Examination Standard for Electrostatic Finishing Equipment

Class Number 7260

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Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety, and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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Notice: The Asterisk (*) following the subsection number signifies that explanatory material on that paragraph appears in the Appendix.

1 INTRODUCTION

1.1 Purpose

This standard states testing and certification requirements for electrostatic finishing equipment.

1.2 Scope

1.2.1 * This standard contains the basic requirements for the construction and testing of electrostatic finishing equipment. This standard does not include powder applicators that function using the principles of triboelectric charging of the powder particles.

1.2.2 The requirements of this standard apply to the following equipment types whereby the spray material originates from applicators of the automatic (reciprocator or robot) and manual (hand-held) type. This equipment is used for the application of ignitable liquid-based spray material or dry powders using grounded spray material supply systems, or waterborne systems.

1.2.3 Electrostatic finishing equipment for use with waterborne spray materials using ungrounded spray material columns is also addressed by this standard. However, any reference to spark ignition testing is not applicable for these types of systems, as waterborne spray material is not considered to be an ignition hazard. Waterborne systems covered by this standard are examined for affording protection against electric shock, fire and injury where the spraying area is not a hazardous (classified) location. See definitions. Where it cannot be confirmed that the waterborne spray material is non-ignitable, it should be treated as an ignitable liquid-based spray material and the waterborne manual applicator shall be tested as “Nonincendive” to Section 4, and the waterborne automatic applicator as “Incendive” to Section 5 or “Nonincendive" to Section 4.

1.2.4 This standard anticipates the submittal of electrostatic finishing equipment for use in an ambient temperature range of 0°C to 40°C (32°F to 104°F). Systems with operating parameters outside this temperature range will be the subject of special investigation.

1.3 Applicability of Other Standards

1.3.1 Except where modified by the requirements of this standard, electrostatic finishing equipment shall comply with the applicable requirements for ordinary locations, in accordance with FM Approvals Examination Standard 3810 - Electrical and Electronic Test, Measuring and Process Control Equipment.

1.3.2 Associated apparatus and circuits shall conform to the requirements for the location in which they are installed.

1.4 Basis for Certification

Certification is contingent upon satisfactory results of analysis of the product (compliance with this standard) and the manufacture of the product in the following major areas:

1.4.1 Products for which an examination standard for product performance exists, shall also be examined in accordance with that examination standard. These standards typically include requirements for the following:

- the suitability of the product;
- the proper operation and performance of the product as specified by the manufacturer and required by the certification agency and, as far as practical;

- the durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures shall be made to evaluate the manufacturer's ability to produce the product which is identical to that which was examined and tested, and the marking procedures used to identify the product. These examinations are repeated as part of the certification agency's product follow-up program.

1.5 Basis for Continued Certification

Continued certification is based upon:

- production or availability of the product as currently certified;
- the continued use of acceptable quality control procedures;
- satisfactory field experience;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agencies product surveillance program.

1.6 Basis for Requirements

1.6.1 The requirements of this standard are based on experience, research, testing and the standards of other national and international organizations. The advice of manufacturers, users, trade associations and loss control specialists were also considered.

1.6.2 The requirements of this standard reflect tests and practices used to examine characteristics of electrical equipment for the purpose of obtaining certification. These requirements are intended primarily as guides, and strict conformity is not always mandatory. Electrical equipment having characteristics not anticipated by this standard may be certified if performance equal or superior to that required by this standard is demonstrated, or if the intent of the standard is met. Alternatively, equipment which does meet all the requirements identified in this standard may not be certified if other conditions which adversely affect performance exist or if the intent of this standard is not met.

1.6.3 The construction, tests, and markings required by this standard are equivalent and consistent with the intent of ANSI/NFPA 33, "Standard for Spray Application Using Flammable or Combustible Materials."

1.7 Effective Date

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

1.8 System of Units

Units of Measurement are U.S. Customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversions are in accordance with ANSI/IEEE/ASTM SI-10. Where units of measurement are expressed only in SI units, no US customary units are provided.

1.9 Terms and Definitions

The following definitions, specific to electrostatic paint and powder spray applicator and associated apparatus, are applicable to this standard:

Electrical Equipment — All items applied as a whole or in part for the utilization of electrical energy. These include, among others, items for the generation, transmission, storage, measurement, regulation, conversion, and consumption of electrical energy and items for telecommunications.

Maximum Surface Temperature — The highest temperature which is attained in service under the most unfavorable conditions (but within tolerances) by any surface of the electrical equipment.

Note: The most unfavorable conditions include recognized overloads and fault conditions specified in the standard for the type of protection concerned.

Rating — The designed performance of the electrical equipment.

Electrostatic Finishing Equipment — Equipment for producing, charging, and depositing suspended particles with the assistance of electric fields. In general, the equipment may consist of, but is not restricted to, the following items: spray applicator, the high voltage generator and connecting cable.

Automatic Spray Applicator: Spray applicator which is designed to be attached to a mechanical support or manipulator, including robotic devices, and from which the electrostatically charged spray material emerges.

Handheld Spray Applicator: spray applicator which is designed to be held and operated by the hand and from which the electrostatically charged spray material emerges.

High Voltage Electrode: a part of the spray applicator which is at high voltage for the purpose of charging the spray material.

High Voltage Generator: the part of the equipment for producing the high voltage and the current required.

Note: The high voltage generator may, in certain cases, be incorporated in the spray applicator.

Connecting Cables: all electrical cables to the spray applicator, including any high voltage and/or low voltage control cable.

Ignitable Liquid based Spray Material – An ignitable liquid applied by means of electrostatic finishing equipment. The liquid can support combustion. Other terms that maybe used to describe these liquids are: flammable liquid, combustible liquid or solvent based.

Water-based or Waterborne Spray Material — For the purpose of this standard, this is a non-ignitable liquid material applied by means of electrostatic finishing equipment. The liquid does not support combustion.

Spray Material Supply — the equipment which supplies the spray material at rated pressure to the spray applicator.

Pressure — This standard considers low pressure systems to be those operating at less than 1000 psi, and systems operating at or above 1000 psi to be high pressure systems. This is consistent with the requirements of the Occupational, Safety and Health Administration (OSHA) Safety and Health Standard 29 CFR 1926.

UMAX — the maximum rated voltage of the high voltage generator.

