240. SPRAY FINISHING USING FLAMMABLE AND COMBUSTIBLE MATERIALS

01. Scope

a. Spray finishing using flammable and combustible materials shall conform to all other applicable requirements of this standard, as well as the following provisions. Nothing in this standard shall be construed to prohibit better or otherwise safer conditions than specified herein. (7-1-97)

b. This section applies to flammable and combustible finishing materials when applied as a spray by compressed air, airless, or hydraulic atomization, steam, electrostatic methods, or by any other means in continuous or intermittent processes. This section also covers the application of combustible powders by powder spray guns, electrostatic powder spray guns, fluidized beds, or electrostatic fluidized beds. The section does not apply to outdoor spray application of buildings, tanks, or other similar structures, nor to small portable spraying apparatus not used repeatedly in the same location. (7-1-97)

c. Spray booths or spray rooms are to be used to enclose or confine all spray finishing operations covered by this section. (7-1-97)
02. Definitions: For definitions of other terms used in this section, see sub-section 010 of this standard. (7-1-97)

a. Aerated Solid Powders are any powdered material used as a coating material which shall be fluidized within a container by passing air uniformly from below. It is common practice to fluidize such material to form a fluidized powder bed and then dip the part to be coated into the bed in a manner similar to that used in liquid dipping. Such beds are also used as sources for powder spray operations. (7-1-97)

b. Fluidized Bed is a container holding material which is aerated from below so as to form an air-supported expanded cloud of such material through which the preheated object to be coated is immersed and transported. (7-1-97)

c. Fluidized Bed, Electrostatic, is a container holding powder coating material which is aerated from below so as to form an air supported expanded cloud of such material which is electrically charged with a charge opposite to the charge of the object to be coated; such object is transported through the container immediately above the charged and aerated materials in order to be coated. (7-1-97)

d. Minimum Maintained Velocity is the velocity of air movement which must be maintained in order to meet minimum specified requirements for health and safety. (7-1-97)

e. Spraying Area is any area in which dangerous quantities of flammable vapors or mists or combustible residues, dusts, or deposits are present due to the operation of spraying processes. (7-1-97)

f. Spray Booth is a power ventilated structure provided to enclose or accommodate a spraying operation, to confine and limit the escape of spray, vapor, and residue, and to safely conduct or direct them to an exhaust system. (7-1-97)

g. Spray Booth, Waterwash, is a spray booth equipped with a water washing system designed to minimize dusts or residues entering exhaust ducts and to permit the recovery of over-spray finishing material. (7-1-97)

h. Spray Booth, Dry, is a spray booth not equipped with a water washing system as described in Subsection d. of this section. A dry spray booth may be equipped with: distribution or baffle plates to promote an even flow of air through the booth or cause the deposit of over-spray before it enters the exhaust duct; or over-spray dry filters to minimize dusts; or over-spray dry filters to minimize dusts or residues entering exhaust ducts; or over-spray dry filter rolls designed to minimize dusts or residues entering exhaust ducts; or where dry powders are being sprayed, with powder collection systems so arranged in the exhaust to capture over-sprayed material. (7-1-97)

i. Spray-Finishing Operation are employment of methods wherein organic or inorganic materials are utilized in dispersed form for deposit on surfaces to be coated, treated, or cleaned. Such methods of deposit may involve either automatic, manual, or electrostatic deposition but do not include metal spraying or metalizing, dipping, flow coating, roller coating, tumbling,
centrifuging, or spray washing and degreasing as conducted in self-contained washing and degreasing machines or systems. (7-1-97)

ej. Spray Room is a room in which spray-finishing operations, not conducted in a spray booth, are performed separately from other areas. (7-1-97)

03. General Requirements: (7-1-97)

a. Respiratory protection is to meet the requirements of section 050 of this standard. (7-1-97)

