Equipment – Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains, UL 60384-14.

- 22.8 A dry-metallized-film capacitor operating:
 - a) At a voltage of less than 330 V need not have a maximum available fault current rating; or
 - b) At a voltage equal to or greater than 330 V shall:
 - 1) Comply with the applicable requirements in the Standard for Capacitors, UL 810; and
 - 2) Have an available fault current rating in accordance with 22.6.

23 Receptacles

- 23.1 The face of a receptacle shall:
 - a) Be flush with, or project beyond, a nonconductive surrounding surface; or
 - b) Project not less than 0.015 in (0.38 mm) beyond a conductive surrounding surface.

24 Spacings

24.1 The spacings at wiring terminals shall not be less than the values specified in <u>Table 24.1</u>. See <u>11.2.1.2</u>.

	Minimum spacings, in (mm)						
Potontial involved	Between wiring terminals, through air or over surface		Between terminals and other uninsulated metal parts not always of the same polarity ^a				
V			Over	surface	Through air		
250 or less	1/4	(6.4)	1/4	(6.4)	1/4	(6.4)	
More than 250	1/2	(12.7) ^b	1/2	(12.7) ^b	3/8	(9.5)	
^a Applies to the sum o	f the spacings inv	olved where an iso	plated dead metal	part is interposed.			
^b In a compartment or terminals is acceptabl	box that is integra	al with a motor, a s	pacing of not less	than 3/8 in through a	air and over surfa	ce at wiring	

Table 24.1Spacings at wiring terminals

24.2 At other than a field-wiring terminal, or as specified in 24.3 - 24.5, 24.7 and 24.8, the spacings between uninsulated current-carrying parts of opposite polarity, and between an uninsulated live part and a dead metal part, shall not be less than the values specified in Table 24.2. If an uninsulated current-carrying part is not rigidly fixed in position by means other than friction between surfaces, or if a movable dead metal part is in proximity to an uninsulated current-carrying part, the construction shall be such that the minimum acceptable spacings are maintained. See 24.11.

	Minimum through air or over surface spacings,					
Potential involved, V	in	(mm)				
0 – 125	1/16	1.6				
126 – 250	3/32	2.4				
251 – 600	1/4	6.4				

Table 24.2 Spacings at other than wiring terminals, in a motor circuit, or inside a motor

24.3 In a motor circuit other than inside the motor, the spacings between uninsulated current-carrying parts of opposite polarity, and between an uninsulated live part and a dead metal part shall not be less than the values specified in <u>Table 24.3</u>. If an uninsulated live part is not rigidly fixed in position by means other than friction between surfaces, or if a movable dead metal part is in proximity to an uninsulated current-carrying part, the construction shall be such that the minimum spacings are maintained. See <u>24.11</u>.

Exception No. 1: Spacings as specified in <u>24.7</u> and <u>24.8</u> comply with this requirement.

Exception No. 2: Investigating a circuit in which the only motor load is a timer motor to <u>24.2</u> and <u>Table 24.2</u> complies with the requirement when the investigation of the circuit indicates that such spacings comply for this application.

	Minimum spacings, in (mm)								
	Disposer	Disposer using a motor having a diameter 7 in (178 mm) or less ^a				Disposer using a motor having a diameter more than 7 in (178 mm), through 11 in (279 mm) ^{a, b}			
Potential involved, V	Over surface		Through air		Over surface		Through air		
0 – 125	3/32	(2.4) ^c	3/32	(2.4) ^c	1/4	(6.4)	1/8	(3.2)	
126 – 250	3/32	(2.4)	3/32	(2.4)	1/4	(6.4)	1/4	(6.4)	
251 – 600	1/2	(12.7)	3/8	(9.5)	1/2	(12.7)	3/8	(9.5)	

 Table 24.3

 Spacings in a motor circuit other than inside the motor

^aThis is the diameter, measured in the plane of the laminations of the circle circumscribing the stator frame, excluding lugs, fins, boxes, or similar parts used only for motor mounting, cooling, assembly, or connection.