Spark — For the purposes of Section 5 of this standard, is defined as release of electric energy that would result in ignition of the respective paint or powder, test gas mixture if tested in accordance with 4.1.

Rotary Atomizer — An automatic paint or powder applicator operating at rated system electrostatic voltage which employs a device, typically a bearing turbine, which rotates at high speed to which a bell or disk is attached for the purpose of applying paint or powder to the work piece.

Bell — A conductive or non-conductive bell-shaped device which is the rotating operating element of the rotary atomizer which atomizes, or assists, in the atomization of the paint or powder.

Disk — A conductive or non-conductive flat circular device which is the rotating operating element of the rotary atomizer which atomizes, or assists, in the atomization of the paint or powder.

Bearing Turbine — A device designed to operate at high speeds which is typically air driven to which the rotating bell or disk is attached.

Nonincendive — Electrical equipment and associated wiring that are incapable, under normal operating conditions, of releasing sufficient electrical or thermal energy to cause ignition of specific hazardous materials in their most easily ignited concentrations in air.

1.10 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies.

ANSI/IEEE/ASTM SI-10, American National Standard for Metric Practice

ANSI/NFPA 33, Standard for Spray Application Using Flammable and Combustible Materials.

FM Approvals Examination Standard 3611, Nonincendive Electrical Equipment for Use in Class I and II, Division 2, and Class III, Divisions 1 and 2, Hazardous (Classified) Locations

FM Approvals Examination Standard 3810, Electrical and Electronic Test, Measuring and Process Control Equipment.

2 GENERAL REQUIREMENTS

2.1 Marking

Electrostatic finishing equipment shall be marked with the following information. Practical consideration shall be given to alternate locations for the markings when insufficient space is available on any particular piece of equipment.

2.1.1 Each piece of equipment comprising the electrostatic finishing equipment shall be marked with the following:

- the name of the manufacturer or registered trademark;
- the manufacturer's product identification, which shall be unique in order to ensure the proper safe use of interconnected combinations of apparatus;
- the certification agency's mark of conformity (applied to each piece, e.g., applicator, power unit); and
- where the high voltage generator is a separate unit having appropriate space, it shall bear marking identifying all apparatus comprising the Electrostatic Finishing Equipment. When labeled in this manner each item of electrostatic finishing equipment need not bear the agency's mark of conformity.

2.1.2 Product ratings, electrical and mechanical.

2.1.3 The maximum operating temperature, or temperature range (Temperature Identification Code) referenced to a 40°C (104°F) ambient according to the following table. Equipment which is certified for Class I and Class II shall be marked with the maximum operating temperature, as determined by simultaneous exposure to the combinations of Class I and Class II conditions (i.e., dust-blanketing).

EXCEPTIONS

No. 1: Equipment of the non-heat-producing type, such as junction boxes, conduit, and fittings and equipment of the heat producing type having a maximum temperature not more than 100°C (212°F) shall not be required to have a marked operating temperature or temperature range (temperature identification code).

No. 2: Equipment for use in Class II locations subject to over- loading shall not exceed 150°C (302°F) in normal operation and shall not exceed the ignition temperature of the specific rated dust or 200°C (392°F), whichever is lower, when installed in locations that are classified due to carbonaceous dusts.

Table 1. Temperature Marking Code

Max Temperature *°C* *°F*	*Identification Number code*	*Max Temperature* *°C* *°F*	*Identification Number Code*
450 (842)	T1	180 (356)	T3A
300 (572)	T2	165 (329)	T3B
280 (536)	T2A	160 (320)	T3C
260 (500)	T2B	135 (275)	T4
230 (446)	T2C	120 (248)	T4A
215 (419)	T2C	100 (212)	T5
200 (392)	T3	85 (185)	T6

Compliance shall be verified by measurement based on the highest temperature which may be attained in service under the most adverse conditions (but within rated values) by any part or surface of the equipment. The most adverse conditions include overloads and fault conditions recognized in the specific standard for the Type of Protection concerned.

2.1.4 * The following statements, as applicable, shall appear adjacent to the certification agency's mark of conformity:

a) "For Electrostatic Finishing Applications using Class I, Group D, Spray Material." This statement may be abbreviated to read: "For Electro. Fin. Appl. CL. I, GP. D, Spray Matl."

b) "For Electrostatic Finishing Applications using Class II, Spray Material." This statement may be abbreviated to read: "For Electro. Fin. Appl. CL. II, Spray Matl."

c) "For Waterborne Electrostatic Finishing Applications." This statement may be abbreviated to read: "For Waterborne Electro. Finish. Appl."

d) For automatic applicators the optional additional marking of "Type N-I" or "Type I" depending on whether tested to Section 4 as "Nonincendive" or Section 5 as "Incendive". (Refer to Section 2.2 for mandatory marking of "Incendive" or "Nonincendive"

e) Any associated equipment for use within a hazardous (classified) location (i.e., a powder applicator controller) shall be appropriately examined, tested and marked for the hazardous location in which it will be used.

2.2 Instruction Manual and Other Marking

The electrostatic finishing equipment shall be supplied with an instruction manual. In addition to the marking information above, the instruction manual shall contain the following:

- all technical specifications of the electrostatic finishing equipment, i.e., rated output voltage of the high voltage generator, rated output current of the high voltage generator, conductivity of the spraying material (solvent based) to be used, fluid pressure, air pressure, etc. Reference to whether applicator tested as "Incendive" or Nonincendive"

- A sign shall be made available that must be conspicuously posted stating the safe distance which is defined as twice the spark distance. Refer to Paragraph 5.3.1. This does not apply to equipment meeting the requirements of Section 4.

2.3 Required Documentation

For the purposes of (1) assessing compliance of equipment with certification requirements, (2) determining what test samples will be required for the test and examination program, and (3) providing a means for design modification control, the manufacturer shall submit documents which give a full and correct specification of the critical construction aspects of the equipment. One copy (except as noted) of the following documentation as it pertains to the certification request should be assembled in an organized manner. All documents shall

identify the following: the manufacturer's name, document number or other form of reference identification, title, and date of latest revision and/or the revision reference (i.e., number or letter indicating revision level).

Note 1: Test programs will be scheduled only upon receipt of all the material listed herein.

Note 2: Drawings in a language other than English may require partial translation for use in a certification program.

