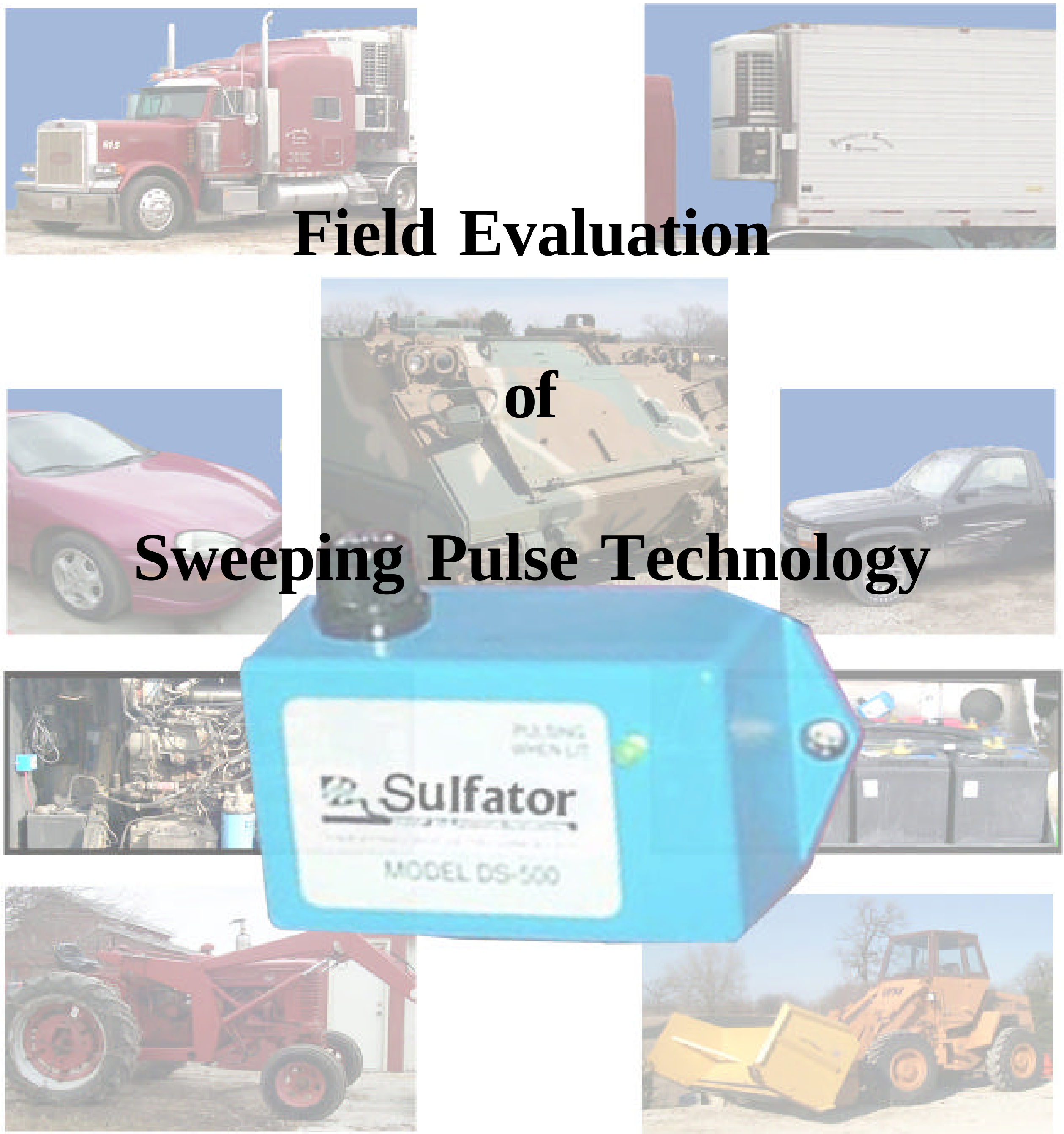
Field Evaluation

of

Sweeping Pulse Technology



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1.0 Executive Summary

This report summaries the field evaluation of Innovative Energy Systems (IES) line of battery desulfation products performed by Braun's R&D. Braun's R&D evaluated the following products: DS500 Battery Conditioner, DS500 Plus Prototype Battery Conditioner, T-360 Battery Conditioner/Maintainer, S550 Solar Battery Maintenance System, and S1000 Solar Battery Maintenance System. All products were tested on "lead-acid" 12 volt batteries.

1.0.1 Qualifications

Braun's R&D, a subsidiary of Braun's Energy Products, provides independent product testing, evaluation, and support materials to manufacturers of industrial and transportation maintenance products.

The staff at Braun's R&D holds the following distinctions:

- Fourteen U.S. and Foreign Patents
- Over 100 years combined industrial, automotive, aviation, military, and agricultural product maintenance, testing, and evaluation experience.

We have provided services to the following organizations:

U.S. EPA	Wisconsin DOT
Illinois EPA	Wisconsin DNR
Snap-on Tools	Hickok Tools
Weakon Tools	U-View Ultraviolet Products
AccuTemp Heat Treating	Auto-Logic
U.S. Air Force	StormGuard

1.0.2 Contact Information

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1.0.3 Field Evaluation

The field evaluation tested the products in actual service. Performance was evaluated by tracking six battery properties over time. Batteries were tested using two battery-testing technologies, that are available for field testing. The first technology, determines battery performance by measuring internal impedance, the second technology used a 50-amp load to evaluate the batteries condition. Both technologies utilized automated testing. The following battery proprieties were evaluated:

1. Percentage of Cold Cranking Amps. Calculated during impedance testing.
2. Available Amps. Calculated during impedance testing.
3. Internal Resistance. Measured during impedance testing.
4. Load Voltage. Measured during load testing.
5. State of Charge. Calculated during load testing.
6. Resistance. Measured during load testing.

