

# **University of Kansas – Lawrence Campus**

## **EHS Guide -- December 2019**

### **Requirements for Power strips, Surge suppressors, and Electrical Extension cords**

Per the Office of the State and University Fire Marshals, the following regulate these devices:

- Kansas Fire Prevention Code
- International Fire Code- 2018 IFC
- National Electric Code- 2017 NEC (NFPA 70)

Failure to use these devices per the applicable codes may result in a hazardous condition and fire citations, fines and or a personal liability claims. These devices if not used correctly can and do result in fires. (50% of campus fires in the past 5 years)

- Extension Cords: Use for temporary loads only, not to be connected longer than 90 days and must be sized per the load with the proper ground. See reference information.
- Power Strips & Surge-Suppression devices: Must have overcurrent protection (circuit breaker).
- They are required to plug directly into a permanent wall or plug mold outlet.
- Do NOT plug them into each other or piggyback them.
- Replaced damaged devices and / or cords.
- Cords shall not pass through doors, walls or ceilings.
- Replace device if the overcurrent indicators, red light, flash sporadically.

### **DISCUSSION:**

Problems arise when using power strips and extension cords in situations for which they are not designed. Unless specified, power strips are designed for a *high concentration of low-powered devices*, not for high-power appliances.

High-power devices often have high startup/surge loads that can overload a circuit. Devices such as refrigerators, coffee pots, space heaters, microwave ovens, toasters, as well as lab equipment used for warming, heating, cooling, or other high-power applications.

### **Power Strips and Surge Protectors/Suppressors**

*Dedicated surge-suppressor outlets are preferred over power strips for permanent applications.*

Surge suppressors (and power strips with surge protection) must be UL 1449 listed, plugged directly into a wall receptacle. Relocatable power taps (ie: power strips) must be UL 1363 listed, plugged directly into a wall receptacle.

Not all surge protectors/suppressors are equipped with overcurrent protection. A device with overcurrent protection has an electric circuit that prevents damage resulting from excessive current, interrupting the flow of current at a predetermined value. Surge protectors/suppressors can be used for specific equipment. In the view of the State Fire Marshal, surge protectors/suppressors which are not equipped with overcurrent protection are considered a multi-plug extension cord and cannot supply electrical service to other equipment, a relocatable power strip or an extension cord.

Surge suppressors include a Metal-Oxide Varistor (MOV) to protect equipment from damaging power surges that can occur during utility shutdowns and electrical storms. *Select a device with a high Joule rating and a feature that indicates the protective MOV device is not damaged.* Joule ratings vary from 200 to 1000 or more. Replace the device if the indicator shows unit is no longer functioning.

#### Units with 15 and 20 amp circuits are available

- 15 amp is suitable for office applications.
- 20 amp is appropriate for lab and industrial applications
- A 20 amp circuit breaker is necessary when using a 20 amp strip/suppressor.
- Power strips are not approved in chemical fume hoods.
- Multiple power strips in series (Daisy chaining) is not allowed and subject to a fine by Fire Marshal.

#### Evaluating power strip/suppressor capacity

The total loading of all connected appliance must not exceed the capacity of the device. The National Electrical Code specifies a circuit should only carry 80% of its rated load during normal operations.

An example of determining capacity for a 15 Amp strip in office setting:

Two desk-top computers	500 Watts	Watts/Volts = Amps
Two 19 Inch LCD displays	80 Watts	640 Watts/115 volts = 5.6 Amps
Desk Lamp	<u>60 Watts</u>	5.6/15.0 Amps = 37% of capacity
Total	640 Watts	

#### Extension Cords

Extension cords are for temporary use only, typically for portable devices, or short-term, temporary events.

- Do not use in lieu of permanent wiring.
- Do not use with refrigerators, ice machines, or other high amperage appliances including portable space heaters. Space heaters, if allowed shall be plugged directly into a wall outlet. Refer to the KU space heater policy.

Some buildings may not have the infrastructure to meet all operational needs. In these cases power strips and surge suppressors may be possible. In other cases it may be necessary to expand the building's electrical system.

#### Extension cords requirements

- Underwriters Laboratory (UL)-approved. (UL 817 indoor, and UL 2438 or 'W' for outdoor).
- Minimum 16 gauge, double insulated, grounded, and no longer than needed.
- Polarized electrical appliance with polarized plugs are approved. (Polarized plugs have 2 prongs with one prong larger than the other).
- Recommend no longer than 100 feet for light duty, and 50 feet for medium duty.
- Do Not exceed the amperage rating of the cord. (See table.)
- Do Not use where flammable or explosive atmospheres exist.

A smaller “gauge” number indicates a thicker cord.

- 18 gauge (not approved for lab or industrial use).
- 16 gauge (light duty) for equipment up to 13 amps (e.g., portable lights and fans).
- 14 gauge (medium duty) for 14 to 15 amps, such as portable power tools.
- 12 gauge (heavy duty) for 16 to 20 amps.
- 10 gauge (extra heavy duty) is for air compressors, electric chain saws, etc.

#### Extension Cord Length

When using cords greater than standard lengths, heavier cords are required. For planning purposes, the following table shows recommended gauge based on length of cord.