04. Spray Booths and Rooms: (7-1-97)

a. Spray booths shall be substantially constructed of steel, securely and rigidly supported, or of concrete or masonry except that aluminum or other substantial noncombustible material may be used for intermittent or low volume spraying. Spray booths shall be designed to sweep air currents toward the exhaust outlet. (7-1-97)

b. The interior surfaces of spray booths and rooms shall be smooth and continuous without edges and otherwise designed to prevent pocketing of residues and facilitate cleaning and washing without injury. (7-1-97)

c. The floor surface of a spray booth or room and operator's working area, if combustible, shall be covered with noncombustible material of such character as to facilitate the safe cleaning and removal of residues. (7-1-97)

d. Distribution of baffle plates, if installed to promote an even flow of air through the booth/room or cause the deposit of over-spray before it enters the exhaust duct, shall be of noncombustible material and readily removable or accessible on both sides for cleaning. Such plates shall not be located in exhaust ducts. (7-1-97)

e. The spraying operations except electrostatic spraying operations shall be so designed, installed, and maintained that the open face of the booth (or booth cross section during spraying operations) shall be not less than one-hundred (100) linear feet per minute. Electrostatic spraying operations may be conducted with an air velocity over the open face of the booth of not less than sixty (60) linear feet per minute, or more, depending on the volume of the finishing material being applied and its flammability and explosion characteristics. Visible gauges or audible alarm or pressure activated devices shall be installed to indicate or insure that the required air velocity is maintained. Dry spray booths equipped with a filter roll which is automatically advanced should be arranged to cause shutdown of spraying operations if the filter roll fails to advance automatically. Maintenance procedures should be established to assure replacing filter pads before excessive restriction to air-flow occurs. Filter pads should be inspected after each period of use and clogged filter pads discarded and replaced. Filter rolls shall be inspected to insure proper replacement of filter media. (7-1-97)
f. All discarded filter pads and filter rolls shall be immediately removed to a safe, well-detected location or placed in a water-filled metal container and disposed of at the close of the day's operation unless maintained completely in water. (7-1-97)

g. The location of filters in a spray booth/room shall be so as to not reduce the effective booth/room enclosure of the articles being sprayed. (7-1-97)

h. Space within the spray booth/room on the downstream and upstream sides of filters shall be protected with approved automatic sprinklers. (7-1-97)

i. Filters or filter rolls shall not be used when applying a spray material known to be highly susceptible to spontaneous heating and ignition. (7-1-97)

j. Clean filters or filter rolls shall be noncombustible or of a type having a combustibility not in excess of Class two (2) filters as listed by Underwriters' Laboratories, Inc. Filters and filter rolls shall not be alternately used for different types of coating materials, where the combination of materials may be conducive to spontaneous ignition. (7-1-97)

k. Each spray booth having a frontal area larger than nine (9) square feet shall have a metal deflector or curtain not less than two and one-half (2 1/2) inches deep installed at the upper outer edge of the booth over the opening. (7-1-97)

l. Where conveyors are arranged to carry work into or out of spray booths/rooms, the openings therefor shall be as small as practical. (7-1-97)

m. Each spray booth shall be separated from other operations by not less than three (3) feet, or by a greater distance, or by such partition or wall as to reduce the danger from juxtaposition of hazardous operations. (7-1-97)

n. Spray booths shall be so installed that all portions are readily accessible for cleaning. A clear space of not less than three (3) feet on all sides shall be kept free from storage of combustible construction. (7-1-97)

o. When Spraying areas are illuminated through glass panels or other transparent materials, only fixed lighting units shall be used as a source of illumination. Panels shall effectively isolate the spraying area from the area in which the lighting unit is located, and shall be of a noncombustible material of such a nature or so protected that breakage will be unlikely. Panels shall be so arranged that normal accumulations of residue on the exposed surface of the panel will not be raised to a dangerous temperature by radiation or conduction from the source of illumination. (7-1-97)

p. Spray booths or spray rooms are to be used to enclose or confine all spray-finishing operations. (7-1-97)
q. Spray booths shall be designed and constructed in accordance with this subsection and NFPA No. 33 for general construction specifications. For a more detailed discussion of fundamentals relating to this subject, see ANSI Z9.2. (7-1-97)

r. Lights, motors, electrical equipment, and other sources of ignition shall conform to the requirements of sub-section 240.05 of this section, section 150 of this standard, and the National Electric Code (7-1-97)