Evaluating the trends of these six characteristics established the relative health of the battery. The results of this evaluation should be rrepresentative of results that would be encounter in most applications.

1.1 Conclusions

Based on the data collected during our field evaluation, we reached the following conclusions:

1. The sweeping pulse technology improves the performance of most batteries.
2. The sweeping pulse technology did not have any “negative” effects. The operation of the IES devices was transparent to the operators of all of the vehicles tested.
3. The DS500 Battery Conditioner proved significantly beneficial for most batteries.
4. The T-360 Battery Conditioner/Maintainer proved beneficial for most batteries.
5. The S500 Solar Battery Maintenance System proved significantly beneficial for most batteries.

6. The S1000 Solar Battery Maintenance System proved significantly beneficial for most batteries.
7. The units were more benficial to newer batteries over “seasoned” batteries.

We have used the term “most batteries” because the Sweeping Pulse Technology cannot restore a battery that has structural damage. During our field evaluation we encountered several structurally damaged batteries. It should be noted that several of the damaged batteries actually showed improvements in several tested areas, just not enough to return them to service. We defined “performance” in terms of available amperage and load voltage, i.e., higher available amperage and high load voltage values equals a “stronger” battery.

Although we did not directly measure reserve capacity and life span, we believe that the sweeping pulse technology devices we have a positive effect on these characteristics. We base this statement on the fact that these characteristics are directly influenced by the performance we did measure.

2.0 Background

2.1 Lead-Acid Batteries

Lead-acid batteries are constructed of alternating plates of lead dioxide (positive) and sponge lead (negative) submerged in sulfuric acid (electrolyte). A block of positive and negative plates is a cell. Each cell produces 2.1 volts. A 12-volt battery has six cells. The capacity and “strength” of the battery is determined by the size and number of plates in each cell. During the discharge of a battery, sulfur from the electrolyte combines with the lead in the plates to form lead-sulfate. During the charging process, the sulfur “leaves” the lead-sulfate and returns to the electrolyte. Over time, the lead-sulfate “hardens” and the sulfur can no longer return to the electrolyte. This has the double effect of weakening the electrolyte and reducing the “working” area of the plates. This reduced the “strength” and “capacity” of the battery.

2.2 Sweeping Pulse Technology

Based on data provided by IES, the sweeping pulse technology utilizes a radio-frequency signal to "soften" the lead-sulfate crystals allowing the sulfur to return to the electrolyte. This should increase the strength of the electrolyte and the "working" area of the plates.

2.3 Battery Testing

There are two common methods of testing batteries in the field, impedance and load testing. Both technologies utilize automated testing sequences to test a battery and usually output several measured and calculated values, as well as a "good" or "bad" determination of overall battery condition.

Note: It is possible for a battery to be "bad" on one tester, while testing "good" on another.

2.3.1 Impedance Testing

Impedance testing is a relatively new battery testing technology. Impedance testing measures internal resistance to determine the condition of a battery. The internal resistance varies with the size, state of charge, temperature, and extent of sulfation. Larger batteries have lower internal resistance, as the battery becomes discharged resistance increases, and temperatures below freezing can cause internal resistance to double. The more sulfation present in a battery, the higher the internal resistance.

2.3.2 Load Testing

Load testing is the most common type of testing performed in the field today. During a load test, an amperage load is applied to the battery (typically 175 amps) and the voltage level of the battery is measured.

3.0 Field Evaluation

This section will detail the testing methods used by Braun's R&D to evaluate the effectiveness of IES Sweeping Pulse Technology products.

3.1 Vehicle Selection

Vehicles selected to this field evaluation were as varied as possible, and representing as many different levels of technology as available. The testing fleet varied from military & construction vehicles to modern OBD-II controlled automobiles.

3.1.1 Battery Selection

The T-360 Battery Conditioner/Maintainer were tested on the bench. The batteries selected for these tests come from several sources. One group of batteries were currently being unused (from cars, boats, and motorcycles in storage). The second group consisted of batteries that had been condemned at area repair shops. The third group came from "Boost Packs", these are deep-cycle battery packages designed to assist in "jump-starting" vehicles with dead batteries.

3.2 Testing

All batteries were tested prior to the installation of the Sweeping Pulse Technology device and at regular intervals after installation.

3.2.1 Load Testing

Load tests were performed first because the surface charge needs to be removed for impedance testing, and load testing removes this charge. The load tests were performed by a VAT45 manufactured by Snap-on Diagnostics, inc. The automated testing function records the following parameters:

1. Battery voltage: Voltage of the battery without a load.
2. Load voltage: Battery voltage with a 100-amp load applied.
3. State of charge: Calculated value.
4. Resistance: Calculated internal battery resistance.
5. Battery Condition: Based on other factors, rates battery as "Good", "Bad",

or “Good, needs charge”.

Note: The battery cannot be tested if the battery state of charge is too low.

3.2.2 Impedance Testing

Impedance tests were performed by a MicroVAT manufactured by Snap-On Diagnostics, Inc. The automated testing function records the following parameters:

1. Battery Voltage: Voltage of the battery without a load.
2. Percentage of CCA: Calculated value.
3. Available Amps: Calculated value.
4. Internal Resistance: Measured battery resistance.

