29.2 If the component is made of nonmetallic material, the ball-impact test is to be performed on the sample or samples in the as-received condition. The test is then to be repeated on a different sample or samples that have been conditioned in an air oven for 7 hours at a uniform temperature not less than 10°C (18°F) higher than the maximum operating temperature of the material measured during the Temperature Test, Section 30, but not less than 70°C (158°F). The conditioned samples are to be tested after they have returned to room temperature.

29.3 Upon removal from the oven mentioned in 29.2 and before being subjected to the ball-impact test, no sample shall show checking, cracking, or other deleterious effects from the oven conditioning, nor shall any sample show distortion sufficient to impede the intended use of the lawn mower.

29.4 If the component is nonmetallic, a lawn mower that has an accessory that adapts the lawn mower for use at low temperatures, such as a lawn mower with a snow moving accessory, shall also be subjected to the ball-impact test immediately after being conditioned at minus 20°C (minus 4°F) for 7 hours.

29.5 Deformation of a guard during the ball-impact test is acceptable if:

a) Operation of the lawn mower or performance of the guard is not affected; or

b) The guard can be readily restored to its original shape.

29.6 A functional component, including a cutting tool or portion of the drive system, need not comply with the requirement for the ball-impact test if the lawn mower is not capable of its intended operation after the test.

30 Temperature Test

30.1 A lawn mower, when tested under the conditions described in 30.3 and 30.7, shall not attain a temperature at any point sufficiently high to constitute a risk of fire or to adversely affect any materials employed in the lawn mower, or to show a temperature rise greater than those specified in Table 30.2. An overcurrent protective device shall not open the circuit during the test.

30.2 During the temperature test, the temperature on a surface of a lawn mower that may be contacted by the user, other than a cutting or functional edge, shall not be more than the value specified in Table 30.1. If the test is conducted at a room temperature of other than 25° C (77° F), the results are to be corrected to that temperature.

Table 30.1
Maximum temperatures of surfaces exposed to user contact

Location	Metal		Nonmetallic	
	°C	(°F)	°C	(°F)
A handle or knob that is grasped for lifting, carrying, or holding	50	(122)	60	(140)
A handle or knob that is contacted but does not involve lifting, carrying, or holding; and other surfaces subject to contact in the intended use of the product	60	(140)	85	(185)

30.3 For the temperature test, a lawn mower is to be loaded by an eddy-current brake, dynamometer, or the like as follows:

a) A single-speed lawn mower with a universal motor is to be operated and loaded to rated current.

b) A lawn mower with an induction motor is to be operated at rated voltage and loaded to obtain rated current. The input wattage is to be measured. If the lawn mower is intended for use on a nominal 120-V or a 240-V supply, the load is to be increased until the initial wattage is obtained at 120 or 240 V.

c) A variable-speed lawn mower with a universal motor, and discrete speed setting, is to be operated while loaded to rated current at highest and lowest speed settings and may be operated at intermediate speed settings.

d) An infinitely variable-speed lawn mower with a universal motor, without feedback, is to be operated as follows:

1) At the maximum-speed setting, while loaded to rated current.

2) At the no-load speed setting equal to 25 percent of the no-load maximum speed and then loaded to obtain 25 percent of the maximum speed obtained with rated current.

e) An infinitely variable-speed lawn mower with feedback is to be operated as follows:

1) At the maximum-speed setting while loaded to obtain rated current.

2) At a no load speed setting equal to 25 percent of the maximum no load speed and then loaded to obtain rated current.

Exception: If a lawn mower with feedback employs circuits to limit the current at low speed, so that rated current cannot be obtained at 25 percent of no load speed, then the load is to be adjusted to result in the maximum current obtainable at 25 percent of the maximum no load speed.

30.4 With reference to feedback as mentioned in 30.3 (d) and (e), a lawn mower is considered to have feedback if the rated current is exceeded when making the adjustment described in 30.3 (d) and (e)(2).