^b A spacing of not less than 3/32 in, over surface and through air, between film-coated wire, rigidly supported and held in place on a coil, and a dead metal part complies.

^c For a disposer only using motors rated 1/3 hp (249 W output) or less, these spacings not less than 1/16 in (1.6 mm) comply with the requirement.

24.4 The spacings within a motor shall comply with the spacing requirements in the Standard for Rotating Electrical Machines – General Requirement sUL 1004-1.

24.5 Spacings for solid-state circuits that comply with the Standard for Solid-State Controls for Appliances, UL 244A, comply with the intent of the requirements. Compliance with the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, and/or the applicable Part 2 standard from the UL 60730 series fulfills these requirements.

24.6 The spacing between parts of different circuits shall not be less than the largest spacings required for the circuits involved.

24.7 The spacing requirements in $\underline{24.3}$ do not apply to the inherent spacings of a component of the disposer, such as a snap switch. Such spacings shall comply with the requirements for the particular component if they are smaller than the values specified in <u>Table 24.3</u>.

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24.8 At a closed-in point, such as the screw and washer construction of an insulated terminal mounted in metal, a spacing of not less than 3/64 in (1.2 mm) complies.

24.9 In applying <u>Table 24.3</u> to a motor circuit in which two or more motors of different sizes are connected, the spacings in the motor circuit shall be judged on the basis of the size of the largest motor involved.

24.10 Film-coated wire is determined to be an uninsulated current-carrying part when spacings are being investigated.

24.11 At terminal screws and studs to which wire connectors, eyelets, or similar devices as described in <u>11.2.1.2</u> are connected in the field, spacings shall not be less than those specified in <u>Table 24.2</u> when such connectors, eyelets, or similar devices are in a position that minimum spacings to opposite polarity and dead metal exist.

24.12 An insulated liner or barrier of vulcanized fiber or similar material used as an alternative to spacings shall be 1/32 in (0.8 mm) thick or greater and shall be located or constructed of material that is not adversely affected by arcing.

Exception: Using fiber not less than 1/64 in (0.4 mm) thick in conjunction with an air spacing of not less than 50 percent of the spacing required for air alone complies with the requirement.

25 Grounding

25.1 Exposed dead metal parts that can become energized, and dead metal parts inside the enclosure of a disposer that are exposed to contact during any servicing operation, including maintenance and repair, and that can become energized shall be reliably connected to:

a) A knockout or equivalent opening in the metal enclosure of a disposer intended to be permanently connected by a metal-enclosed wiring system.

b) An equipment grounding terminal or lead in a disposer intended to be permanently connected by a nonmetal-enclosed wiring system, for example, nonmetallic-sheathed cable.

c) The equipment-grounding conductor of the power-supply cord of a cord-connected disposer.

Exception: A portable cord-connected disposer intended to be used on a circuit operating at 150 V to ground or less and that is provided with a system of double insulation as an alternative to a grounding means, complies with the requirement.

25.2 Using double insulation for a 2-wire disposer marked 120/240 V or otherwise marked to indicate that the disposer is to be connected to a circuit operating at 150 V or less to ground complies.

25.3 A disposer provided with a system of double insulation shall not be provided with a means for grounding.

25.4 A grounding conductor of a flexible cord shall:

a) Be provided with an outer surface that is green with or without one or more yellow stripes;

b) Be connected to the grounding blade of an attachment plug of the grounding type; and

c) Be connected to the enclosure of the disposer.

This connection shall be made by means of a screw. The screw shall not require removal during servicing not involving the power-supply cord. Solder alone shall not be used for making this connection. A sheet-metal screw shall not be used to secure a grounding conductor to the enclosure.

25.5 If a disposer is intended to be grounded and is provided with means for separate connection to more than one power supply, each such connection shall be provided with a means for grounding.