3.2.3 Suggestive Evaluation

Owners of vehicles with a DS500 Battery Conditioner, DS500 Plus Prototype Battery Conditioner, S550 Solar Battery Maintenance System, or S1000 Solar Battery Maintenance System installed were asked to continue to operative their vehicles as normal and report any unusual occurrences. Specific areas of evaluation were:

1. Check engine light concerns.
2. Charging light concerns.
3. Radio interference.
4. Engine performance concerns.
5. Fuel economy.
6. Electrical problems.

3.2.4 Evaluation

Our evaluation is based on the pretence that if the Sweeping Pulse Technology devices are actually reducing the sulfate build-up found in any battery, we should see a decrease in resistance, and increases in available amperage and loaded voltage. The performance of each product was judged on a point scale. Each area of performance was scored as follows:

1. Percentage of CCA:
   A. Upward trend = +1
   B. Little or no change = 0
   C. Downward trend = -1

2. Available Amperage:
   A. Upward trend = +1
   B. Little or no change = 0
   C. Downward trend = -1

3. Internal Resistance:
   A. Downward trend = +1
   B. Little or no change = 0
   C. Upward trend = -1

4. Load Voltage:
   A. Upward trend = +1
   B. Little or no change = 0
   C. Downward trend = -1

5. State of Charge:
   A. Upward trend = +1
   B. Little or no change = 0
   C. Downward trend = -1

6. Resistance (load Test):
   A. Downward trend = +1
   B. Little or no change = 0
   C. Upward trend = -1

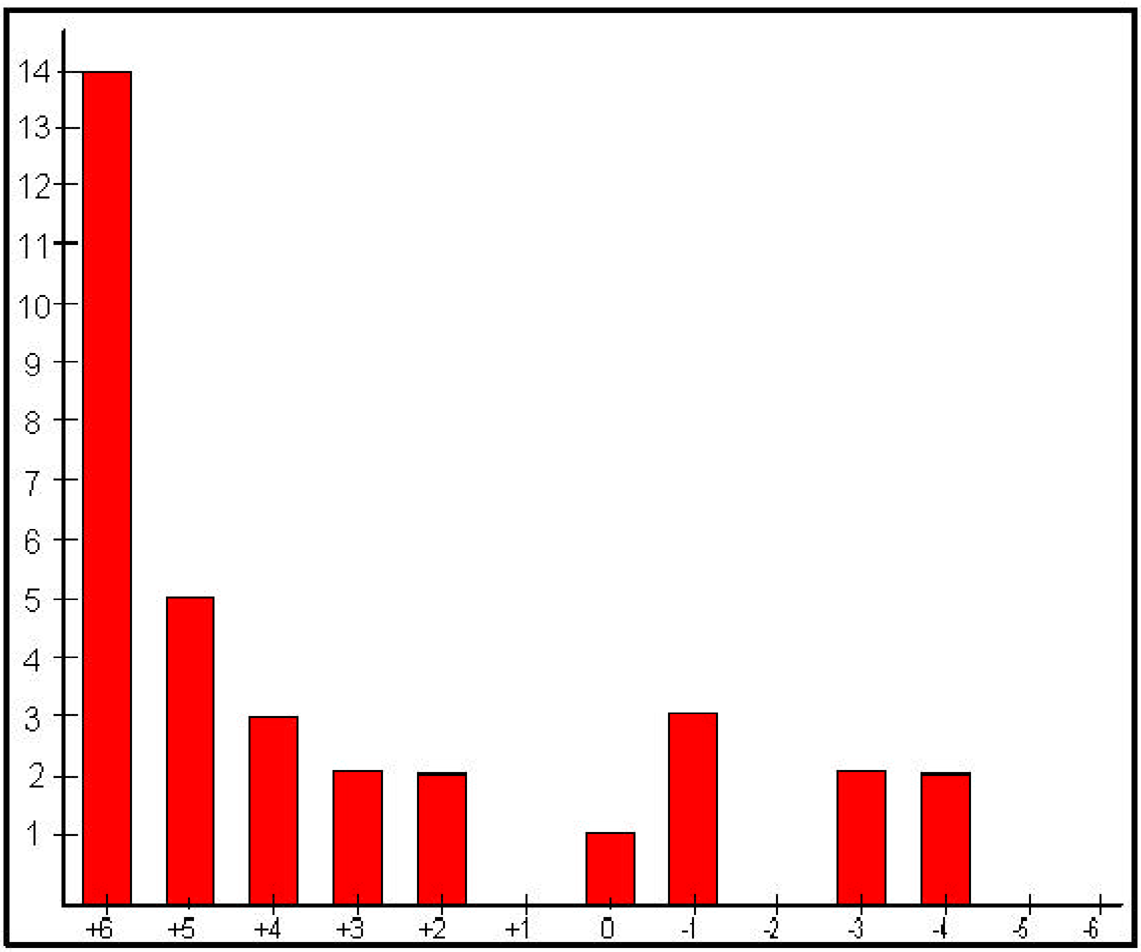
For each vehicle or battery tested, the score from each area is totaled. A score of +6 would indicate that the battery has improved in all areas. A score of -6 would indicate that the battery performance has deteriorated.

4.0 Product Performance

This section details actual product performance. The following areas where evaluated: All products, DS500 Battery Conditioner, DS500 Plus Prototype Battery Conditioner, T-360 Battery Conditioner/Maintainer, S550 Solar Battery Maintenance System, and S1000 Solar Battery Maintenance System.