30.5 All values for temperature rises in Table 30.2, are based on an assumed ambient temperature of 25°C (77°F). Tests are to be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F).

30.6 A 100-foot-long (30.5 m) cord set, as described in 33.2.2, is to be used when the temperature test is conducted.

30.7 For the test, the voltage of a direct-current power-supply circuit is to be 115 or 230 volts, and that of an alternating-current circuit is to be 120 or 240 volts, depending on whether the lawn mower has a nominal voltage rating of 115 or 230 volts. For a lawn mower voltage rating other than those just indicated, the voltage of the power-supply circuit is to equal the maximum rated voltage of the lawn mower. If the lawn mower has a single frequency rating, the test is to be conducted at that frequency. A lawn mower rated a-c – d-c, d-c – 60 hertz, or d-c – 25 hertz – 60 hertz is to be tested on direct current or 60-hertz alternating current, whichever results in higher temperatures. A lawn mower rated 25 – 60 hertz or 50 – 60 hertz is to be tested on 60-hertz alternating current.

30.8 To determine whether a lawn mower complies with the requirements of 30.1, it is to be connected to a voltage supply as described in 30.7, and operated continuously until constant temperatures have been reached.

30.9 Thermal equilibrium or constant temperature is considered to exist when three successive readings, taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5-minute intervals, indicate no change.

30.10 Temperatures are to be measured by thermocouples except when the resistance method is to be used as provided in 30.13. The thermocouples are to consist of wires not larger than 24 AWG (0.21 mm^2) and not smaller than 30 AWG (0.05 mm^2). The thermocouples and related instruments shall be accurate and calibrated in accordance with laboratory practice. The thermocouple wire is to conform to the requirements given in the Tolerances on Initial Values of EMF versus Temperature tables in ANSI/ASTM E230/E230M.

Table 30.2
Maximum acceptable temperature rises

Materials and component		Degrees	
		°C	(°F)
1.	Varnished-cloth insulation	60	(108)
2.	Fuses	65	(117)
3.	Fiber employed as electrical insulation	65	(117)
4.	Wood and other combustible material	65	(117)
5.	Phenolic composition employed as electrical insulation or as a part the deterioration of which results in a risk of fire, electric shock, or injury to persons.	125[a]	(225)[a]
6.	Rubber or thermoplastic-insulated wires and cords	34[a,b]	(63)[a,b]
7.	Capacitor		
	Electrolytic	40[c]	(72)[c]
	Other type	65[d]	(117)[d]
8.	Class 105 insulation systems on windings of a transformer		
	Thermocouple method[e]	65	(117)
	Resistance method[e]	75	(134)
9.	Class 105 insulation systems on windings of a relay, a solenoid, etc.		
	Thermocouple method[e]	65	(117)
	Resistance method[e]	85	(153)
10.	Class 130 insulation systems on windings of a relay, a solenoid, etc.		
	Thermocouple method[e]	85	(153)
11.	Class A insulation systems on coil windings of an a-c motor having a diameter of more than 7 inches (178 mm), of a d-c motor, and of a universal motor:[e,f]		
	A. In a open motor		
	Thermocouple method	65	(117)
	Resistance method	75	(134)
	B. In a totally enclosed motor		
	Thermocouple method	70	(126)
	Resistance method	80	(144)
12.	Class A insulation systems on coil windings of an a-c motor having a diameter of 7 inches or less (not including a universal motor) and on a vibrator coil:[e,f]		
	A. In an open motor and on a vibrator coil		
	Thermocouple or resistance method	75	(135)

Table 30.2 Continued on Next Page

Table 30.2 Continued

Materials and component	Degrees	
	°C	(°F)
B. In a totally enclosed motor		
Thermocouple or resistance method	80	(144)
13. Class B insulation systems on coil windings of an a-c motor having a frame diameter of more than 7 inches, of a d-c motor and of a universal motor:[e,f]		
A. In an open motor		
Thermocouple method	85	(153)
Resistance method	95	(171)
B. In a totally enclosed motor		
Thermocouple method	90	(162)
Resistance method	100	(180)
14. Class B insulation systems on coil windings of an a-c motor having a diameter of 7 inches or less (not including a universal motor) and on a vibrator coil:[e,f]		
A. In an open motor and on a vibrator coil		
Thermocouple or resistance method	95	(171)
B. In a totally enclosed motor		
Thermocouple or resistance method	100	(180)
15. Class E insulation systems on coil windings and core laminations		
Thermocouple method	80	(144)
Resistance method	90	(162)

[a] The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and found to have special heat-resistant properties.

