, (4) Voltage, and (5) Battery product No. (the number shown on the nameplate)

- The data shown in this catalog are as of Oct. 2020.
- The contents of this catalog are based on tests we performed with meticulous care; however, they do not guarantee actual on-site results.
- Product use examples shown in photographs and illustrations may be different from current use situations.
- It is not guaranteed that methods to use this product, and parts or equipment using this product do not infringe industrial properties possessed by third parties.
- Please note that specifications and appearance of the product are subject to change without prior notice.
- Please note that the colored design appearing in product photographs may be different from the actual one more or less due to printing conditions.
- Be sure to read the operation manual prior to use of the product.

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