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Standard Guide for Personal Cannabis/Hemp Plant Growing Appliances[1]

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1. Scope

1.1 This guide is intended to define characteristics, functions and technologies commonly present in personal cannabis/hemp plant growing appliances

1.2 This guide will provide clarity and understanding to the industry, government, consumers and the general public on different features and technologies that may be present and/or are used in the design and manufacture of personal cannabis/hemp plant growing appliances.

1.3 This guide shall be used in conjunction with Classification D8390.

1.4 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D8390 Classification for Domestic Cannabis/Hemp Plant Indoor Growing Appliances

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *array pattern, n*—a group of LEDs arranged in rows and columns that form a complete unit.

3.1.2 *bubbler, n*—an irrigation system component that resides at the end of a micro delivery line from which small low-pressure water stream bubbles upward in a similar manner to a drinking fountain stream that wets the cannabis plants root zone.

3.1.3 *closed cell foam, n*—a type of foam material that is commonly used where liquid resistance is desirable.

3.1.4 *drip emitter, n*—an irrigation system delivery component that resides at the end of a micro delivery line used to deliver drips of water directly to the cannabis plants roots in a slow and steady manner.

3.1.5 *fertilizer, n*—a term used for chemical substances that contain nutrients that aid in plant growth.

3.1.5.1 *Discussion*—Fertilizers are typically applied to soil medium to supplement or enhance elements found naturally in soil and to help in the replacement of these elements that have been consumed by plants.

3.1.5.2 *Discussion*—Fertilizers are composed of primary (macro nutrients), secondary (micro nutrients), and tertiary (minor nutrients). The most prominent macro nutrients for cannabis growth are Nitrogen (N), Phosphorus (P), and Potassium (K) commonly referred to as NPK. In addition, micro nutrients such as Calcium (Ca), Magnesium (Mg), and Sulfur(S) are used to supplement cannabis plant growth, as well as other minor nutrients such as Manganese (Mn), Boron (B), Iron (Fe), Copper (Cu), Nickel (Ni), Zinc (Zn), Molybdenum (Mo), and Chlorine (Cl).

3.1.6 *main delivery line, n*—a larger diameter supply line that is directly connected to a main water supply which may/may not be pressure regulated and timer controlled.

3.1.6.1 *Discussion*—the main delivery line will have multiple micro delivery lines inserted to which drip emitters, stream emitters, bubblers, micro sprayers or combinations are attached for controlled water delivery.

3.1.7 *medium, n*—a means to carry nutrients to help in plant growth and development.

3.1.8 *micro sprayer, n*—a low pressure irrigation system component that resides at the end of a micro delivery line with/without an elevated stake, used to deliver water directly to

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

plants in an umbrella like spray pattern. Spray patterns may cover various angles such as 90°, 180° and 360°.

3.1.9 *nutrient, n*—any substance that provides nourishment for plants growth and development during its growth cycle.

3.1.9.1 *Discussion*—Nutrients can be organic materials, such as animal biproducts or inorganic materials, such as chemical fertilizers.

3.1.10 *stream emitter, n*—an irrigation system component that resides at the end of a micro delivery line used to deliver an adjustable stream of water directly to the cannabis plants roots.

3.1.11 *tank, n*—a large receptacle for holding or storing liquids

3.1.11.1 *Discussion*—the term tank in irrigation is a reservoir that may hold water, a solution of nutrient-rich oxygenated water or other liquid solution that is used or delivered to the cannabis plants root system during plant growth.

3.2 *Abbreviated Terms — Acronyms and Initialisms:*

3.2.1 *LED*—light emitting diode

3.2.2 *HID*—high intensity discharge

3.2.3 *HPS*—high pressure sodium

3.2.4 *MH*—metal halide

3.2.5 *NPK*—nitrogen, phosphorous, potassium

3.2.6 *EC*—electrical conductivity

3.2.7 *TDS*—total dissolved solids

3.2.8 *CO2*—carbon dioxide

3.2.9 *pH*—potential of hydrogen ion

4. Significance and Use

4.1 This guide is intended to educate new and experienced users of personal cannabis/hemp plant growing appliances on the various characteristics that can be available in personal cannabis/hemp plant growing appliances.

4.2 This guide will outline characteristics of personal cannabis/hemp plant growing appliances, which includes individual components, design elements, and basic universal functions.

4.3 This guide will categorize common characteristics using categories based on different technologies and describe in simple terms the details attributable to each category but is not intended to be all inclusive.

4.4 This guide will serve to provide clarity to industry, government, and the public on terminology, and universal functions of personal cannabis/hemp plant growing appliances.