[b] Rubber-insulated conductors within a Class-A-insulated flexible cord entering a motor and subjected to a temperature rise of more than 35°C (63°F), comply with the requirement when braid intended for the temperature is employed on the conductor of other than a flexible cord. However, this does not apply to thermoplastic-insulated wires or cords.

[c] For an electrolytic capacitor that is physically integral with or attached to a motor, a temperature rise on insulating material integral with the capacitor enclosure of more than 65°C (117°F) meets the intent of the requirement.

[d] For a capacitor that operates at a temperature rise of more than 65°C (117°F), its marked temperature limit is to be taken into consideration.

[e] See 30.13.

[f] See note (a) to Table 22.1.

30.11 A thermocouple junction and adjacent thermocouple lead wire are to be securely held in thermal contact with the surface being measured. In most cases, adequate thermal contact will result from securely taping or cementing the thermocouple in place; but if a metal surface is involved, brazing or soldering the thermocouple to the metal may be necessary.

30.12 Whenever referee temperature measurements are necessary in connection with the heating of electrical equipment, thermocouples consisting of 30 AWG (0.05 mm^2) iron and constantan wires and a temperature indicating instrument are to be used.

30.13 The temperature of a coil or winding is to be measured by means of thermocouples mounted on the outside of the coil wrap. When the coil is inaccessible for mounting thermocouples – for instance, when the coil is immersed in sealing compound or when the coil wrap includes thermal insulation such as asbestos, or more than 1/32 inch (0.8 mm) of cotton, paper, rayon, or similar insulation – the resistance

method is to be used. For the thermocouple-measured temperature of a coil of an alternating-current motor other than a universal motor having a frame diameter of 7 inches (178 mm) or less, see entries 12 and 14 in Table 30.2, the thermocouple is to be mounted on the integrally applied insulation of the conductor.

30.14 When using the resistance method, the windings are to be at room temperature at the start of the test. The temperature rise of a winding is to be calculated from the formula:

$$t = \frac{R_2}{R_1} \times (K + t_1) - (K + t_2)$$

in which:

t is temperature rise in °C;

R_2 is resistance of the coil at the end of the test in ohms;

R_1 is resistance of the coil at the beginning of the test in ohms;

t_1 is room temperature at the beginning of the test in °C;

t_2 is room temperature at the end of the test in °C; and

k is 234.5 for copper, 225.0 for electrical conductor grade (EC) aluminum. Values of the constant (k) for other grades must be determined.

31 Dielectric Voltage-Withstand Test

31.1 A lawn mower shall withstand without breakdown for 1 minute the application of a 60-hertz essentially sinusoidal potential of 1000 volts plus twice rated voltage, other than as specified in 31.2, between live parts and dead metal parts, with the lawn mower at the temperature reached during the temperature test.

31.2 For a lawn mower employing an induction motor rated less than 1/2 horsepower (373 W output) and 250 volts or less, the test potential for the motor – but not for the remainder of the lawn mower – is to be 1000 volts.

31.3 In applying 31.2, to a motor not rated in horsepower, use is to be made of the appropriate table of ANSI/NFPA 70, which specifies the relationships between horsepower and full-load currents for motors. For a universal motor, the table applying to a single-phase, alternating-current motor is to be used when the lawn mower is marked for use on alternating current only; otherwise, the table applying to direct-current motors is to be used.