s. In no case shall combustible material be used in the construction of a spray booth or room and supply or exhaust duct connected to it. (7-1-97)

t. Unobstructed walkways shall not be less than six-point-five (6.5) feet high and shall be maintained clear of obstruction from any work location in the booth to a booth exit or open booth front. In booths where the open front is the only exit, such exits shall be not less than three (3) feet wide. In booths having multiple exits, such exits shall not be less than two (2) feet wide, provided that the maximum distance from the work location to the exit is twenty-five (25) feet or less. Where booth exits are provided with doors, such doors shall open outward from the booth. (7-1-97)

u. Over-spray filters shall be installed in a location easily accessible for inspection, cleaning, or replacement. (7-1-97)

v. Where effective means, independent of the over-spray filters, are installed which will result in design air distribution across the booth cross section, it is permissible to operate the booth without the filters in place. (7-1-97)

w. For wet or water-wash spray booths/rooms, the water-chamber enclosure within which intimate contact of contaminated air and cleaning water or other cleaning medium is maintained, if made of steel, shall be eighteen (18) gage or heavier and adequately protected against corrosion. (7-1-97)

x. Water chambers may include scrubber spray nozzles, headers, troughs, or other devices. Chambers shall be provided with adequate means for creating and maintaining scrubbing action for removal of particulate matter from the exhaust air stream. (7-1-97)

y. Collecting tanks shall be of welded steel construction or other suitable non-combustible material. If pits are used as collecting tanks, they shall be concrete, masonry, or other material having similar properties. (7-1-97)

z. Collecting tanks shall be provided with tiers, skimmer plates, or screens to prevent sludge and floating materials from entering the pump suction box. Means for automatically maintaining the proper water level shall also be provided. Fresh water inlets shall not be submerged. They shall terminate at least one pipe diameter above the safety overflow level of the tank. (7-1-97)

aa. Collecting tanks shall be so constructed as to discourage accumulation of hazardous deposits. (7-1-97)
bb. Pump manifolds, risers, and headers shall be adequately sized to insure sufficient water flow to provide efficient operation of the water chamber. (7-1-97)

c. Spray rooms, including floors, shall be constructed of masonry, concrete, or other noncombustible material. (7-1-97)

dd. Spray rooms shall have noncombustible fire doors and shutters. (7-1-97)

ee. Spray rooms shall be adequately ventilated so that the atmosphere in the breathing zone of the operator shall be maintained in accordance with the requirements of sub-section 241.06. of this section. (7-1-97)

ff. Spray rooms used for production spray-finishing operations shall conform to the requirements for spray booths. (7-1-97)

05. Electrical and Other Sources of Ignition: (7-1-97)

a. Conformance. All electrical equipment, open flames and other sources of ignition shall conform to the requirements of this section, except as follows: Electrostatic apparatus shall conform to the requirements of sub-sections 240.11 and 240.12 of this section. Drying, curing and fusion apparatus shall conform to the requirements of sub-section 240.13 of this section. Automobile undercoating spray operations in garages shall conform to the requirements of sub-section 240.14 of this section. Powder coating equipment shall conform to the requirements of sub-section 240.15 of this section. (7-1-97)

b. There shall be no open flame or spark producing equipment in any spraying area nor within twenty (20) feet thereof, unless separated by a partition. (7-1-97)

c. Space-heating appliances, steam pipes, or hot surfaces shall not be located in a spraying area where deposits of combustible residues may readily accumulate. (7-1-97)

d. Electrical wiring and equipment shall conform to the provisions of this section and shall otherwise be in accordance with section 150 of this standard. (7-1-97)

e. Unless specifically approved for locations containing both deposits of readily ignitable residue and explosive vapors, there shall be no electrical equipment in any spraying area, wherein deposits of combustible residues may readily accumulate, except wiring in rigid conduit, in boxes, or fittings containing no taps, splices, or terminal connections. (7-1-97)