4.5 Reference to a type characteristic in this guide is not intended in any manner to denote endorsement or approval of said type by ASTM International.

5. Characteristics

5.1 The various characteristics of personal cannabis/hemp plant growing appliances appear in Table 1.

5.2 *Characteristic I: Grow Medium:*

5.2.1 *a. Soil*—A grow medium of organic matter for seed germination with sufficient nutrients and good water and oxygen retention properties that allows the cannabis plant to grow.

5.2.2 *b. Soilless*—A grow medium composed of non-soil ingredients. Examples of these medium are perlite, peat moss, coco coir, rockwool, and vermiculite to name a few. Typically, no nutrients are present. Nutrients are instead added to water, which is used to feed the cannabis plant.

5.2.3 *c. Combination*—A grow medium comprising of a mixture of organic and inorganic ingredients.

5.3 *Characteristic II: Lighting System:*

5.3.1 *a. Light Emitting Diode (LED*—A lighting system commonly used in the aid of growing cannabis plants in a controlled environment. This type of lighting system consists of a series of small semiconductor components that are laid out in an array pattern. When an electric charge or current is applied through the array, each individual LED emits visible light. The visible light produced by the LED's is part of the light spectrum (**1**).[3] These lighting systems can also have optional electronic controls used to vary wavelengths and

[3] The boldface numbers in parentheses refer to a list of references at the end of this standard.

TABLE 1 Characteristics of Personal Cannabis/Hemp Plant Growing Appliances

Characteristics	Categories					
I. Grow Medium	a. Soil	b. Soilless	c. Combination			
II. Lighting System	a. Light Emitting Diode (LED)	b. High Pressure Sodium (HPS)	c. Metal Halide (MH)	d. Fluorescents	e. Inter-Changeable	
III. Irrigation	a. Hydroponics	b. Aquaponics	c. Aeroponics	d. Manual	e. Sprinkler System	f. Combination
IV. Water Supply and Drainage	a. Hard Plumbing	b. Manual Fill Reservoir	c. Manual Watering	d. Combination		
V. Atmospheric Sensors and Controls	a. Atmospheric Control System	b. Atmospheric Monitoring or Sensoring System	c. No Control System or Sensors			
VI. Growing Aid	a. Nutrient Liquid	b. Nutrient Solid	c. None (Organic)			
VII. Plant Contact Material	a. Coated	b. Plastic	c. Glass	d. Combination		
VIII. Grow Chamber Size	a. Single Plant	b. Multiple Plants				
IX. Automation	a. Fully Automated	b. Semi-Automated				
X. Information Readout	a. Application Readout	a. Digital Readout	c. Analog Readout	d. No Information Readout		

control the light spectrum during vegetation to flowering stages of plant growth. This type of lighting system is very efficient and produces little heat.

5.3.2 *b. High Pressure Sodium (HPS)*—A lighting system commonly used for various lighting applications, including plant grow lights. This type of lamp or bulb is commonly referred to as a High Intensity Discharge (HID) lamp. It consists of a bulb, which inside contains a frame that supports a ceramic arc tube (**2**). The arc tube is typically made of aluminium oxide and inside contains a mix of sodium and mercury combined with xenon gas. Additionally, the system contains an electrical ballast (**3**), which is used for regulating voltage and electrical current. When an input voltage is applied, an electric current is passed through the arc tube's xenon gas, which heats up the mercury, heating the bulb and as the bulb heats, the sodium vaporises, emitting bright light. The light produced by HPS bulbs lies within the light spectrum but tends have a lower output of white and blue light (due to mercury) and more yellow and red light (due to sodium). Yellow and red wavelength light is very desirable for the flowering stage of plant growth. An HPS bulb light system tends to produce much higher heat than LED's and typically requires a cooling system to aid in heated air exhaust from within the growing appliance.

5.3.3 *c. Metal Halide (MH)*—A lighting system commonly used for plant grow lights. This type of lamp or bulb is also a type of HID lamp. Like an HPS system, it consists of a bulb containing a frame that supports a quartz arc tube containing mercury vapour combined with metal halides (**4**). The commonly used metal halides in these lamps are mixtures of metal iodide and metal bromide complexes. Similar to HPS, an electrical ballast is used for regulating voltage and electrical current. MH type systems provide more blue wavelength light spectrum which is more desirable in the vegetation stage of plant growth. This type of lighting system also produces heat like HPS, thus also requiring a method or cooling system for air exhaust from within the growing appliance.