31.4 To determine whether a lawn mower complies with the requirements in 31.1, the lawn mower is to be tested by means of a suitable 500-volt-ampere or larger capacity transformer the output voltage of which is essentially sinusoidal and can be varied. The applied potential is to be increased from zero until the required test level is reached, and is to be held at that level for 1 minute. The increase in the applied potential is to be at a substantially uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter.

32 Resistance to Moisture Tests

32.1 High humidity

32.1.1 A lawn mower employing insulating material likely to be adversely affected by moisture under conditions of normal use shall be conditioned for 24 hours in moist air having a relative humidity of 85 ±5 percent at a temperature of 32 ±2°C (90 ±4°F). After the conditioning:

a) A lawn mower rated for a nominal 120-volt supply shall comply with the requirements in 25.1, in a repeated leakage current test. The test is to be discontinued when leakage current stabilizes.

b) A lawn mower other than that specified in (a) shall have an insulation resistance of not less than 50,000 ohms between live parts and interconnected dead metal parts.

c) Other than as noted in 32.1.2, a lawn mower shall be subjected to a dielectric voltage-withstand test as described in 31.1, with the lawn mower still in the humidity chamber or room, at the specified humidity and temperature.

32.1.2 If it is necessary to remove the lawn mower from the chamber or room for the test in 32.1.1(c), it is to be tested within 1 minute after removal.

32.2 Water spray

32.2.1 After exposure to water spray as described in 32.2.2 and 32.2.3, a lawn mower:

a) Rated for a nominal 120 volt supply shall comply with the requirement in 25.1, in a repeated leakage-current test, except that the test shall be discontinued when leakage current stabilizes.

b) Of a type other than that specified in (a) shall have an insulation resistance not less than 50,000 ohms between live parts and interconnected dead metal parts.

c) Shall withstand without breakdown for 1 minute the application of a 60-hertz essentially sinusoidal potential between live parts and exposed dead metal parts with the lawn mower at the temperature reached during the temperature test. The dielectric test potential shall be:

1) In accordance with 31.1, for a grounded lawn mower.

2) Twenty-five hundred volts for a double-insulated lawn mower rated a nominal 120 volts.

3) Thirty-five hundred volts plus twice the rated voltage of the lawn mower for a double-insulated lawn mower other than as specified in (c)(2).