- Marketing/Ordering Literature showing general specifications and functions of the equipment. These are useful in determining project costs and may also be used as attachments to the final report for equipment certification projects.

- Product Identification Breakdown document specifying a unique product identification scheme. Generally, this will consist of a model or catalog number system. However, other product identification systems may be acceptable provided the items are uniquely identifiable.

- Instruction Manual(s) providing installation, operation, and maintenance instructions.

- Quality Control Procedures document(s) detailing routine testing and final inspection procedures.

- Production Drawings

  — Electrical Schematic(s).

  — Final Assembly drawing and parts lists.

  — Subassembly drawings or piece-part drawings as necessary to detail primary circuit components, operator controls, enclosure design, and safety interlocks.

  — Other hardware such as hoses, cable, special tools, and the like.

  — Product label drawing(s) showing all required marking information. The label drawing should show proposed artwork indicating the manufacturer's name, location, model and serial numbers (or other means of traceability), equipment ratings, warning markings, and the certification agency's mark of conformity.

  — Protective Grounding Detail drawing(s) showing the method of protective grounding provided, including location, size, and marking.

- Documentation Control Specification showing proposed method of controlling documents which may be identified as Critical documents by the certification agency. These drawings will be identified by the certification agency at the conclusion of the certification program. The certification agency must be notified of changes to these documents.

3 PERFORMANCE AND CONSTRUCTION REQUIREMENTS

3.1 Spray Applicator

A handheld spray applicator shall have a conductive handle, compatible with its location and use, which is electrically connected to ground and constructed so that the operator, during the finishing process, will be in electrical contact with the grounded handle. There shall be an area of exposed conductive material on the handheld spray applicator not less than 3 in.^{2} (20 cm^2). This is to prevent an electrostatic charge build-up on the operator.

3.2 Metal and Conductive Parts

Metal or conductive parts of the spray applicator must be grounded or appropriately insulated so as not to be a source of spark ignition. Insulation characteristics of metal or conductive parts of the spray applicator shall be determined satisfactory by conducting the high voltage dielectric test, described in 4.4, and the spark ignition test described in 4.1.

Note 1: A method of connection between the metal or conductive parts of the spray applicator and the earth ground terminal in the power supply of the high voltage generator is via the conductive sheath of the connection cable referred to in 3.4.

Note 2: Spray applicators not utilizing high or low voltage cable connections for grounding may use other methods to connect the metal or conductive parts to earth ground. The method shall be capable of eliminating electric shock which would otherwise occur due to electrostatic charge build-up on the operator.

3.3 Parts Secured by Hand

Only handheld spray applicators, to be tested in accordance with Paragraph 4, shall be tested with and without items which are only secured by hand.

3.4 Connection Cable

The high voltage connection cable to the spray applicator may be constructed with or without a conductive sheath. The connection cable shall be constructed so that it shall be tool secured at both of its ends. The high voltage cable shall be capable of withstanding the respective high voltage dielectric test described in Paragraph 4.4.

A low voltage connection cable to the spray applicator employing an integral high voltage generator shall include a ground conductor but need not have a grounded conductive sheath. Connection cables shall be provided with an exterior cover or outer jacket to afford abrasion resistance. The low voltage cable shall be capable of withstanding the respective cable pull test described in Paragraph 4.7

3.5 * Spray Applicator Switches

A handheld spray applicator trigger switch, when released, shall switch off the high voltage supply and the spray material supply to the spray applicator within two seconds. Any switches, or other normally arcing or sparking (make or break) devices that are part of the spray applicator assembly shall meet either the requirements for a nonincendive component (i.e., hermetically sealed, or a sealed-component switch) as defined by FM Approvals Examination Standard 3611, or the requirements of FM Approvals Examination Standard 3611 as being nonincendive.

3.6 Examination

The electrostatic finishing equipment shall be examined for conformance to the manufacturer's drawings.

3.7 Adjustable Parts

Potentiometers and any part not operator-accessible, whose adjustment could increase the maximum tested high voltage output, shall not be accessible, except by use of a tool, and shall be set and sealed by the manufacturer.

3.8 Grounded Fluid Supply and Column

Electrostatic finishing systems examined in accordance with these requirements shall be constructed with conductive means for grounding the fluid column supply end, or powder feed apparatus supply end, to the spray applicator.

EXCEPTION

Waterborne systems. See Section 3.11.

3.9 Arc Carbonizing

Spray applicator parts which may be susceptible to carbonizing due to electrostatic arc tracking shall be subjected to preconditioning as specified in Paragraph 4.3 before being assembled to the spray applicator and subjected to the spark ignition tests described in Paragraph 4.1.

3.10 Handheld Spray Applicator Operating at High Pressure

A handheld spray applicator operating at pressures equal to or greater than 1,000 psi (6.89 MPa) shall be equipped with automatic or visible manual safety devices (i.e., trigger lock) which will prevent release of the spray material until the safety device is manually released. The safety device shall continue to function properly after each test has been conducted.

3.11 Waterborne Systems

A waterborne system operating with an electrostatically energized paint fluid supply must provide provisions to protect the operator, and others, from accessibility to electrically energized items which could cause electric shock.

3.11.1 The system shall be provided with a fluid supply hose(s) having either a grounded conductive sheath or protective insulation. Installation means or an exterior cover shall be provided to afford protection against abrasion.

3.11.2 The system when installed shall have a grounded water-based spray material supply. However, the fluid column supply end to an isolated waterborne applicator is not required to be grounded but must meet the test requirement of Section 4.4.5.

3.11.3 Provisions for access to the energized portions of the system shall be interlocked so as to de-energize and ground the high voltage generator output and electrostatically charged system during access. Additionally, if it is not visually evident, mechanical means shall be provided for the operator to manually discharge any items which would normally be energized.

4 PERFORMANCE TESTS AND EVALUATION OF HANDHELD OR AUTOMATIC ELECTROSTATIC FINISHING EQUIPMENT (NONINCENDIVE, TYPE N-I)

This section applies to handheld electrostatic equipment. Automatic electrostatic equipment may also be tested to these requirements if designed to be nonincendive (Type N-I), or at the request of the manufacturer. Automatic equipment not meant to be nonincendive shall meet the requirements of Chapter 5 as incendive systems "Type I". This section describes the tests and compliance requirements. Unless otherwise specified, all tests are conducted under prevailing laboratory conditions with respect to temperature, humidity, and atmospheric pressure. Tests stated in Sections 5.3.3 and 5.4 shall also be met.