26 Arc-Fault, and Leakage Current Detectors/Interrupters

26.1 When required by this end-product standard, or when provided as part of an end-product, an AFCI or LCDI shall comply with 5.9 and 26.2 - 26.3.

26.2 An arc-fault circuit-interrupter (AFCI) or leakage-current detector-interrupter (LCDI) shall be installed as an integral part of the attachment plug or located in the supply cord within 102 mm (4 inches) of the attachment plug.

26.3 Arc fault detection testing shall include the applicable tests in the Standard for Arc-Fault Circuit-Interrupters, UL 1699 required for cord-type arc-fault circuit-interrupters.

Exception: The carbonized path arc clearing time test is not applicable for LCDIs that are provided with shielded power-supply cords.

27 Plumbing Requirements

27.1 A household disposer shall comply with the Performance Requirements for Plumbing Aspects of Residential Food Waste Disposer Units, ASSE 1008.

PROTECTION AGAINST RISK OF INJURY TO PERSONS

28 General

28.1 If the operation of a disposer involves a risk of injury to persons, protection shall be provided to reduce such risk.

29 Sharp Edges

29.1 A part of a disposer such as an enclosure, opening, frame, guard, knob, or handle, shall not be so sharp as to result in a risk of injury to persons during routine maintenance or intended use.

Exception: This requirement does not apply to parts that require a sharp edge to be exposed so that the disposer performs as intended.

30 Automatic Restarting

30.1 If an automatic-reset protective device is used in a disposer, restarting the motor shall not result in a risk of injury to persons.

30.2 Compliance with <u>30.1</u> requires the use of an interlock in the disposer if moving or similar parts result in a risk of injury to persons upon restarting the motor.

31 Moving Parts

31.1 A moving part of a disposer such as a pulley, belt, gear, or rotor of a motor shall be enclosed or guarded to reduce the risk of injury to persons. See <u>28.1</u>.

31.2 The degree of protection required to be provided by the enclosure depends upon the general design and intended use of the disposer. The effects of the following factors shall be assessed to determine compliance of an exposed moving part with 31.1:

- a) The degree of exposure;
- b) The sharpness of the moving parts;
- c) The risk of unintentional contact with the moving parts;
- d) The speed of movement of those parts; and

e) The risk of fingers, arms, or clothing being drawn into the moving parts, such as at points where gears mesh, where belts travel onto a pulley, or where moving parts close in a pining or shearing action.

32 Guards and Interlocks

32.1 The details of a guard, release, interlock, and the like are not specified, but the necessity for such accessories and their acceptability, if provided, are to be determined from a study of the complete appliance, its operating characteristics, and the likelihood of injury to persons resulting from other than gross negligence.

32.2 An interlock shall not be defeated by materials, such as food, that accumulate during intended use. An interlock shall comply with Interlock Switch Tests, Section 34.

32.3 A disposer shall comply with one or more of the following:

a) The opening in the sink flange shall not allow entry of a 2-1/2 in (63.5 mm) diameter cylinder.

b) The sink flange shall be offset so that a 2-1/2 in diameter cylinder, inserted to a depth of 5 in (127.0 mm) or less, does not touch cutting or moving parts.

c) The opening in the sink flange shall have a diameter of 3-5/8 in (92.1 mm) or less, and a truncated cone as illustrated in Figure 32.1, when inserted small end first to a depth of 4 in (102 mm) or less, does not touch cutting or moving parts.

d) If the diameter of the top opening of the sink flange is larger than 3-5/8 in, the distance from the plane of the opening to the nearest cutting or moving parts shall not be less than 1.5 times the largest diameter of the opening of the sink flange.

Exception No. 1: This requirement does not apply to a commercial disposer provided with a hopper that complies with <u>32.4</u>.

Exception No. 2: This requirement does not apply to a disposer equipped with a cover for the sink flange and with an interlock switch arranged so that removal of the cover de-energizes the motor.