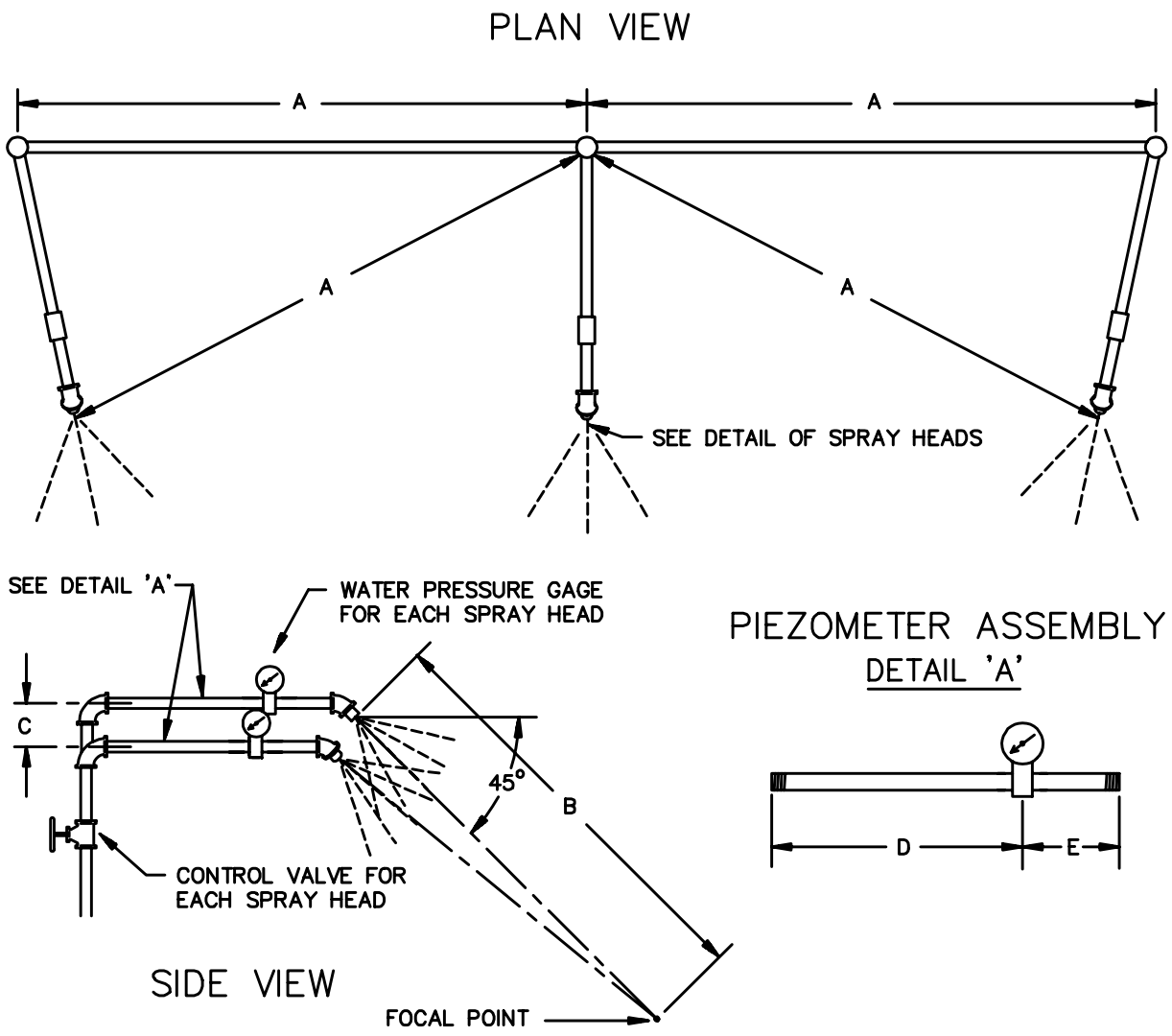
32.2.2 A lawn mower, supported in a normal operating position, is to be subjected for 1 hour to a downward spray of water onto the top and sides, applied to the lawn mower at an angle of 45 degrees to the vertical, and in the direction or directions most likely to cause water to enter. The lawn mower is not to be operating when being subjected to this exposure, but is to be operated for 5 seconds after the spray is removed before being subjected to the tests in 32.2.1.

32.2.3 The water spray test apparatus is to consist of three spray heads mounted in a spray head pipe rack as shown in Figure 32.1. Spray heads are to be constructed in accordance with Figure 32.2. The water pressure for all tests is to be maintained at 5 pounds psi (34.5 kPa) at each spray head. The distance between the center nozzle and the lawn mower is to be approximately 5 feet (1.52 m). The spray is to be directed at an angle of 45 degrees to the vertical toward the louvers or other openings nearest current-carrying parts.

32.2.4 Before the test is started, the resistivity of the water is to be 3500 ohm-centimeters ±5 percent when measured at 25°C (77°F). At the conclusion of the test, the resistivity of the water shall not be less than 3200 ohm-centimeters nor more than 3800 ohm-centimeters when measured at 25°C (77°F).