WARNING

Attention is drawn to the fact that tests contained in this standard require precautions to ensure the safety of personnel carrying out such tests.

4.1 * Spark Ignition Apparatus and Test

The test apparatus consists of a test gas mixing station to obtain the specific concentration of test gas mixture at atmospheric pressure, and an ignition chamber of nonconductive material for the test gas mixture which is enclosed by a polyethylene membrane providing a volume in which to produce spark discharge from the spray applicator. Energy from the spray applicator is discharged during the test period using test probe constructed using a one-inch grounded stainless-steel ball on a handle. Spark discharge occurs from the energized spray applicator by manipulating the grounded test probe. The duration of the test shall be 10 minutes during which time the test gas mixture is passed continuously through the chamber.

Note: Automatic and handheld spray applicators shall have appropriate parts tested for arc carbonizing in accordance with Paragraph 4.3 before being subjected to spark ignition tests. Spray applicators are to be subjected to spark ignition tests both before and after being subjected to the impact test described by Paragraph 4.9. A handheld spray applicator is also to be subjected to spark ignition tests after being subjected to the drop test described by Paragraph 4.5.

Compliance is met if the test gas mixture does not ignite after testing, including all of the above conditions.

4.1.1 * Test Gas Mixtures

The following test gas mixtures are used for spark ignition testing the spray applicator.

Paint test gas (Class I) — A test gas mixture of propane and air with a concentration by volume of 5.25%

±0.25% propane shall be used. (Ignition Energy is 0.24mJ)

Powder test gas (Class II) — A test gas mixture of methane and air with a concentration by volume of 12.0% ±0.1% methane shall be used. (Ignition Energy is 2mJ).

Note: The purity of commercially available methane gas shall be not less than 99%. The purity of commercially available propane shall be not less than 95%.

4.1.2 Atomizing Air

During the spark ignition tests the spray applicator shall be energized without atomizing air flowing through the spray applicator nozzle. This ensures that the most incendiary sparks that the spray applicator is capable of producing take place in an explosive mixture not diluted by the atomizing air.

4.1.3 * Current Limiting Elements

Electrode current limiting elements (e.g., resistors), where used, shall be selected, at their low-end tolerance, to maximize the spark energy for the purposes of spark ignition testing each test sample. Also see Section 4.10.

4.1.4 * Spray Material Fluid

Class I spray applicators having the spray material in contact with electrostatically energized items internal to the applicator shall be spark ignition tested with and without a test fluid within the fluid passages of the grounded fluid supply system. The selected conductivity value of the test fluid shall be such that, when placed in the applicator, the corresponding measured electrode voltage shall be 100% of the rated electrode output voltage, or as close as practical while remaining within the applicator's rated fluid conductivity value. Emission of test fluid through the spray nozzle of the applicator shall not be allowed during the spark ignition test.

4.1.5 High Voltage Output

If the high voltage output is operator adjustable, the control shall be set to produce maximum output voltage. All active circuitry designed to limit the current to the electrode during normal operation shall be made inoperative, resulting in full continuous output of the supply. The spark ignition tests shall be conducted at rated mains supply voltage, ±10%, as necessary to produce maximum high voltage output.

Note: If the controller has a listed switching power supply, +/-10% of the mains supply voltage has no effect on the output of the electrode energy. Power supplies on those systems are exempt. This requirement is applicable to controllers with linear power supplies.

4.1.6 Hand Removable Items

Spark ignition testing of the spray applicator shall be conducted with the applicator fully assembled as well as with hand removable items removed. The hand removable items shall be removed one item at a time, and spark ignition tested, until all items have been removed.

4.1.7 Unsheathed High Voltage Cable

If the high voltage cable to the applicator is not provided with a conductive sheath, a length of cable at least 20 inches long (0.5 m) is put into the ignition chamber in the form of a loop. This is tested for spark ignition, using the test probe, in the same manner as for the spray applicator.

4.2 Material Compatibility

The product manual shall include a statement advising the end-user that it is the end-user's responsibility to ensure that product's materials of construction, and particularly fluid-wetted materials, are compatible with the use of the product and the solvents encountered during normal or maintenance operations. The manufacturer shall provide sufficient data to allow the end-user to reference appropriate documents to make the necessary determination. Alternatively, the applicator manufacturer shall provide the list of materials not compatible for use with the equipment and therefore not to be used.

Compliance is determined by inspection.

4.3 * Arc Carbonizing Test

Materials of construction for the spray applicator may become carbonized due to electrostatic voltage arcing through or across their surface. This carbonizing may contribute to energy released during subsequent electrostatic discharges. To determine the likelihood of carbonizing, the following test shall be conducted.

Spark discharging shall be generated from the spray applicator while energized by its high voltage generator at its maximum rated operating voltage and manually manipulating the grounded stainless-steel ball. The spray applicator under test shall be surface probed using a one-inch grounded stainless-steel ball. The arcs shall be drawn across any and all surfaces of the spray applicator. The test duration shall be 15 minutes with the spray applicator fully assembled and repeated for 15 minutes with each hand removable item removed. The grounded stainless-steel ball shall not be stationary in any one position for more than one minute during any 15-minute test duration. After being subjected to this test, the spray applicator shall be subjected to the spark ignition test described by Paragraph 4.1.

Compliance is determined by satisfactorily conducting the tests described by Paragraph 4.1.

4.4 High Voltage Dielectric Tests

Note: It is recommended that electrode and electrostatic electrical terminations be submerged in dielectric oil while conducting these tests, so as to minimize the effects of corona.

4.4.1 Spray Applicator

All parts of a manual spray applicator made of nonconductive materials, which are accessible during normal operation and precede the applicator's integral energy limiting device(s), shall be covered with conductive foil. The foil shall be connected to ground, together with the parts of the spray apparatus and its connecting cable that are grounded in normal use. The electrode and front section of the applicator shall be submerged in oil until the foil touches the oil. The high voltage parts of the spray applicator and its high voltage connecting cable shall be raised to a voltage equal to 1.5 U_{MAX}. In order to avoid the effects of impulses at the switching on of the equipment, the test voltage shall be increased uniformly from the minimum value up to the final value in 10 seconds and subsequently kept constant for one minute. Automatic applicators shall be tested in their normally grounded fixed mounting position without conductive foil. Refer to 4.4.2 where integral high voltage generators are employed in the applicators.

