

## TROJAN INDUSTRIAL FLOODED WITH SMART CARBON 2V LINE COMPARED TO OPzS BATTERIES

This document summarizes the differences between Trojan's Industrial Line of flooded batteries with Smart Carbon™ technology and OPzS format batteries. This information will enable customers to make informed decisions when comparing both technologies.

Trojan's Industrial Line batteries are made in the USA. Its unique characteristics make the Industrial Line an ideal choice for stationary applications that require heavy duty cycling 2V vented batteries, versus industry-standard OPzS sizes commonly used today.

During IEC 61427 testing, Trojan's first generation, non-carbon Industrial Line surpassed a 17-year cycle life. Trojan expects its Smart Carbon line, which is currently undergoing the same testing parameters, to surpass 20+ years. IEC 61427 testing standards are designed to mimic cycling solar applications in the field.



Trojan Industrial 2V Line with Smart Carbon™

### INTERNAL DESIGN

Component	TROJAN INDUSTRIAL	STANDARD OPzS
<b>Negative Plate</b>	<p><b>Includes Smart Carbon™ formula to address PSOC conditions.</b></p> <p>Smart Carbon increases battery performance when left in a Partial State of Charge (PSOC) condition. Smart Carbon provides for increased life, improved charge acceptance and faster recharge in PSOC applications.</p>	<p><b>Only features standard expander, and no special carbon formula additives.</b></p> <p>Includes no special design or carbon paste formulations to address the impact of PSOC.</p>
<b>Positive Plate</b>	<p><b>Positive plate features substantial reserve of lead and active material for long cycle life and enhanced deep-discharge performance.</b></p> <p>Paste formulation features Trojan's Alpha Plus Paste® with T2 Technology™, a proprietary high-density paste formulation for sustained capacity in high cycling applications.</p> <p>Consists of an alloy grid with a fine grain structure designed to provide:</p> <ul style="list-style-type: none"> <li>• Optimum cycle life</li> <li>• Enhanced recharge characteristics using a larger wire interface area</li> <li>• Improved performance throughout its life cycles.</li> </ul> <p>Flat plate design enables battery to reach peak performance early in its cycle life, with the operation yield of each cycle remaining high throughout. The cycle life curve remains fairly consistent.</p>	<p><b>Most are not designed for true deep-cycle applications, resulting in shorter life and reduced charge acceptance over time.</b></p> <p>A majority are designed for standby/float/UPS use, in which the design of the positive spine has a low reserve of lead and active material. This results in less overall life.</p> <p>As spines corrode over time, the internal resistance continues to increase at a more rapid rate than a flat plate, which reduces the charge acceptance.</p> <p>When a spine cracks or breaks, that entire portion of the tube is lost, which results in the loss of a large percentage of the plate.</p> <p>Due to material washing from the tubular gauntlets, the performance of a tubular battery will decrease much quicker once it passes 80% of cycle life when compared to the flat plate Trojan Industrial battery.</p>



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## INTERNAL DESIGN

Component	TROJAN INDUSTRIAL	STANDARD OPzS
<b>Voltage</b>	<p>Water consumption is only half that of a typical OPzS battery over the battery's life.</p> <p>Because end-of-charge voltage is 2.58 volts per cell, less water is lost during the charging cycle.</p>	<p>Features higher voltage which causes more gassing and more water loss.</p> <p>A typical OPzS battery reaches end-of-charge voltage at 2.68 volts per cell, higher than Trojan's IND line, and results in high water consumption. Up to twice as much over an OPzS battery's life.</p>
<b>Protection Wrap</b>	<p>Reinforced protection wrap protects the positive plate from active material shedding and moss shorting, extending the life of the battery.</p> <p>The multi-layer wrap overlaps ensuring the best plate protection. The layers of glass matting are oriented to filter any displaced positive active material particles, and disperses the bubbles from gassing to give a controlled soft flow to the top of the plate. This provides better acid mixing to prevent stratification, reduces the effects of washing material from the positive plate, and decreases mousing at the negative plate.</p> <p>The Koroseal wrap also protects plate edges from side mousing.</p>	<p>Does not feature plate wrapping to protect the plates from shedding and moss shorting.</p> <p>OPzS plates are more sensitive to active material shedding which reduces capacity and shortens battery life.</p> <p>Overcharging OPzS batteries with higher voltage to avoid stratification often results in more active material shedding. This can greatly diminish performance in the later life cycles and will eventually shorten overall battery life.</p>
<b>Quality control</b>	<p>Pasting of flat plates is easier to control, since it is simple to visibly check during the processing of the plates.</p> <p>Trojan's Industrial line of batteries must pass more than 200 quality check points to ensure the highest quality before leaving the factory.</p>	<p>Higher risk of manufacturing defect due to improper filling of the gauntlet tube area.</p> <p>A potential point of failure common during the manufacturing of OPzS tubular battery plates is the proper filling of the gauntlet tube area around the grid spine.</p> <p>Gauntlets that are improperly filled, compacted or contain voids, can greatly impact battery performance and life.</p> <p>This is a common problem in the manufacturing of tubular batteries, and visual inspection cannot be quickly done by manufacturing staff.</p>
<b>Charge Acceptance</b>	<p>Offers a higher charge acceptance for off-grid solar and hybrid systems.</p> <p>Charging time is critical in applications such as solar systems where the source of energy is limited to a few hours a day. In hybrid systems, reducing diesel genset run time to charge the batteries is also critical to system efficiency and cost.</p> <p>The grid design in flat plate Trojan batteries provides more grid surface for active material interface, which increases conversion of materials from a lead sulfate discharged state back to a charged material state.</p>	<p>Typical OPzS batteries have lower charge acceptance compared to Trojan's Industrial line.</p> <p>The tubular grid has only a singular spine in the center of the active mass contained in the tube gauntlet, offering only a small surface for active material interface. This slows the conversion of the lead sulfate from the discharged state to a charged state.</p> <p>Attempting to speed up the process only adds to heating and additional gassing, instead of converting the material back to a fully charged state. This leads to water loss and possible softening of the materials in the positive plate, and additional material shedding.</p>