5.3.4 *d. Fluorescent*—This lighting system is an alternate and inexpensive lighting system commonly used for plant grow lights. It consists of a glass tube containing an inert gas such as argon, with electrodes on both sides and similarly an electrical ballast. An AC electric current is passed through the ballast, stepping up the voltage to a set value. To regulate and limit the current and prevent overheating, an inductor commonly known as choke (**5**) is used in the electrical circuit. Fluorescent type light systems provide a visible light and are typically used for starting seedlings and provide more blue wavelength light spectrum which is desirable in the vegetation stage of plant growth. This type of lighting system produces little heat in the growing appliance.

5.3.5 *e. Inter-changeable*—A lighting system where multiple lighting systems are used during different stages of plant growth, from seedling to vegetation to flowering stages. An example of such a system may be the use of MH lamps during vegetation stage and HPS lamps during the flowering stage. Different types of lighting systems provide better or optimal blend of light spectrum, thereby allowing optimum lighting characteristics required for plant growth.

5.4 *Characteristic III: Irrigation:*

5.4.1 *a. Hydroponics*—A method or process for growing cannabis plants that does not use soil as a medium, instead it uses a soilless medium with water and nutrients used for growing cannabis plants. In hydroponics, the root system of the plant is supported in mediums such as perlite, peat moss coco coir, rockwool or vermiculite and is irrigated with the nutrient solution.

5.4.2 *b. Aquaponics*—A process for growing cannabis plants that uses a combination aquaculture and hydroponics in a closed loop system. The process involves the growing of fish and/or other aquatic animals and plants. Fish are grown in a tank where they excrete waste into water. This excretion water is comprised primarily of nitrogen in the form of ammonia with other nutrients such as phosphorous and potassium. Microbateria within the water then convert the ammonia to nutrients. The fish wastewater is then pumped into a secondary tank, that is, the plant tank, that contains plants with their roots submerged in the plant tank. The cannabis plants then draw nitrogen and other nutrients from the water and absorbed them through their root system. This both feeds the cannabis plants and filters the water, reducing toxins in the water. The filtered water then recycles back to the fish tank and the cycle repeats itself.

5.4.3 *c. Aeroponics*—A process for growing cannabis plants that uses no soil medium or other soilless mediums. The cannabis plants are held by their stems using a closed cell foam or other material inserted into a growing fixture residing above a tank. The top upper portion of the plant and leaves are divided from roots below the foam insert. The root system for each plant hangs suspended in an air environment and a nutrient rich solution is pumped from a reservoir tank and delivered periodically in the form of an atomized fine mist or water droplets to the plant roots for absorption. Any excess droplets are captured in the tank and are then returned by means of a gravity or pump system to the reservoir.

5.4.4 *d. Manual*—As is inferred, the irrigation process is manual. This is typically applicable to soil medium. The grower may use visual and finger touch methods to detect the wetness of the soil or alternatively a soil moisture meter probe may be used to monitor moisture content of the soil. Based on requirements, the grower waters and applies nutrients accordingly as required throughout the plant growth cycle.

5.4.5 *e. Sprinkler System*—A sprinkler irrigation system is comprised of a water tap or bib connection, a timer for setting a watering schedule, a filter, a pressure regulator, backflow prevention device, a main supply line, and micro delivery line. Various combinations of single drip emitters with and without pressure compensators, micro sprayers, stream emitters, and bubblers are attached to the micro delivery lines which are set near the cannabis plants roots. The system is set to deliver a direct supply of water directly to the roots of the cannabis plants.

5.4.6 *f. Combination*—A process for growing cannabis plants that uses a combination irrigation and nutrient feeding and are sometimes known as dosing and fertigation systems. These systems allow for the distribution of water for watering and root nutrient feeding. These types of systems use the same

common water distribution system which is flushed as required based on the plant grow cycle needs.

5.5 *Characteristic IV: Water Supply and Drainage:*

5.5.1 *a. Hard Plumbing*—A system that is comprised of three components, a water supply system, the appliance itself and a drainage system. The appliance water supply line is connected directly to the house plumbing system through rigid or flexible piping with a valve connection for control purposes. The valve allows for flow of water into the appliance. The appliance is also connected to the house drainage system. The appliance uses the water supply for carrying out various delivery activities such as irrigation, humidification and nutrient mixing to the growing cannabis plants. Water should be allowed to acclimatize to room temperature. Any used (that is, waste) water is then exhausted from the appliance to the drainage system.