Compliance is met if there is no arc over or dielectric breakdown or repeated flash over within cavities, or externally, to the spray applicator which could cause an explosion of the Class I or II atmosphere, or which would otherwise reduce protection afforded by the equipment against electric shock, injury and fire. Corona and other similar phenomena are disregarded.

4.4.2 Integral High Voltage Generator

When the spray applicator employs an integral high voltage generator, it is permissible for test purposes to use a modified circuit which contains all conductive parts of the high voltage generator that normally operate at a voltage exceeding 0.5 U_{MAX}. The applied test voltage shall be 1.5 U_{MAX} and may be supplied from a separate generator. As an alternative, the low voltage input to the high voltage generator may be increased to raise the applicator output to 1.2 UMAX for 20 minutes. The test is otherwise conducted as described in 4.4.1.

4.4.3 High Voltage Cable with Conductive Sheath

A high voltage cable employing a conductive sheath shall be subjected to a dielectric test voltage equal to 1.5 U_{MAX}. The test shall be conducted by applying the test potential between conductive sheath and the center conductor of the cable for one minute. In order to avoid the effects of impulses at the

switching on of the equipment, the test voltage shall be increased uniformly from the minimum value up to the final value in 10 seconds and subsequently kept constant for one minute.

Compliance is met if there is no arc over or dielectric breakdown or repeated flash over. Corona and other similar phenomena are disregarded.

4.4.4 * High Voltage Cable Without Conductive Sheath

A high voltage cable not employing a conductive sheath shall be subjected to a dielectric test voltage equal to 2.0 U_{MAX} plus 1000 V. The test shall be conducted with an 8 ft (2.5 m) long cable sample. The cable sample shall be placed in a water bath containing ordinary tap water, except for 30 in. (75 cm) at each end. Both ends of the cable's center conductor are joined together. The test potential shall be placed between the center conductor of the cable and the water bath for one minute, the water bath being grounded.

Compliance is met if there is no arc over or dielectric breakdown or repeated flash over. Corona and other similar phenomena are disregarded.

4.4.5 Material Supply Hose

An energized material supply hose of a water-based system, or solvent based system if applicable, shall be subjected to a dielectric test voltage equal to 1.5 U_{MAX} with conductive sheath, or a dielectric test voltage of 2.0 U_{MAX} plus 1000 V without a conductive sheath. The test shall be conducted with an 8 ft (2.5 m) long hose sample. The hose sample shall be placed in a water bath containing ordinary tap water, except for 20 inches at each end. The hose shall be filled with ordinary tap water and the appropriate test voltage applied for one minute between the water inside the hose and the water bath.

Compliance is met if there is no arc over or dielectric breakdown or repeated flash over. Corona and other similar phenomena are disregarded.

4.5 Drop Test

A handheld spray applicator with attached high voltage cable and hoses shall be dropped 4 times from a 4 ft (1.3 m) height to a concrete stop. Test shall be conducted on 2 test samples. The attitude of the spray applicator shall be changed for each of the 4 drops. It is not a requirement that the spray applicator remain undamaged. However, after the four drops, repeat ignition tests on the sample shall not result in ignition of the test gas mixture. Also, as a result of the drop test, the spray applicator shall not become electrostatically energized so as to become a source of electric shock.

Compliance is determined by repeating the spark ignition test of Paragraph 4.1.

4.6 Pressure Test

4.6.1 Spray applicator parts required to be operated under pressure shall operate at least 5 times to close reliably against pressure up to 150% of maximum rated operating gauge pressure, as applicable, without visible leakage after 5 minutes. The initial application of test pressure shall be applied at a rate of no less than 100 psi/min (689 kPa/min).

4.6.2 The spray applicator, and associated equipment, subject to air or fluid pressure shall withstand a 5-minute application of 200% of its maximum rated operating gauge pressure without leakage or permanent damage to the assembly.

4.6.3 A handheld spray applicator operating at pressures greater than 1,000 psi (6.890 MPa) shall be equipped with an automatic or visible manual safety device (i.e., trigger lock) which will prevent release of the spray material until the safety device is manually released.

Compliance is checked by visual inspection and operation, as applicable.

4.7 Cable Pull Test

Each end assembly of the connection cable or electrically energized fluid hose, for use with the spray applicator, shall be subjected to a pulling force of 35 lbs., once at 180 degrees from its attachment for one minute, and once from another angle. Each of the cable end assemblies are to be tested separately. As a result of the tests, the connecting cable end assembly and strain relief shall exhibit: 1) no strain transmitted to the electrical connections, 2) no visible movement of the cable in its strain relief assembly, and 3) no cutting or tearing of the cable jacket.

Compliance is determined by test.

4.8 Temperature Test – Automatic Applicators

A test shall be conducted to establish the temperature classification of an automatic spray applicator in the event that its electrode becomes grounded. All active circuitry designed to limit or disable the current of the electrode during normal operation shall be made inoperative, resulting in full continuous output of the supply. The maximum temperature of the automatic spray applicator's external surface shall be measured in (or corrected to) a 40°C ambient with the electrode grounded. An appropriate temperature code marking shall be placed on the product as required by Paragraph 2.1.3.

Compliance is determined by conducting temperature tests until thermal equilibrium has been achieved. Thermal equilibrium shall be considered achieved when three successive readings taken at equal intervals of 5 minutes, or ten percent of the total test time elapsed previous to the start of the first interval, whichever is longer, indicating that there is no temperature change of the part.

4.9 * Impact Test

Impact tests shall be conducted on fully assembled automatic and handheld spray applicator types on any surface of the applicator that may be affected. The impact energy shall result from a test mass of 1 kg falling vertically from a height of 270 mm. The test mass shall be fitted with a steel hemisphere of 25 mm diameter. The spray applicator shall be resting in a stable position on a mass of 20 kg or greater. No location need be subjected to more than one impact. This test need not be conducted on the same handheld applicator sample which was subjected to the Drop Test described by Paragraph 4.5. Repeat ignition tests on the sample shall not result in ignition of the test gas mixture. Also, as a result of the impact test, the spray applicator shall not become electrostatically energized so as to become a source of electric shock.