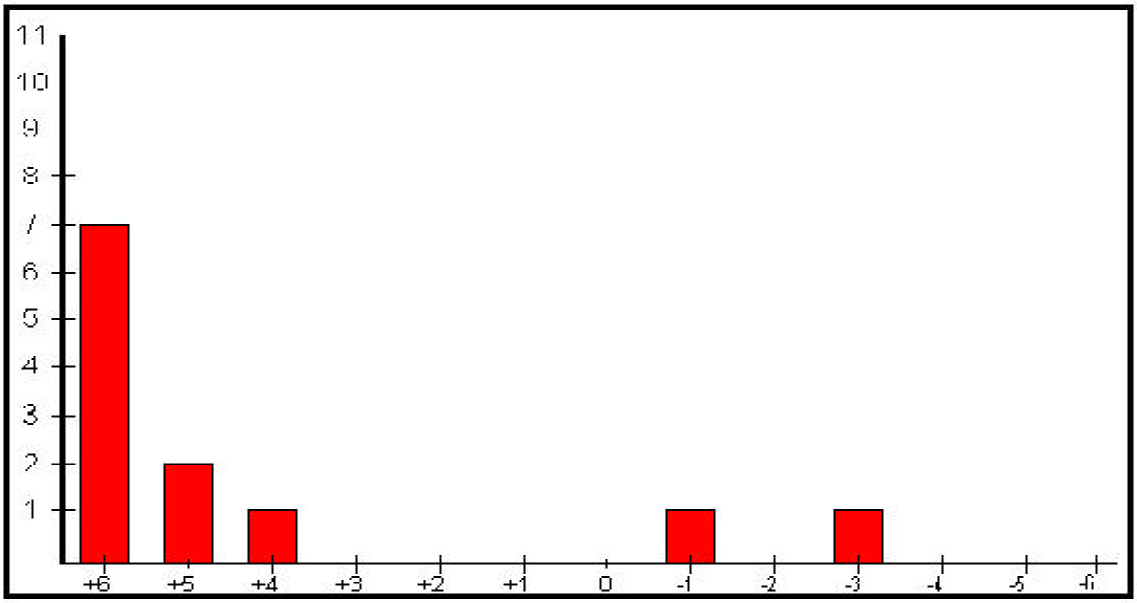
4.1 All products

Overall, the Sweeping Pulse Technology devices were of significant benefit for most batteries. To date; thirty-six batteries have been evaluated and nineteen showed improvements in five or six categories. Twenty-six showed improvements in at least two areas. The average score was 3.2 on a 6.0 scale.



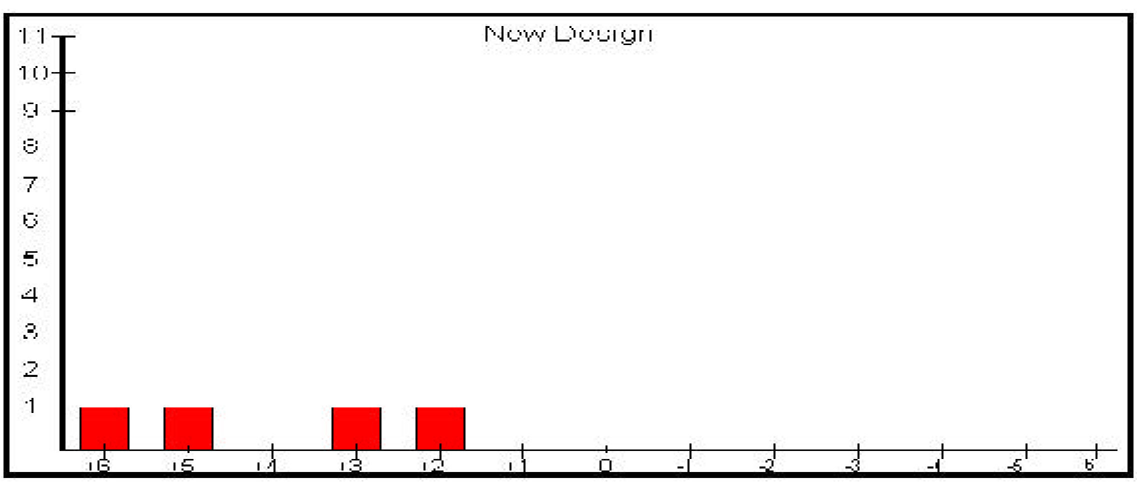
4.2 DS500 Battery Conditioner

The DS500 Battery Conditioners proved to be of significant benefit to the vehicles in which they were installed. To date; eight systems were installed. One vehicle was equipped with dual batteries and one with four batteries. Nine of the twelve batteries evaluated showed improvements in five or six categories. Ten showed improvements in at least four areas. Average score was 4.3 on a 6.0 scale.