Length	0-2 Amps	2-5 Amps	5-7 Amps	7-10 Amps	10-12 Amps	12-15 Amps	16-20 Amps
25 ft	16 gauge	16 gauge	16 gauge	16 gauge	14 gauge	14 gauge	12 gauge
50 ft	16 gauge	16 gauge	16 gauge	14 gauge	14 gauge	12 gauge	12 gauge
100 ft	16 gauge	16 gauge	14 gauge	12 gauge	12 gauge	10 gauge	8 gauge
150 ft	16 gauge	14 gauge	14 gauge	12 gauge	10 gauge	8 gauge	-
200 ft	14 gauge	14 gauge	12 gauge	10 gauge	8 gauge	-	-
300 ft	14 gauge	10 gauge	8 gauge	-	-	-	-
400 ft	12 gauge	8 gauge	-	-	-	-	-
500 ft	12 gauge	8 gauge	-	-	-	-	-

#### Proper Use and Maintenance

Any defect or damage to a cord, power strip, or any electrical component places it out of service and must be disposed and replaced.

Inspect for visible damage, as well as warm connectors, plugs, and cords. *If plugs or cords are warm to the touch an excessive amount of current is flowing through the connection* due to excessive resistance and/or ‘over-Amp’ conditions. The National Electrical Code limits loading to 80% of capacity to minimize problems from excessive resistance and ‘over-Amp’ conditions.

Poor contact between device contacts and plug blades may cause a plug to heat up by increasing resistance. Damage to cord wire may increase resistance and cause heat. Multiple connection-to-plug conditions (Daisy-Chaining) increases current needed at the far end of the chain in order to overcome each point of resistance. Damage to an appliance’s electrical system also cause units to ‘over-Amp’.

These actions will greatly decrease the risk of electrical shock and fire:

- Plug adapters are not approved.
- Plug power strips/suppressors/extension cords directly into a wall receptacle.
- Always grip the plug to disconnect from an outlet. Do not pull by the cord itself.
- Never place cords where they will be driven or ridden over by a vehicle of any kind.
- Never kink, knot or twist cords.
- Provide a bridge for temporary cords placed across walkways and circulation paths to protect the cord and prevent a tripping hazard. Other methods, such as duct tape, are less effective.
- Do Not place cords over sharp or abrasive materials.
- Do Not use in wet locations.
- Do Not use multiple power strips in series (Daisy chaining).
- Do Not connect power strips to extension cords.
- Do Not permanently secure to walls, ceilings, table legs, or similar structures. (Nails, tacks, zip-ties, staples or other methods which may damage cords). It is permissible as long as no tool is required to remove the device.
- Do Not run flexible cords through walls, ceilings, floors, or windows, over drop down ceilings, or under doors, carpets or rugs, or false floors. This is a fire code violation and the condition of the cord cannot be verified if it is hidden from view.

#### **Amperage Draw of Common Laboratory Equipment**

Refrigerators, freezers, ovens, and other high-load equipment have a rated running current as well as a power-up or surge current. A refrigerator surge is generally 2-3 times the amount of running watts added to the total power use/drain on the circuit. Furthermore, older equipment like refrigerators do not maintain set temperatures, causing more frequent peaks or surges.

Refrigerator Types	Voltage (V)	Rated Wattage (w)	Rated current Ampere (A)	Peak/Surge current Ampere (A)
Refrigerator: Fisher Scientific IsoTemp Flammable rated (10 cu. ft.)	115	218	1.9	4 – 6
Refrigerator: Fisher Scientific IsoTemp Flammable rated (50 cu. ft.)	115	600	9.1	10.5 - 15.6
Refrigerator: VWR general purpose (18 cu. ft.)	115	575	5	10 - 15
Refrigerator: GE® Top-Freezer Refrigerator (17.9 cu. ft.) <b>10+ years old.</b>	115	747	6.5	13 – 19.5
Refrigerator: RCA mini fridge (4.5 cu. ft.)	115	92	0.8	1.6 – 2.4

Other Instruments	Voltage (V)	Rated Wattage (w)	Rated current Ampere (A)	Peak/Surge current Ampere (A)
Balance, analytical: Mettler Toledo MS-TS	100	30	0.3	NA
Biological Safety Cabinet: Class II, Type A2. 3ft	115	1380	12	NA
Heat gun: Proheat	120	1080	6-12	12 - 20
Hotplate: Accuplate	110	680	6.2	NA
Incubation/Shaker: HT Infors, Multitron	115	880	7	14 - 21
Incubator/Shaker: New Brunswick Scientific with added refrigeration. Innova 44R	120	1500	15	20-30
Incubator, forced air: The Lab Depot, Inc.	115	365	2.2	NA
Microwave: <b>2003</b> GE Brand	120	1550	13.6	15 - 20
Rotary evaporator: 2L CGOLDENWALL	110	400	2.75	NA
Rotary evaporator: 7 L Yamato	115	1380	12	NA
Stirrer: Eurostar 20 digital overhead	115	70	0.6	NA
Vacuum pump: Labconco hybrid	115	655	5.7	NA
Vortex mixer: Benchmark Scientific BenchMixer	115	180	1.5	NA

**Rated or Running Current / Power:** Rated current is the maximum current at which the unit can operate in a continuous mode. Continuous amperage draw beyond the rated current can result in component failure. This value can be found on the nameplate inside the device.

**Startup or Surge Current / Power:** Startup current is the amperage / power draw peak that occurs when an appliance is operating in its most strenuous condition or cycle. For a compressor based refrigeration unit this would be at unit/compressor startup. After the internal compressor components have reached running state (usually less than a few seconds) the amperage draw will return to normal operation. Various levels of surge current conditions can exist as well depending on operating conditions and environmental conditions (room temp and humidity).

### **Questions:**

Contacts:

EHS – 785-864-4089.

University Fire Marshal – 785-864-3431

Reference: International Fire Code, Article 6 National Electrical Code, Article 400

Reference: TRIPP-LITE, How to Choose the Right Surge Protector

<https://assets.tripplite.com/white-paper/how-to-choose-the-right-surge-protector-white-paper-en.pdf>