Compliance is determined by performing the tests described in Paragraph 4.1.

4.10 * Current Limiting Elements

Any current limiting element of an automatic spray applicator shall be so mounted, insulated or otherwise protected that it is unlikely to be subject to a short circuit and shall be so rated that it is undamaged when a short circuit occurs between the high voltage electrode of the spray applicator and ground.

Compliance is determined by subjecting the current limiting element to the energy available when the high voltage electrode is continuously grounded for a period of one hour. There shall be no permanent change in the current limiting element specifications.

5 PERFORMANCE TESTS AND EVALUATION OF AUTOMATIC ELECTROSTATIC FINISHING EQUIPMENT (INCENDIVE SYSTEMS, TYPE I)

This section applies to a single automatic applicator, as well as each automatic spray applicator of a multiple automatic spray applicator system. Each applicator or applicator electrode is connected to a high voltage source for charging and precipitation of spray materials for coating on articles or for other similar purposes having the automatic spray applicator attached to a mechanical support or manipulator. This includes robotic automatic spray applicators. This section shall not apply to handheld spray applicators and automatic applicators meeting the requirements of Section 4, or waterborne applicators. Tests stated in Sections 4.2, 4.4.3 through 4.4.5, 4.6, 4.7, 4.8, 4.9 and 4.10 shall also be met.

5.1 Test Apparatus

5.1.1 The test probe employed to determine the sparking and safe distances uses a grounded conically shaped stainless-steel mass attached to a rigid support. The dimensions of the test probe are 1 in. diameter solid bar stock tapered to a 1 in. long point having a 1⁄32 in. radius tip. The test probe shall be connected to ground with a resistance of less than one ohm.

5.1.2 The test probe employed to de-energize the high voltage electrode shall be a one-inch grounded stainless-steel sphere attached or suspended from a fixed support by a conductive material. The test probe shall be connected to ground with a resistance of less than one ohm.

5.2 Automatic Spray Applicator

5.2.1 Energized Parts

The energized automatic spray applicator or applicator electrode shall be of the type supported in permanent locations and shall be effectively insulated from ground. To determine if there is effective insulation between energized elements of the applicator and ground a dielectric test shall be conducted. The manufacturer's recommended distances between the applicator and any other items, including ground shall be considered when setting up the applicator. A test potential equal to 1.5 U_{MAX} shall be applied between the high voltage energized items of the applicator and ground, for one minute. In order to avoid the effects of impulses at the switching on of the equipment, the test voltage shall be increased uniformly from the minimum value to the maximum value in 10 seconds and subsequently kept constant for one minute. Refer to 4.4.2 where integral high voltage generators are employed in the applicators.

Compliance is met if there is no arc over or dielectric breakdown or repeated flash over. Corona and other similar phenomena are disregarded.

5.2.2 De-energizing High Voltage

a) Electrostatic finishing equipment shall provide control circuits that shall be used in conjunction with finishing system inputs to de-energize the high voltage elements under any of the following conditions:

- Stoppage of ventilating fans or failure of ventilating equipment from any cause;
- Stoppage of the conveyor carrying goods through the high voltage field unless stoppage is required by the spray process.

Compliance is determined by inspection.

b) Electrostatic finishing equipment shall de-energize the high voltage elements upon the occurrence of excessive current leakage at any point on the high voltage system.

Compliance is determined by conducting the tests in Paragraph 5.3.2.

c) De-energizing the primary power input to the high voltage generator shall de-energize the high voltage electrode.

Compliance is determined by monitoring to ensure that the high voltage electrode is de-energized, zero volts as measured between the electrode and ground, within two seconds of removing primary power.

5.3 Tests

The following tests shall be carried out on any area of the automatic spray applicator which is energized and likely to result in an electric spark to a grounded object, as represented by the test probe. Electric spark and its location from the automatic spray applicator shall be determined by probing the automatic spray applicator while it is energized using the grounded test probes described in Paragraph 5.1.

5.3.1 Safe Distance

ANSI/NFPA 33 requires conveyors or hangers to be so arranged to maintain a safe distance of at least twice the sparking distance between goods being finished and the automatic spray applicator.

The safe distance is determined by conducting the following:

The electrostatic finishing equipment shall be arranged or otherwise adjusted so as to maximize its output from the high voltage generator. All automatic or other means for de-energizing the high voltage generator (circuits) shall be rendered inoperable. The test probe to be used is described in Paragraph 5.1.1. The distance between the test probe and the automatic spray applicator shall be reduced at a rate of 6 in./min (152 mm/min) until a spark occurs and the resultant remaining distance between them shall be recorded. The maximum distance at which sparking occurs, after repeating this procedure three times, shall be defined as the sparking distance. The safe distance is defined as twice the sparking distance. A warning sign defining the safe distance shall be provided by the manufacturer, to be displayed prominently in the finishing area.

5.3.2 Automatic Means of De-energizing

The electrostatic finishing equipment shall provide an automatic means of rapidly de-energizing the high voltage electrode to prevent a spark in the event the clearance between the objects or materials being painted and the automatic spray applicator is reduced below the safe distance during normal operation and start up. Protective circuits which may be manually or automatically reset (allow the high voltage circuit to reenergize) are acceptable; however, they must also function to pass the following tests. The tests and compliance requirements are stated in the following sections.

5.3.2.1 Provision shall be made so that the minimum distance measured between the probe, at its final resting location, and the automatic spray applicator shall be adjusted to be 90% of the safe distance. The electrostatic circuits and all automatic means of de-energizing the high voltage electrode shall be operating. All automatic means, accessible to the operator, shall be set (adjusted) at their least sensitive setting to cause high voltage circuits to de-energize. The 1-inch spherical steel test probe shall be used for this test. The test probe shall approach the high voltage electrode of the spray applicator from an initial distance not less than the safe distance, three times at a rate of approximately 6 in./min (152 mm/min) and three times at a rate determined by setting the probe up as a pendulum. The test probe shall also be suspended from a pivot point by the pendulum arm through a distance equal to 500% of the sparking distance. The test probe shall pass through an arc determined by dropping it from a point level with the pivot point with the pendulum arm fully extended. The pendulum arm shall be conductive material such that the resistance from the test probe to ground is less than one

ohm. In each case de-energizing the high voltage electrode is determined by monitoring a continuous decrease in the output of the high voltage generator.