5.5.2 *b. Manual Fill Reservoir*—A system that has a permanent or removable reservoir that is manually filled with water. The filling process is flexible. The user can use a hand connected hose or a handled container to place water in the reservoir. Water is then allowed to acclimatize to room temperature before nutrient mixing takes place for delivery to the growing cannabis plants.

5.5.3 *c. Manual Watering*—A system that implies a manual method where the plants are watered manually by the grower. Water should be allowed to acclimatize to room temperature to allow for pH reading and addition of nutrients for feeding as required.

5.5.4 *d. Combination*—A system that combines various methods dependent on the plants grow cycle stage and preference by the grower.

5.6 *Characteristic V: Atmospheric Sensors and Controls:*

5.6.1 *a. Atmospheric Control System*—A system that provides factory defined settings within the control system for growing cannabis plants through stages of the plant grow cycle. The control system programming can include options for temperature, humidity, moisture, lighting and CO2 values based on optimal grow conditions and plant type. All settings can be user defined or adjusted by manual input as desired.

5.6.2 *b. Atmospheric Monitoring/Sensing System*—A system that uses sensors to monitor atmospheric conditions including external ambient, internal temperature, humidity and CO2 concentration within the grow appliance and automatically makes real time adjustments using programmed logic for best growing conditions. This type of system is/can be dependent and work in parallel with the grow system and lighting system controls.

5.6.3 *c. No Control or Sensor System*—As implied, no control or sensor systems are present in the growing appliance. The user must use manual instrumentation and manually measure readings to determine atmospheric conditions and adjust accordingly through manual methods.

5.7 *Characteristic VI: Growing Aid:*

5.7.1 *a. Nutrient Liquid*—All plants require nutrients for plant growth. Cannabis plants require nutrients to also grow and thrive in the environment. All nutrients are impacted by pH level in the medium the plants are grown in. pH level needs to be controlled and adjusted depending on medium used for growing cannabis. Macro nutrients come in a high concentrated liquid solution that are diluted with water and applied to both soil and soilless medium during the various stages of plant growth. Nitrogen helps to promote green foliage and makes the plants grow during the vegetation stage. Phosphorous promotes healthy flower and bud's growth during flowering stage. Potassium functions as a catalyst for healthy plant photosynthesis and helps in the development of fuller and more dense flower buds. Liquid nutrients typically have a limited shelf life and can be expensive.

5.7.2 *b. Nutrient Solid*—These are nutrients for cannabis growth that come in a crushed powder or solid granular format. Solid nutrients are applied directly to soil medium in crushed powder or solid granular form with better control. These nutrients can also be dissolved in water to make a nutrient rich solution to add to soil or soilless mediums. In the same essence as liquid nutrients, NPK macro nutrients composition and supporting micro and minor nutrients are required for good cannabis plant growth and development. Solid nutrients tend to be most cost effective and have a long shelf life as they are less susceptible to environmental factors of storage, package and shipping.

5.7.3 *c. None*—These are nutrients for cannabis growth that fall into a category called organic nutrients. These nutrients are mainly animal by-products such as animal manures. Common materials used (chicken, cow, goat, rabbit etc.), guano (bat or bird), bone and blood meal, fish meal, and worm castings to name a few. Organic nutrients contain various percentages of NPK, but these are typically low and hard to quantify based on volume required.

5.8 *Characteristic VII: Plant Contact Material:*

5.8.1 *a. Coated*—The surface of the specific substrate materials will have a coating that has been applied to the substrate. Such surface coatings fall into various categories of corrosion resistance, reflectivity and anti microbial. Common material used are polished aluminium, steel and stainless steel.

5.8.2 *b. Plastic*—A material made of synthetic or semi-synthetic organic compounds that are moldable, shapeable into various forms while soft, that will retain a permanent shape once cured. This category of contact material is good for corrosion and chemical resistance, and is heat and fire resistant depending on the compounds used for its manufacture.

5.8.3 *c. Glass*—A growing appliance that has components manufactured of glass such as a viewing window or protective lighting system cover.

5.8.4 *d. Combination*—An appliance manufactured from a combination of various materials dependent on factors required. As an example, plastic may allow for the addition of reflective metal and anti microbial coatings.

5.9 *Characteristic VIII: Grow Chamber Size:*

5.9.1 *a. Single Plant*—A chamber that allows for a single cannabis plant to grow in a specific medium. This chamber commonly uses soil or soilless mediums for growing.

5.9.2 *b. Multiple Plants*—A chamber that allows for multiple plants to grow in a set medium. Numbers of plants can vary, but typically run from 2–8 plants depending on cannabis subspecies of Indica, Sativa, or Hybrid being grown.