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## EXTERNAL DESIGN

Component	TROJAN INDUSTRIAL	STANDARD OPzS
<b>Voltage</b>	<p><b>Industrial Line offers 4V and 6V battery configurations, in addition to 2V sizes.</b></p> <p>These offer fewer series connections for easier system design, less complex installation for enhanced reliability, and lower overall system costs.</p>	<p><b>Industrial OPzS batteries are offered only in a 2V configuration.</b></p> <p>This requires cable connections between every 2V cell and special copper bar connections in some of the larger sizes.</p>
<b>Stability</b>	<p><b>Designed with stability in mind.</b></p> <p>With a lower battery profile and wider stance design, weight is evenly distributed throughout the battery. This creates a wider and lower center of gravity enhancing overall stability, and eliminates the additional cost of racks.</p> <p>When racks are necessary in non-seismic zones, the Trojan IND line requires a simple open placement rack that is about 1/3 the cost of an upper support special rack.</p>	<p><b>Unstable battery design.</b></p> <p>OPzS batteries are designed using tall, narrow battery cells which are not optimal for stability.</p> <p>Even in non-seismic zones, the tall OPzS batteries require special racks to avoid falling over, increasing the cost of the overall system installation.</p>
<b>Durability</b>	<p><b>Batteries are comprised of 2V cells bundled in a secondary containment case to form single, high-capacity 2V, 4V and 6V battery solutions.</b></p> <p>Components of the individual cells are assembled in rugged polypropylene housing which protect the internal plates from damage that may occur during transport and installation. The 2V cells are enclosed in a larger polyethylene outer case that protects against damage caused by harsh environmental conditions such as moisture and dirt buildup, as well as safeguarding against potential acid leaks.</p> <p>For added protection, the thick-walled case features a lattice-design that reinforces the structural integrity of the outer case. The combined insulation of the dual container construction provides added protection against extreme temperatures.</p>	<p><b>OPzS batteries use a single case design, offering no extra protection against breakage of the jar and spillage of acid.</b></p> <p>Users must purchase separate spill-proof containers to protect the floor from potential acid spills commonly seen with OPzS battery installations.</p>
<b>Handling</b>	<p><b>Battery cases feature built-in handles which lowers the time and cost of handling batteries.</b></p> <p>The handles are molded into the case design enabling easy movement of the batteries during transport and installation.</p>	<p><b>OPzS cells provide no handles.</b></p> <p>This makes them more difficult to move and install. Large cells require special lifting and handling slings and equipment.</p>
<b>Connections</b>	<p><b>Heavy-duty terminals are widely spaced for easier installation of double connections and leads, without need for copper bar connectors or buss bar systems.</b></p> <p>A soft cover boot provides the protection from shorting and eases maintenance.</p>	<p><b>OPzS batteries typically feature bolt-on terminals with copper/brass inserts.</b></p> <p>These usually require optional copper tab/buss-bar connections to allow for double connection take-off cables/leads in some cell/system layouts.</p> <p>Some of the larger cells may have multiple bolt-on terminals, which require cable connections for each connector, or optional special copper buss-bar attachments.</p>



Trojan batteries are available worldwide through Trojan's Master Distributor Network. We offer outstanding technical support, provided by full-time application engineers.

**For a Trojan Master Distributor near you,  
call 800.423.6569 or + 1.562.236.3000 or visit [www.trojanbattery.com](http://www.trojanbattery.com)**