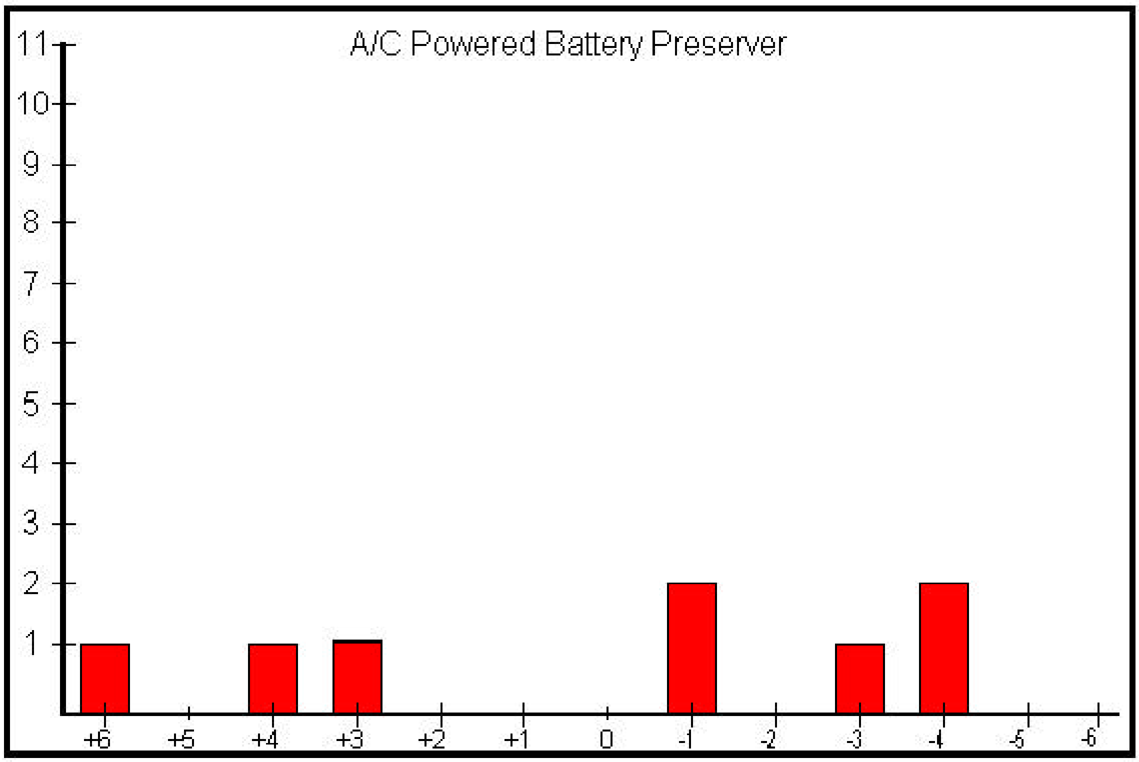
4.3 DS500 Plus Battery Conditioner (prototype)

Three New-Design Battery Conditioners were installed. One vehicle was equipped with dual batteries. Fifty percent of the evaluated batteries showed improvement in 5 or 6 of the tested categories. Seventy-five percent of the evaluated batteries showed improvement in three or more of the test categories and all showed improvements in at least two areas. Average score was 4.0 on a 6.0 scale.



4.4 T-360 Battery Conditioner/Maintainer

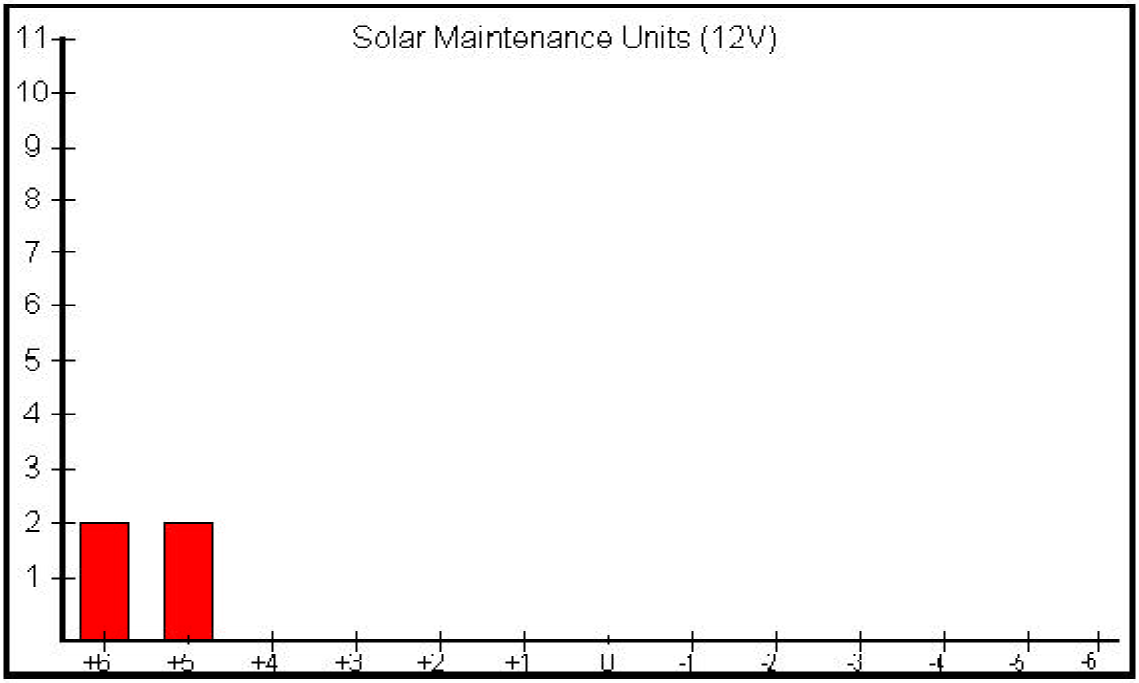
The T-360 Battery Conditioner/Maintainers proved to be of benefit to the batteries to which they were connected. To date; nine batteries were evaluated. Six showed improvements in three or more areas and seven showed improvements in at least one area. Four of the batteries had evidence of internal structural failure.



The T-360's had the lowest percentage of improved bateries, but also were tested on the largest percentage of "poor" batteries. Of the eight battries tested, four were in poor shape. The manufacturer does not claim that the T-360 will rejuvenate a bad battery. However, we felt that the units might be used in this manner in the field. It does appear that the unit might have success in this environment, but results will depend solely on the structural integrity of the battery before conditioning.