5.3.2.2 Provision shall be made so that the minimum distance measured between the probe, at its final resting location, and the automatic spray applicator shall be adjusted to be 10% of the safe distance. The electrostatic circuits and all automatic means of de-energizing the high voltage electrode shall be operating. All automatic means shall be set (adjusted) at their least sensitive setting to cause high voltage circuits to de-energize. The 1-inch spherical steel test probe shall be used for this test. The test probe shall approach the high voltage electrode from an initial distance not less than the safe distance. The test probe shall approach the automatic spray applicator three times at a rate of 6 in./min (152 mm/min) and three times at a rate determined by setting the probe up as a pendulum. The test probe shall be suspended from the pivot point by the pendulum arm through a distance equal to 500% of the sparking distance. The test probe shall pass through an arc determined by dropping it from a point level with the pivot point, with the pendulum arm fully extended. The pendulum arm shall be conductive material such that the resistance from the test probe to ground is less than one ohm. In each case the high voltage electrode is determined to have rapidly de-energized by monitoring a continuous decrease in the output of the high voltage generator, without the high voltage electrode sparking to the test probe.

5.3.2.3 The electrostatic circuits shall be energized, and all automatic means shall be set (adjusted) at their least sensitive setting to cause high voltage circuits to de-energize, and the high voltage output setting shall be placed at its maximum position. Subsequent to these adjustments all circuits shall be placed in the "off" state. The 1-inch spherical steel test probe shall be used for this test. The distance from the test probe, at rest, to the automatic spray applicator shall be adjusted to be 10% of the safe distance. There shall be no high voltage electrode spark to the test probe when the circuits for electrostatic voltage and automatic means of de-energizing the high voltage electrode are powered up and powered down (defined as one cycle) for three cycles with a 2-minute delay between each cycle.

Compliance for the following items is determined by conducting the tests described in 5.3.2.1 through 5.3.2.3.

- to determine if there is an automatic means of de-energizing the high voltage electrode and prevent a spark.
- to determine if the speed at which de-energizing the high voltage electrode occurs is sufficient to prevent a spark.
- to determine if insufficient clearance shall cause an automatic means of de-energizing the high voltage electrode and prevent a spark.

5.3.3 Over Speed Test for Rotary Atomizers

The following sections describe the tests which shall be used to evaluate physical integrity of all rotating parts when operated at 150% of maximum rated speed without damage or causing injury to personnel. Disable all active speed control circuitry before conducting tests of 5.3.3.1 and 5.3.3.2.

WARNING: Any protective measures deemed necessary shall be taken to protect test personnel against injury that might occur if rotating elements fail (i.e., physically comes apart).

5.3.3.1 Type Test #1 - A single rotary atomizer shall be set-up as it would be during normal operating service. The bearing turbine shall be driven by appropriate means to achieve a speed equal to

150% of its maximum rated rotational speed, for a period of one minute. If 150% of rated speed cannot be reached refer to Type Test #2 below.

5.3.3.2 Type Test #2 - Alternatively, if it is not possible to test the product as described in Type Test #1, then testing shall be conducted on three samples at maximum attainable speed until the test sample seizes or for a period not less than 10 minutes.

The test sample(s) used shall be concluded to have demonstrated satisfactory mechanical strength, as it is applicable to over speed, if there are no apparent adverse effects on the Rotary Atomizer or any of its parts which would result in flying fragments or separation of the bell cup or disk from the applicator at the end of the test.

5.4 Multiple Automatic Spray Applicator Systems

These systems will be evaluated based on any combination of the multiple automatic spray applicators operating or not operating, connected or not connected, which will represent the worst-case condition(s)

6 OPERATIONS REQUIREMENTS

6.1 Demonstrated Quality Control Program

6.1.1 A Quality Control Program is required to assure that each subsequent unit produced by the manufacturer shall present the same quality and reliability as the specific samples examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests and may be documented in the certification report.
- Continued conformance to this standard is verified by the certifier's surveillance program.
- Quality of performance is determined by field performance and by periodic reexamination and testing.

6.1.2 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines;
- incoming quality assurance, including testing;
- in process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and
- handling and disposition of non-conforming materials.

6.1.3 Documentation/Manual

There should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

6.1.4 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

6.1.5 Drawing and Change Control

- To The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the certification report, may be required to be reported to, and authorized by the certification agency prior to implementation for production.
- Records of all revisions to all certified products shall be maintained.

6.2 Surveillance Audit

6.2.1 An audit of the manufacturing facility is part of the certification investigation to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment,

procedures, and quality program are maintained to ensure a uniform product consistent with that which was tested and certified.

6.2.2 An audit of the manufacturing facility may be part of the certification agencies surveillance requirements to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to ensure a uniform product consistent with that which was tested and certified.

6.2.3 Certified products or services shall be produced or provided at, or provided from, location(s) disclosed as part of the certification examination. Manufacture of products bearing a certification mark is not permitted at any other location prior to disclosure to the certification agency.

6.3 Installation Inspections

Field inspections may be conducted to review an installation. The inspections are conducted to assess ease of application, and conformance to written specifications. When more than one application technique is used, one or all may be inspected at the discretion of the certification agency.

6.4 Manufacturer’s Responsibilities

The manufacturer shall notify the certification agency of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation.

7 BIBLIOGRAPHY

ANSI/NFPA 34, Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids.

ANSI/NFPA 70, National Electrical Code® (NEC®)

ANSI/UL 1410, Television Receivers and High Voltage Video Products.

BSI BS 6742, Electrostatic Painting and Finishing Equipment Using Flammable Materials.

CENELEC EN 50050-1, Electrostatic hand-held spraying equipment – Safety requirements – Part 1: Hand-held spraying equipment for ignitable liquid coating materials

CENELEC EN 50050-2, Electrostatic hand-held spraying equipment – Safety requirements – Part 2: Hand-held spraying equipment for ignitable coating powder

CENELEC EN 50059, Specification for Electrostatic Hand-Held Spraying Equipment for Non-Flammable Material for Painting and Finishing.

OSHA 29 CFR 1926, Safety and Health Standard

SAA AS 2268, Electrical Equipment for Explosive Atmospheres Electrostatic Paint and Powder Spray Guns.