32.4 With reference to <u>32.3</u>, Exception No. 1, an inverted truncated cone or pyramid with a depth as specified in items (a) and (b) is a hopper that complies with the requirement:

a) Not less than the maximum internal dimension of throat opening – the diameter if the opening is a circle, the major axis if the opening is an ellipse, and the longest diagonal if the opening is a polygon; and

b) Not less than 5 in (127.0 mm) in any case.

32.5 The hopper or cone of a commercial disposer that is provided in order to comply with 32.3 or 32.4 is not required to be shipped with the remainder of the unit:

a) If the disposer is provided with a means (such as an electrical or mechanical interlock) that reduces the risk of the disposer being energized or used when the hopper is not properly installed, see also 32.4; or

b) If the disposer and a hopper or a cone are marked in accordance with <u>63.23</u>, and the instruction manual includes the instructions specified in Instruction Manual – Commercial Disposers – General, Section <u>70</u>.

32.6 An interlock provided in accordance with 32.5(a) shall comply with the accessibility requirements specified in Interlock Switch Tests, Section 34.

32.7 If the disposer is adjustable for sink bottoms of different thickness, the depth measurements mentioned in 32.3(b), (c), and (d) are to be made with it adjusted for minimum thickness. The depth

measurements mentioned in (b) and (c) are to be made vertically from the plane of the opening in the top of the sink flange.

32.8 A household disposer shall be provided with a cover or baffle that reduces the risk of objects being expelled from the disposer.

PERFORMANCE

33 General

33.1 In tests on a disposer, maximum normal load is the load that approximates the most severe conditions of intended operation. The load shall not be a deliberate overload. However, a deliberate overload shall be used when the conditions of actual operation are determined to be more severe than the maximum-load conditions that are specified by the manufacturer of the disposer. Test loads that have been found to be close approximations of the most severe conditions of normal use are specified in $\underline{33.5} - \underline{33.6}$ for some common forms of disposers.

33.2 All tests are to be performed with the product connected to a power-supply circuit of rated frequency. The voltage of the supply circuit is to be:

a) For a product rated from 110 V up to and including 120 V, 120 V;

b) For a product rated from 200 V up to and including 208 V, 208 V;

c) For a product rated from 220 V up to and including 240 V, 240 V;

d) For a product rated from 440 V up to and including 480 V, 480 V; or

e) For a product rated other than as mentioned in (a) - (d), the maximum rated voltage of the product.

33.3 If the rating of a product is given in terms of a range of voltage, the maximum rated voltage is the highest value of the range.

33.4 If a disposer has a single frequency rating, the test is to be performed at that frequency. A disposer rated for both alternating and direct current is to be tested on both alternating current and direct current supply circuits. A disposer having a frequency rating of 25 - 60 Hz or 50 - 60 Hz is to be tested on 60-Hz alternating current.

33.5 For tests involving water, the water temperature is to be $18 - 24^{\circ}C$ ($65 - 75^{\circ}F$) unless otherwise noted.

33.6 The flow of water through a:

a) Household disposer is to be adjusted to a rate of 1 gal/min (3.78 L/min).

b) Commercial disposer is to be adjusted to the minimum rate required to flush ground waste material out of the disposer.

34 Interlock Switch Tests

34.1 A disposer equipped with a cover for the sink flange and with an interlock switch constructed so that removal of the cover de-energizes the motor shall be subjected to the test described in 34.2. During the test, the interlock switch shall not become actuated.

34.2 A 2-1/2 in (63.5 mm) diameter, nonmagnetic cylinder with a hemispherical tip is to be inserted at any angle into the throat of the disposer. The cylinder is to be pressed against the inner surface of the throat using the maximum force that can be exerted without damaging the disposer such that it does not operate as intended.