4.5 S550 Solar Battery Maintenance System

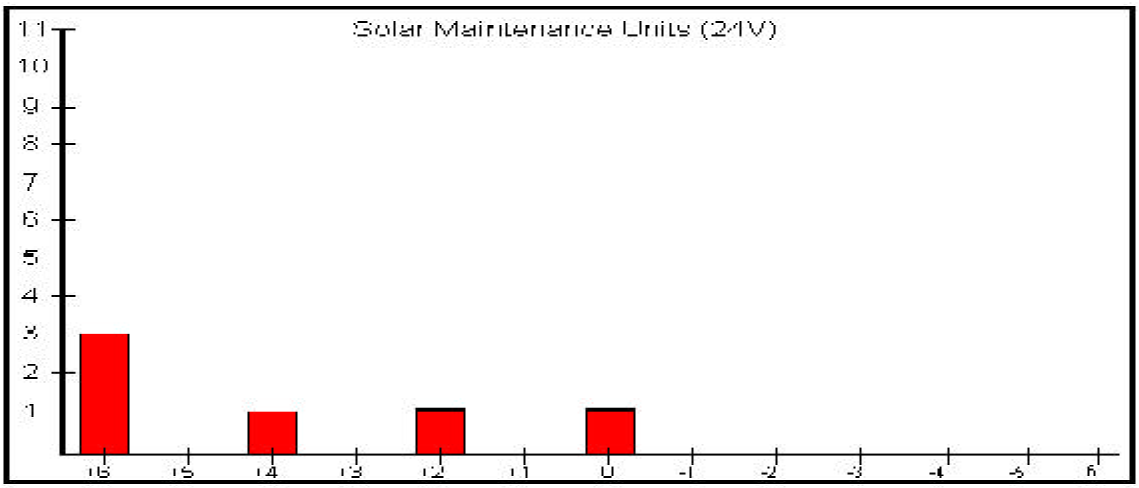
The S550 Solar Battery Maintenance Systems proved to be of exceptional benefit to the vehicles to which they were connected. To date; four vehicles were evaluated. All fourshowed improvements in five or six areas. Average score was 5.5 on a 6.0 scale.



One vehicle showed mixed effects from the solar unit, at times the battery performance would be lower and at other times battery performace would increase. Further investigation showed that this vehicle is only exposed to sunlight a portion of the time. The vehicle is an industrial forklift that is used both indoors and outdoors. As the vehicle is only used occasionally, and tended to be parked where it was used last. It is estimated that the vehicle was exposed to sunlight half of the time.

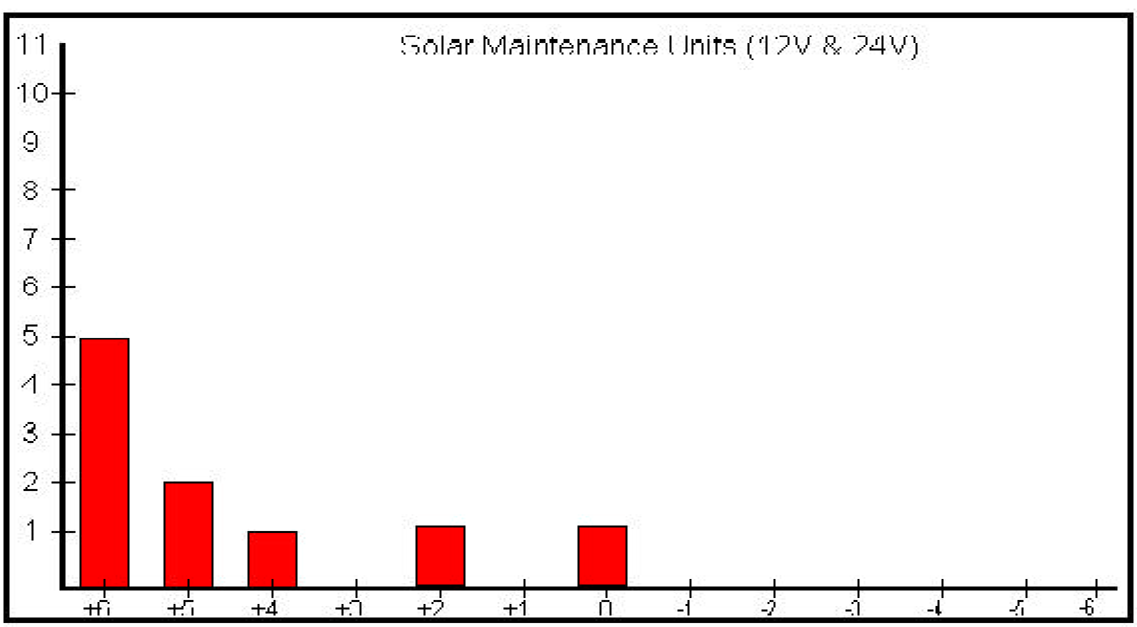
4.6 S1000 Solar Battery Maintenance System

The S1000 Solar Battery Maintenance Systems proved to be of exceptional benefit to the vehicles to which they were connected. To date; three vehicles were evaluated. Each vehicle was equipped with two batteries. Of the six batteries evaluated eighty-three percent showed improvement in five or six areas. Five of the batteries showed improvement in at least one area. Average score was 4.0 on a 6.0 scale.



