Battery Capacity and Charge Mode Battery Charger Power Consumption

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Chris Calwell
calwell@ecosconsulting.com
970-259-6801 x301
Director of Policy and Research
Ecos Consulting
New Battery Charger Measurements Ongoing…

Li-Ion power tool charger

NiCd power tool chargers

Cordless hygiene products
Power Conversion During a Cordless Tool Battery Charge Cycle

- Power supply efficiency @ charge start = 40%
- Power supply efficiency @ 2 Hr. = 51%
- Power supply efficiency @ charge end = 58%

AC Input Power
DC Power Entering Charger
DC Power Entering Battery

Power (Watts) vs. Hours

0.0 0.4 0.8 1.3 1.7 2.1 2.5 2.9 3.3 3.8 4.2 4.6 5.0 5.4 5.8 6.3 6.7
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Big differences between charge and maintenance mode power use in fast chargers

Charge for 14.4V NiMH Power Tool Battery Charger

Charge Mode
~ 49 watts

Maintenance Mode
~ 3 watts
Not all Lithium Ion Chargers Have Low Power Use in Battery Maintenance Mode

Charge for 10.8V Li-Ion Multipurpose Tool Battery Charger

- **Charge Mode**: ~ 9.5 watts
- **Maintenance Mode**: ~ 4 watts
In some products, power use high in all “low power” modes, even with extra features switched off.
In some consumer battery chargers, little difference between charge and maintenance.

Charge Curve for 9.7 Volt Cordless Drill NiCd Battery Charger

- **Charge Mode**: 4 - 5.5 watts
- **Battery Maintenance Mode**: 4 watts
AC Energy: 24 Hour Cycle

D + E + F = 24 hours
AC Energy: 24 Hour Cycle

Power vs. Time

Charge and Maintenance

Standby

24 - Y

Y
Battery discharge at different rates can yield more/less energy

10.8V Li-Ion Multipurpose Tool Battery Discharge

- **1C discharge:** 12.9 Wh
- **0.2C discharge:** 13.2 Wh
On a percentage basis, nominal battery capacity can be higher than, lower than, or similar to measured battery capacity.
## Differences by Chemistry

<table>
<thead>
<tr>
<th>Charge Rates</th>
<th>Nicad</th>
<th>NiMh</th>
<th>Li-Ion</th>
<th>Lead Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Slow</strong></td>
<td>0.2C</td>
<td>0.2C</td>
<td>0.2C</td>
<td>?</td>
</tr>
<tr>
<td><strong>Fast</strong></td>
<td>1.0C</td>
<td>0.5C</td>
<td>1.0C</td>
<td>?</td>
</tr>
<tr>
<td><strong>Voltage Indicating End of Charge</strong></td>
<td>0.9 volts</td>
<td>0.9 volts</td>
<td>3.0 volts</td>
<td>1.75 volts</td>
</tr>
</tbody>
</table>
Charge and Maintenance Power Levels Are Closer to Each Other in Slow Chargers; Much Different in Fast Chargers

Power Consumption in Battery Chargers

- Charge
- Maintenance
- Standby
User behavior determines which mode dominates annual energy use.

Annual Energy Use of 15-Minute AA Battery Charger

- **Standby Mode**: 0.8 kWh per 1 charge/week
- **Maintenance Mode**: 0.3 kWh per 1 charge/week
- **Charge Mode**: 0.8 kWh per 1 charge/week

Annual Energy Use (kWh): 13.2 kWh for 1 charge/week continuous standby.