Appliance Switch Safety

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Different types of Switches

• Appliance Switches UL1054, UL61058-1
• Pendant and through-cord switches
• Switches for industrial applications
• Clock-operated switches
• Photoelectric switches
• General-use snap or flush-mounted switches
Developments in Switch Standards.

- September 2005 – introduction of UL61058-1 harmonized to IEC and Canada.
- Q2 2008 - New IEC amendment 61058-1 UL61058-1 (3rd edition, am. 2)
- June 2015 - Legacy Standard, UL1054, to be withdrawn.
North American use of the IEC

- National Differences as few as possible. Those necessary to acceptance in the electrical and safety infrastructure of North America and consumer demands.
- Addition of electrical loads unique to North American
- Temperature rise limits allowing compatibility to legacy end product standards for North American
- Addition of plastic requirements (flame UL94, RTI).
What’s important to a Safety Standard

• Mix of safety and performance
• Terminals (can you connect, reliably)
• Temperature (don’t overheat the device)
• Endurance (control the load you claim)
• Isolation (power to user, circuit to circuit)
• Mechanical strength (stay put)
Component + stuff = product

• There’s more to a product than the advertisement.
• Finding components that work together and safely.
Mechanical or Electronic Switch

- Mechanical – device controlling a circuit by separation of contacts (open/closing). Normally on/off, power, safety, air gap applications.
Mechanical Switch

• Positive - Constructions are simple, reliable, rugged, low noise and smaller. Amps to $ cost is favorable. Air gap isolation supply to load.

• Negative – Simple on/off operations, arcing parts, limited life span, limited tactile “feel” for the user.
Mechanical or **Electronic** Switch

- Electronic – device that carries load current through a Solid State Device.
  Normally active load (speed) control, such as a trigger switch.
Electronic Switch

• Positive – Active control of load, extended contact life span, designer tactile “feel”. Non arc producing.

• Negative – heat producing SSD, may introduce noise on circuit, sensitive to heat and current inrush, design dependant isolation of supply to load (high impedance “off”). Larger size.
Terminals/Conductor – construction!

- **Push-in** – easy connection. Caution - risk of poor/under connectivity, limited wire type (solid, solder dipped), non power cord.
- **Quick-connect** – easy connection,. Caution- risk of higher temp. connection, crimping factor, non power cord.
- **Screw** – secure, better connection temp., power cord. Caution- torque limits.
- **Solder**- good thermal connection. Caution – skilled labor, risk of changing position of terminal in switch body, non power cord.
Environment – IP or Listed “Type”

- In what environment do you expect the switch to operate (actuator and body)?
- Most 1054 switches have not been evaluated for environmental conditions.
- Switches with environmental ratings have specific installation limitations such as size of product opening, or orientation.
Example of switch advertisement

- It’s time to pick a switch …
  or it was picked for you…
How to check up on your switch

• Quick way – UL.com
  – Click the icon for IQ Database for Switches

  – This allows you to search by a variety of parameters (model, manufacturer, electrical ratings, etc..) This is presently a UL1054 search only.

• Or.. UL.com, select “Certifications”
  – look up the model card by manufacturer.
How to use a “Model Card”

- Each manufacturer has a UL file number and each file number has model card.
- Categories are: UL1054, WOYR2 and, UL61058-1, WKKY2

<table>
<thead>
<tr>
<th>Model - Cat No.</th>
<th>Load</th>
<th>Amps</th>
<th>Volts</th>
<th>Hz</th>
<th>Temp</th>
<th>POL/THR</th>
<th>30C cycle</th>
<th>55C cycle</th>
<th>IP 40</th>
<th>DIS (mm)</th>
<th>SPCQA</th>
<th>ed</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1 (Report Date: 12/07/1999)</td>
<td>RM</td>
<td>8(5)</td>
<td>125</td>
<td>50</td>
<td>80</td>
<td>1/1</td>
<td>6K</td>
<td>50K</td>
<td>Full 1.5</td>
<td>2, A</td>
<td>20050</td>
<td>930</td>
</tr>
<tr>
<td>R</td>
<td>5</td>
<td>250</td>
<td>60</td>
<td>80</td>
<td>1/1</td>
<td>15K</td>
<td>--</td>
<td>--</td>
<td>micro</td>
<td>--</td>
<td>20050</td>
<td>930</td>
</tr>
<tr>
<td>A1</td>
<td>¼ hp</td>
<td>2.9</td>
<td>250</td>
<td>60</td>
<td>55</td>
<td>1/1</td>
<td>6K</td>
<td>100K</td>
<td>micro</td>
<td>3</td>
<td>20050</td>
<td>930</td>
</tr>
</tbody>
</table>