4.7 Solar Battery Maintenance Systems (12V & 24V)

We have combined the data from the 12 and 24 volt tests to get an idea of the performance of the solor units in general by using a larger sample size. Average score was 4.6 on a 6.0 Scale.

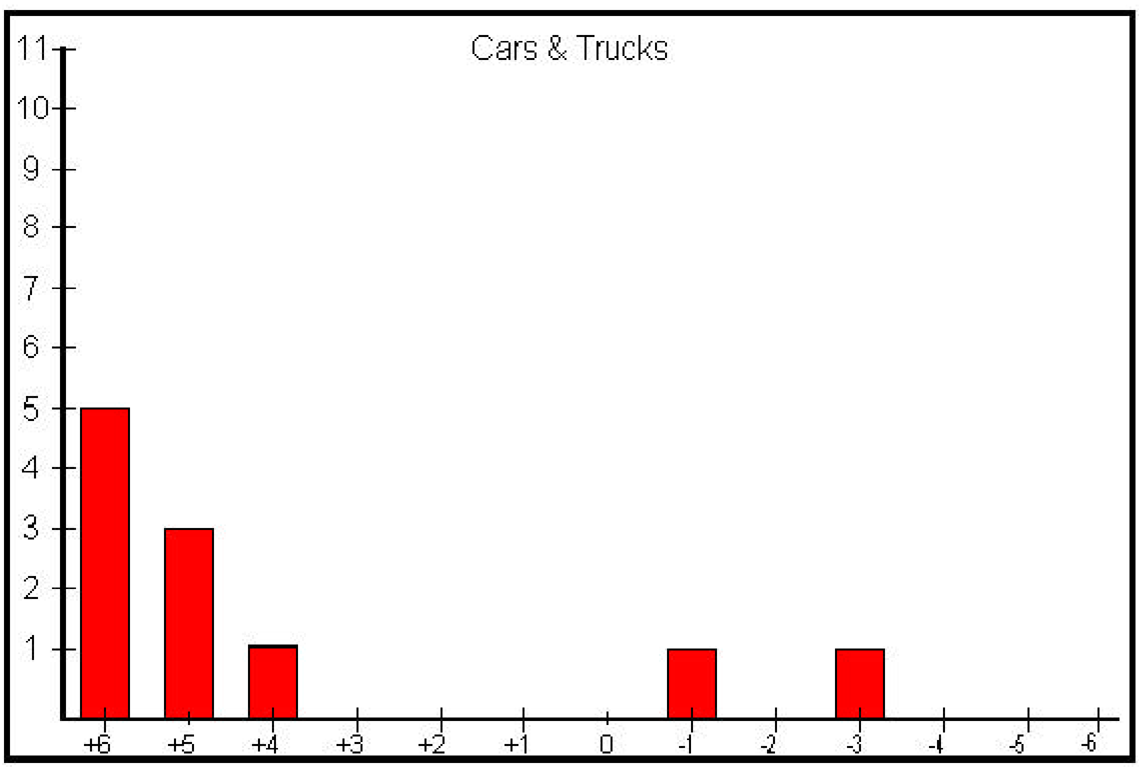


4.8 Application Evaluations

In this section we grouped our case histories by application. The point of this section is to determine if the sweeping pulse technology performs better in certain applications.

4.8.1 Cars & Trucks

Overall, the Sweeping Pulse Technology devices performed well in car and truck applications. The vehicles that showed the most improvement had batteries that where in fair or better condition. Drivers did not report any adverse affects from the Sweeping Pulse Devices and their operation was totally transparent to the vehicle operator. An area of concern was with OBD-I & OBD-II controlled vehicles. These vehicles have sophisticated engine control systems, and require stable voltage levels. We can not find any evidence that the Sweeping Pulse Technology devices influence engine control computers in any way. Average score was 4.0 on a 6.0 scale.