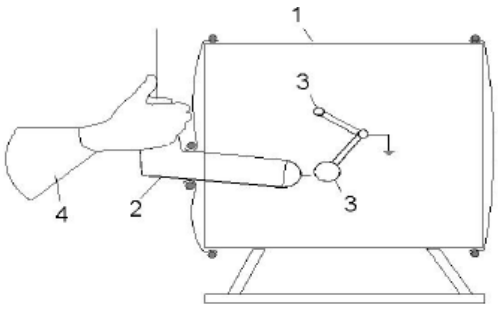
APPENDIX A
Information Related To Specific Paragraphs In This Standard

Appendix A does not describe requirements of this standard but is included for informational purposes only.

A1.2.1, A2.1.4 and A3.5 — A typical manual electrostatic finishing system consists of a handheld spray applicator, the high voltage generator and connecting cable. In most applications of a manual system, except for the hand spray applicator, all equipment is located outside of the hazardous location as defined by ANSI/NFPA 33, "Spray Application Using Flammable and Combustible Materials." In this situation the hand spray applicator is located in the area defined as Class I or II, Division 1. Marking for the spray applicator identifies this suitability, according to Paragraph 2.1.4. However, the handheld spray applicator is evaluated to determine that it is "designed so as not to produce a spark of sufficient intensity to ignite the most hazardous of those vapor-air mixtures or powder-air mixtures likely to be encountered, under all normal operating conditions." The ANSI/NFPA 33 further requires interlocking for power and ventilation to maintain vapor-air or powder-air concentrations below the lower explosive limits in the spray area and exhaust.

It would be inconsistent to consider the handheld spray applicator electrode spark intensity under normal operating conditions and treat another section of same device to more stringent criteria (i.e., trigger switch, or other normally arcing devices integral to the handheld spray applicator). Therefore, the hand spray applicator and its integral circuitry (i.e., trigger switches and the like), as required by Paragraph 3.5, are evaluated to also determine that it is designed so as not to produce a spark of sufficient intensity to ignite the most hazardous of those vapor-air or powder-air mixtures likely to be encountered, under all normal operating conditions.

A4.1 Ignition Test Apparatus — The small test chamber in which the spray applicator is placed, and also contains the explosive test gas mixture, is constructed of an insulating material. The insulating material is chosen to minimize the unwanted corona effects which otherwise occur when grounded metal (except the grounded metal test probe) is in close proximity to the high voltage energized electrode of the spray applicator. (If the metal is ungrounded it may result in an undesirable high energy discharge). The corona effects are realized by a reduction in electrode voltage and increase in electrode current supplied from the high voltage generator. Both of these effects are considered to result in adversely affecting the spark ignition tests.



Key

1 ignition test chamber

2 applicator with accessories

3 electrode

4 hand protected by fire resistant glove

Figure A.1 - Example of test arrangement
Extract from EN 50050-1

An automated grounded rotating test probe for use with this test apparatus was considered. The CENELEC EN 50050-1 and SAA AS 2268 standards use this type of test probe. However, the opinion stands that there is a physical limitation, contributed to this arrangement, in achieving arc discharge from the spray applicator electrode that is not encountered when compared to using a manually manipulated probe. Therefore, the manually manipulated grounded probe was considered to be more effective.

The electrostatic discharge occurring during this testing is known to produce ozone, a triatomic form of oxygen. This production of ozone could result in an oxygen enriched mixture within the test chamber causing it to be more easily ignitable, an unwanted side effect. It is understood that ozone is normally produced. However, this occurs in a moving air environment. Therefore, to minimize the concentration of ozone and to be more representative of operating conditions the gas flows continuously through the test chamber.

A4.1.1 Test Gas Mixture — Propane is the generally accepted test gas for Class I, Division 1, Group D hazardous location testing. The 5.25% propane-in-air test gas mixture is consistent with the requirements for other equivalent hazardous locations. The 12% ±0.1% methane-in-air test gas mixture is introduced here for the testing of electrostatic powder equipment and recognizes the difference and increased energy level necessary to ignite powder as compared to solvent vapor in-air test gas mixtures. The 12% ±0.1% mixture is also consistent with other standards referenced in Section 1.10.

A4.1.3 and A4.10 Current Limiting Elements — Current limiting elements are typically resistors placed between the output of the high voltage generator and the electrode of the spray applicator. This paragraph is written in this manner so that it does not preclude other design concepts from being considered. Worst case, from an ignition standpoint, is obtained by selecting these elements, within their tolerances, so as to maximize the energy released in the spark ignition testing. In addition, for automatic spray applicators where continuous grounding of the electrode may occur, the energy limiting element(s) shall be designed to dissipate the fault (electrode shorted to ground) energy without harm to the element.

A4.1.4 Spray Material Fluid — The electrode voltage and fluid conductivity are the significant factors affecting the highest available ignition energy. Based on this, conducting the test at the highest rated electrode voltage and with fluid passages filled with fluid is considered to represent worst case. A specific test fluid is not stated as the conductivity of a specified standard test fluid in its pure state may be too high for any given system's design, and therefore not appropriate for all systems. Given these factors, it is necessary to choose a test fluid, for any given system, which would have the highest conductivity and still not reduce the electrode voltage below its nominally rated value. The fluid hose having the largest diameter shall be selected for testing purposes.

A4.3 Arc Carbonizing Tests — It has been demonstrated that material carbonizing due to electrostatic discharge results in an energy increase released in the subsequent arcs produced as a result of the carbonizing. This is due to the fact that the material becomes relatively more conductive as a result of carbonizing. This increased energy released in the arc discharge can result in ignition of the test gas rendering the spray applicator unsafe. This test is conducted to determine if the materials concerned are susceptible to arc carbonizing.

A4.4.4 High Voltage Cable Without Conductive Sheath and A4.4.5 Material Supply Hose Without Conductive Sheath — The test potential used for this test, 2.0 U_{MAX} plus 1000V, is for determining the protective insulation characteristics of the cable or supply hose.

A4.9 Impact — The test method described was settled on to be consistent with other standards for Class I and II hazardous location equipment. The other standards referenced, such as CENELEC, give a table of impact values. The absence of acquiring an explanation of the relationship between the impact energy of the table and the described part, and the consistency among our own standards, are considered predominant factors for deciding on the value stated.