34.3 Unless known to be acceptable for 100,000 cycles of operation, an interlock switch used to reduce the risk of injury to persons from moving parts, and actuated during the use of the disposer or during disassembly for cleaning or maintenance shall not malfunction, electrically or mechanically, when subjected to 100,000 cycles of operation, and shall function as intended. Devices such as rods, shafts, levers, or springs, used to transmit force to the switch actuator shall also be subjected to 100,000 cycles of operation.

35 Leakage Current Test

35.1 When tested in accordance with 35.2 - 35.8, the leakage current of a cord-connected disposer rated 250 V or less shall not be greater than:

- a) 0.5 mA for a portable disposer; and
- b) 0.75 mA for a stationary or fixed disposer.

35.2 Leakage current refers to all currents, including capacitively coupled currents, that may be conveyed between exposed conductive surfaces of a disposer and ground or other exposed surfaces of the disposer.

35.3 Exposed conductive surfaces are to be tested for leakage currents. The leakage currents from these surfaces are to be measured to the grounded supply conductor individually as well as collectively if simultaneously accessible and from one surface to another if simultaneously accessible. Parts are to be considered to be exposed surfaces unless guarded by an enclosure considered acceptable to reduce the risk of electric shock as required by $\underline{7.3.1}$ and $\underline{7.3.7}$. Surfaces are considered to be simultaneously accessible if they can be readily contacted by one or both hands of a person at the same time. These measurements do not apply to terminals operating at voltages that are not considered to present a risk of electric shock.

35.4 If a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using metal foil with an area of 100 by 200 mm in contact with the surface. If the surface is less than 100 by 200 mm, the metal foil is to be the same size as the surface. The metal foil is not to remain in place long enough to affect the temperature of the disposer.

35.5 The measurement circuit for leakage current is to be as illustrated in Figure 35.1. The measurement instrument is defined in (a) – (c). The meter used to measure the current during the test is required to indicate the same numerical value for a particular measurement as the defined instrument. The test meter used is not required to have all the attributes of the specified instrument.

a) The meter is to have an input impedance of 1500 Ω resistive shunted by a capacitance of 0.15 mF.

b) The meter is to indicate 1.11 times the average of the full-wave rectified composite waveform of the voltage across the resistor or current through the resistor.

c) Over a frequency of 0 – 100 kHz, the measurement circuitry is to have a frequency response – ratio of indicated to actual value of current – that is equal to the ratio of the impedance of a 1500- Ω resistor shunted by a 0.15-mF capacitor to 1500 Ω . At an indication of 0.5 or 0.75 mA, the measurement is to have an error of not greater than 5 percent.

35.6 Unless the meter described in 35.5 is used to measure leakage from one part of a disposer to another, the meter is to be connected between accessible parts and the grounded supply conductor.

35.7 The leakage current is to be measured on a sample of the disposer that has not been previously energized other than as occurs as part of the production-line testing. The sample, including the water, is to be isolated from ground. The supply voltage is to be adjusted to the voltage specified in <u>33.2</u>. The test sequence with reference to the measuring circuit in <u>Figure 35.1</u> is to be as follows:

a) With switch S1 open, the disposer is to be connected to the measuring circuit. Leakage current is to be measured using both positions of switch S2, and with the disposer switching devices in all their normal operating positions.

b) Switch S1 is then to be closed energizing the disposer, and within 5 s the leakage current is to be measured using both positions of switch S2 and with the disposer switching devices in all their normal operating positions.

c) The leakage current is to be monitored until thermal stabilization. Both positions of switch S2 are to be used in determining this measurement. Thermal stabilization is to be obtained by operating the disposer as described in Temperature Test, Section <u>39</u>.

Figure 35.1

Leakage current measurement circuits



Product intended for connection to a 120-volt power supply, as illustrated above.



Product intended for connection to a 3-wire, grounded neutral power supply, as illustrated above.



Product intended for connection to a 3-wire, grounded neutral power supply, as illustrated above. LC300J

A – Probe with shielded lead.

B – Conductor separated and used as clip when measuring currents from one part of appliance to another.