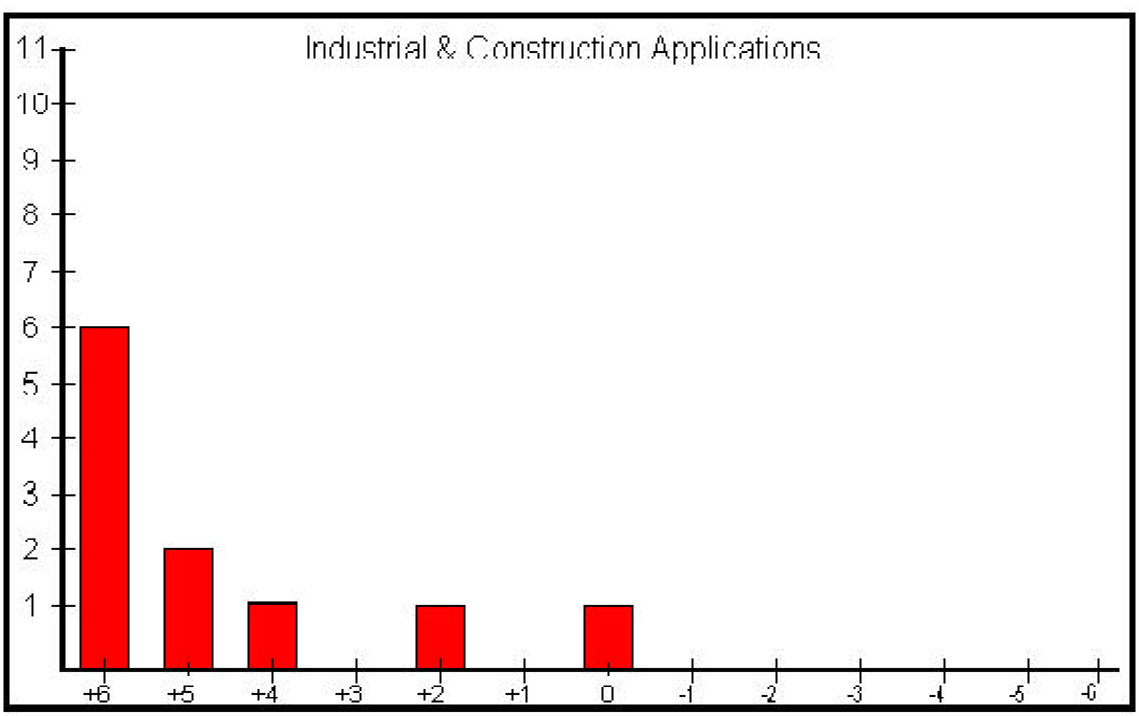


Summary of performance areas evaluated:

Area	**Concern**
Check Engine Lights	None
Charging Light	None
Radio Interference	None
Engine Performance	None
Fuel Economy	None
Electrical Problems	None

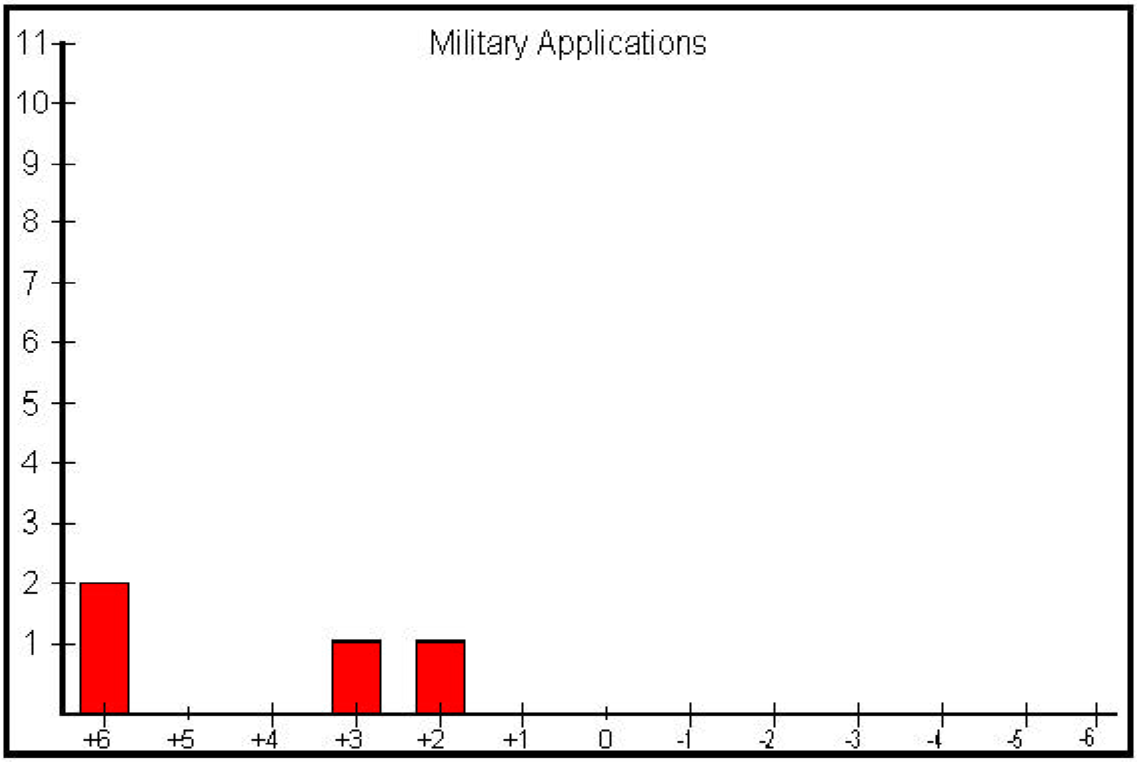
4.8.2 Industrial & Construction

The Sweeping Pulse Technology Devices performed well in Industrial and Construction applications. These applications place extreme demands on the battery. Many units sit neglected for extended periods of time, but when they are needed any battery failure costs time and money. Because of the financial penalties of a battery failure, many are replaced as a time-chance item. Based on our evaluations, we believe that the Sweeping Pulse Technology Devices can significantly increase the life expectancy of most batteries, particularly if installed early in the battery's service-life. Average score was 4.7 on a 6.0 scale.



4.8.3 Military

Military applications also place extreme demands on batteries. Many vehicles are stored for extremely long periods of time. In the post-Gulf War period, most military units are subject to rapid and short notice deployments. If a vehicle does not start, the unit must do without it, and this can adversely affect unit readiness. Average score was 4.25 on a 6.0 scale.



5.0 Glossary

Cold Cranking Amps (CCA): A rating that indicates a battery's ability to deliver current at low ambient temperatures.

Cranking Amps (CA): A rating that indicates a battery's ability to deliver current for engine starting.

ODB-I: On-Board Diagnostics - First Generation: A sophisticated engine management system mandated on all vehicles produced between 1988 to 1996.

ODB-II: On-Board Diagnostics - Second Generation: A sophisticated engine management system mandated on all vehicles produced after 1996.

Time-Change Item: Any item that is replaced at regular time intervals regardless of condition. The interval is set so that the item is replaced prior to reaching the end of its life cycle.

Surface Charge: A surface charge exists when battery voltage is above 12.6 volts.