Figure 32.1

Rain test spray head pipe rack

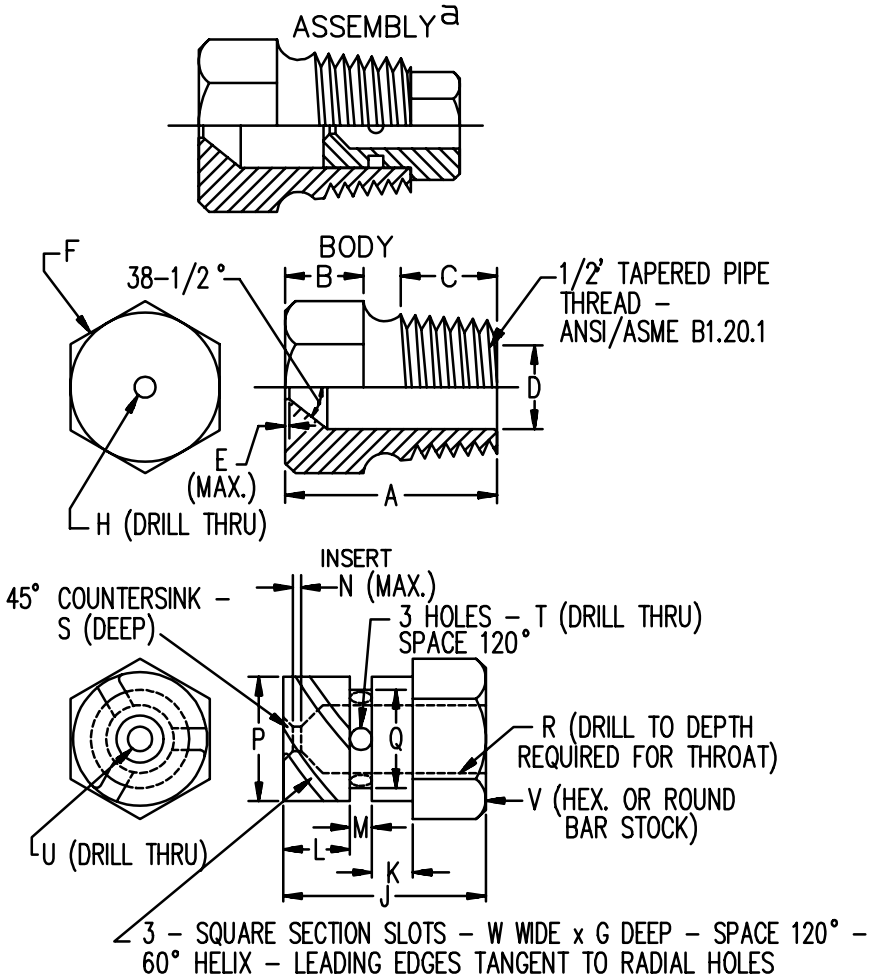


Item	inch	mm
A	28	710
B	55	1400
C	2–1/4	55
D	9	230
E	3	75

RT101E

Figure 32.2

Rain test spray head assembly



Item	inch	mm	Item	inch	mm
A	1–7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0		.576	14.63
D	.578	14.68	Q	.453	11.51
	.580	14.73		.454	11.53
E	1/64	0.40	R	1/4	6.35
F	c	c	S	1/32	0.80
G	.06	1.52	T	(No. 35) [b]	2.80
H	(No.9) [b]	5.0	U	(No. 40) [b]	2.50
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

[a] Nylon Rain–Test Spray Heads are available from Underwriters Laboratories

[b] ANSI B94.11M Drill Size

[c] Optional – To serve as a wrench grip.

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33 Operation Tests

33.1 Blade stopping time after long term cycling

33.1.1 After 6000 cycles of operation, rotation of the blades shall cease within 5 seconds after the power is shut off. Mechanical means for braking the rotation shall show no evidence of malfunction.

33.1.2 To determine whether a mower complies with the requirements in 33.1.1, one sample is to be tested. Each cycle is to consist of 45 seconds on at maximum operating speed and 15 seconds off.

33.2 Peripheral speed

33.2.1 With the mower at maximum operating speed, the peripheral speed of any blade shall not exceed 19,000 feet (5791 m) per minute.

33.2.2 With reference to the requirement in 33.2.1, a 100-foot-long (30.5 m) cord set is to be used when the starting current is measured. If the manufacturer supplies a 100-foot cord set, that cord set is to be used. If a cord set of the required length is not supplied by the manufacturer, the following is to be used:

a) A 100-foot-long cord set having 16 AWG (1.3 mm^2) conductors if a 15 ampere attachment plug is provided on the lawn mower; or

b) A 100-foot-long cord set having 10 AWG (5.3 mm^2) conductors if a 20 ampere attachment plug is provided on the lawn mower.