# Electrical Loads

## North American

<table>
<thead>
<tr>
<th>Type</th>
<th>Power Factor (PF)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistive</td>
<td>0.9–1.0</td>
<td></td>
</tr>
<tr>
<td>General Purpose (GP)</td>
<td>0.75-0.8</td>
<td></td>
</tr>
<tr>
<td>Horse power (hp)</td>
<td>0.5–0.45 overload, 0.75 endurance</td>
<td></td>
</tr>
<tr>
<td>Lamp loads (T, L)</td>
<td></td>
<td>high inrush</td>
</tr>
<tr>
<td>TV loads (TV)</td>
<td></td>
<td>high inrush</td>
</tr>
</tbody>
</table>

## IEC (European)

<table>
<thead>
<tr>
<th>Type</th>
<th>Power Factor (PF)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistive</td>
<td>0.9–1.0</td>
<td></td>
</tr>
<tr>
<td>Inductive</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>Resistive/Motor</td>
<td>0.6</td>
<td>different make/break load</td>
</tr>
<tr>
<td>Lamp loads</td>
<td></td>
<td>high inrush</td>
</tr>
<tr>
<td>Capacitive load</td>
<td></td>
<td>high inrush</td>
</tr>
</tbody>
</table>
Amps

Caution – Double and multi-pole switch, amp rating must be verified per pole or parallel pole.
Volts

- Voltage has three parts
- What is the total potential 12, 125, 250V…
- What is the frequency (Hz) 50, 60, DC …
- What is the potential to ground. Not all 240/250 volt rated switches are evaluated 250V to ground based on our North American electrical model. When selecting a switch for an international system, this must be verified.
Temperature

• The temperature of the plastics defines the temperature of most mechanical switches.
• The temperature of the Solid State Device in conjunction with the plastics defines the temperature for most electronic switches.
• The application must consider the effect of outside heating sources on the switch and heat from the switch on the end product.
Poles / Throws / Test Circuit

- The application defines the number of poles and throws the switch will need.
- The Test Circuit defines the amps that flow through each pole.
Endurance cycles with a 30K rise

- North America, connection temperature rise limited to 30C.
- IEC, the temperature rise limited to 55C.
- Transitioning UL1054 to UL61058-1 required a compromise to allow backward compatible use of switches in legacy end products.
- Endurance test (to minimum required cycles), with temperature rise (30C limit). Option to continue endurance testing to IEC limit (55C).
- 30C cycle limit for use in legacy end product standards.
Endurance cycles with a 55C rise

- After verifying the level of safety required for legacy North American standards, the switch may continue the endurance cycles for a rating with a temperature rise above 55C.
- The 55C endurance cycle rating is for Standards harmonized to the IEC only (such as UL60950 or UL60745).
Endurance Cycles

- Example switch rated 6K and 50K cycles

Cycles 0 to Final

0 cy – 6000 cy

6001 cy – 50,000 cy

cycle 6K or more

Temperature △30 C rise test

Temperature △55 C rise test
IP (Environmental ratings)

- IP codes (Dust, Water)
Disconnect Dimensions (Full or FULL)

• Disconnection (distance between contact surfaces) + distance between live parts of opposite polarity. (electronic, micro, Full)

• Table 22 (overvoltage cat.II,, pollution deg. 2)
  – 100V disconnect distance = 0.2mm
  – 150V disconnect distance = 0.5mm
  – 300V disconnect distance = 1.5mm

• It is not enough to specify full disconnect.
Special Conditions of Acceptability

• What can you expect to see.
• Numeric codes correspond to the Guide page for general and common SPCA.
• Alphabetic codes are defined in the individual report and are unique to the design, such as installation or specific use.
RoHs Concerns for switch manufacturer

- Cadmium (AgCdO) for contact hardness is being replaced (AgSnO).
- Lead, Lead/Tin for terminations is being replaced with lead free. (Caution, higher end product assembly temperatures due to lead free my damage switch.)
Membrane Switch

• UL is working with the ASTM to develop a standard for membrane switches.
• These switches are moving into safety and line voltage applications.
• Represent away to give end products a completely new look and interface as well as their own set of unique design challenges.