33.3 Direction

33.3.1 The only direction of powered travel for a self-propelled mower shall be in the direction away from the handle.

33.3.2 Unless the direction of travel is governed by the position of the handle, a swing-over handle shall not be provided on a self-propelled mower.

33.4 Operation indicator

33.4.1 If the operation of a mower is so quiet that rotation of the blade or blades is not evident to the operator, an audible or visible indicator of blade rotation shall be provided on the mower.

33.5 Sound level

33.5.1 The sound level from a lawn mower shall not exceed 92 decibels on the "A" scale (dBA) with the microphone located 10 inches (254 mm) to the right and left of the position assumed by the operator when operating the product and 66 inches (1.68 m) above the ground.

33.5.2 Measurements of sound level are to be made with instrumentation conforming with IEC 61672-1 and IEC 61672-2.

33.5.3 The sound level test procedure is to be performed in accordance with the following:

a) An operator is to be at the lawn mower control when readings are taken;

b) The microphone is to be mounted independent of the equipment and operator; and

c) The sound-level meter is to be set on slow response (see 33.5.2).

33.5.4 The test site is to be a flat open space free from any large reflecting surfaces, such as sign boards, buildings, or hillsides located within 100 feet (30.5 m) of the equipment being tested. The surface of the test area is to be grass, approximately 2 inches (51 mm) high. Equivalent laboratory conditions may be used.

33.5.5 The following operating conditions are to be established for the sound level test:

a) Ambient sound level, including wind, is to be at least 10 decibels below that of the equipment being tested;

b) Cutting height of the mower is to be adjusted for 2 inches (51 mm); and

c) The mower is to be operated at maximum speed in revolutions per minute in all modes of operation, but in a stationary position. Self-propelled lawn mowers may be blocked in position with clearance provided for the drive wheels.

34 Abnormal Operation Test

34.1 If a lawn mower employs a semiconductor or one or more semiconductor junctions, a capacitor, or a combination of both, no risk of fire, electric shock, or injury to persons shall result when either any semiconductor junction or capacitor is short or open-circuited.

34.2 To determine whether a lawn mower complies with the requirements in 34.1, the lawn mower is to be connected to a grounded supply of rated frequency and maximum rated voltage and is to operate at no load with the short- or open-circuited condition introduced. Only one abnormal condition is to be simulated at a time.

34.3 If the lawn mower is provided with a momentary-contact switch having no provision for being locked on and if there is indication of malfunction of the lawn mower, such as emission of smoke, inability of the lawn mower to operate in the normal manner, or other indication, the test is to be discontinued when the malfunction becomes evident. Otherwise, the test is to be continued until ultimate results occur. Exposed dead metal parts of the lawn mower are to be connected to ground through a 3-ampere fuse. The results are unacceptable if the fuse opens during the test.

34.4 During the tests described in 34.2, the lawn mower is to be connected in series with a nontime-delay fuse of the maximum current rating that can be accommodated by the fuseholder of the branch circuit to which the lawn mower could be properly connected. Opening of the fuse before a risk of fire, electric shock, or injury to persons results is an acceptable conclusion of a test.

35 Handle Durability Test

35.1 If the insulating material used for handles, as specified in 6.4.1, overlies dead metal:

a) The material shall not show holes, cracks, distortion, or other evidence of unacceptable deterioration after being conditioned as described in 35.2; and

b) The material shall not break, crack, rupture, or show other adverse effects after the lawn mower has been subjected to the impacts described in 35.3. The impact test is to be conducted on the samples that have been conditioned as described in 35.2.

35.2 The conditioning specified in 35.1, is to consist of keeping the lawn mower for 7 hours in an air-circulating oven at a temperature that is 10°C (18°F) more than the temperature attained by the handle under conditions of normal operation, but at not less than 70°C (158°F).