f. Electrical wiring and equipment not subject to deposits of combustible residues but located in a spraying area as herein defined shall be of explosion-proof type approved for Class I, Group D locations and shall otherwise conform to the provisions of section 150 of this standard, for Class I, Division I Locations. Electrical wiring, motors, and other equipment outside of but within twenty (20) feet of any spraying area, and not separated therefrom by partitions shall not produce sparks under normal operating conditions and shall otherwise conform to the provisions of section 150 of this standard, for Class I, Division 2 Hazardous Locations. (7-1-97)
g. Electric lamps outside of but within twenty (20) feet of any spraying area, and not separated therefrom by a partition, shall be totally enclosed to prevent the falling of hot particles and shall be protected from mechanical injury by suitable guards or by location. (7-1-97)

h. Portable electric lamps shall not be used in any spraying area during spraying operations. Portable electric lamps, if used during cleaning or repairing operations, shall be of the type approved for hazardous Class I locations. (7-1-97)

i. All metal parts of spray booths, exhaust ducts, and piping systems conveying flammable or combustible liquids or aerated solids shall be properly electrically grounded in an effective and permanent manner. (7-1-97)

j. Airless high-fluid pressure spray guns and any conductive object being sprayed shall be properly electrically grounded. (7-1-97)

06. Ventilation: (7-1-97)

a. Ventilation and exhaust systems shall be in accordance with NFPA 91 where applicable and shall also conform to the provisions of this section and section 300 of this standard. (7-1-97)

b. Ventilation shall be provided in accordance with provisions of NFPA No. 33, and in accordance with the following: Where a fan plenum is used to equalize or control the distribution of exhaust air movement through the booth, it shall be of sufficient strength or rigidity to withstand the differential air pressure or other superficially imposed loads for which the equipment is designed and also to facilitate cleaning. Construction specifications shall be at least equivalent to those of sub-section 240.06.c. of this section. (7-1-97)

c. All spraying areas shall be provided with mechanical ventilation adequate to remove flammable vapors, mists, or powders to a safe location and to confine and control combustible residues so that life is not endangered. Mechanical ventilation shall be kept in operation at all times while spraying operations are being conducted and for a sufficient time thereafter to allow vapors from drying coated articles and drying finishing material residue to be exhausted. (7-1-97)

d. Each spray booth shall have an independent exhaust duct system discharging to the exterior of the building, except that multiple cabinet spray booths in which identical spray finishing material is used with a combined frontal area of not more than eighteen (18) square feet may have a common exhaust. If more than one (1) fan serves one (1) booth, all fans shall be so interconnected that one (1) fan cannot operate without all fans being operated. Exhaust discharge shall be so directed that it is not reintroduced into buildings through air intakes of heating/ventilation equipment. (7-1-97)

e. The fan rotating element shall be nonferrous or nonsparking or the casing shall consist of or be lined with such material. There shall be ample clearance between the fan rotating element and the fan casing to avoid a fire by friction, necessary allowance being made for ordinary expansion and loading to prevent contact between moving parts and the duct or fan housing. Fan blades
shall be mounted on a shaft sufficiently heavy to maintain perfect alignment even when the blades of the fan are heavily loaded, the shaft preferably to have bearings outside the duct and booth. All bearings shall be of the self lubricating type, or lubricated from the outside of the duct. (7-1-97)

f. Clean fresh air, free from contamination from adjacent industrial exhaust systems, chimneys, stacks, or vents, shall be supplied to a spray booth or room in quantities equal to the volume of air exhausted through the spray booth/room. (7-1-97)

g. Where a spray booth or room receives make-up air through self-closing doors, dampers, or louvers, they shall be fully open at all times when the booth or room is in use for spraying. The velocity of air through such doors, dampers, or louvers shall not exceed two-hundred (200) feet per minute. If the fan characteristics are such that the required air flow through the booth will be provided, higher velocities through the doors, dampers, or louvers may be used. (7-1-97)

h. Where the air supply to a spray booth or room is filtered, the fan static pressure shall be calculated on the assumption that the filters are dirty to the extent that they require cleaning or replacement. The rating of filters shall be governed by test date supplied by the manufacturer of the filter. A pressure gage shall be installed to show the pressure drop across the filters. This gage shall be marked to show the pressure drop at which the filters require cleaning or replacement. Filters shall be replaced or cleaned whenever the pressure drop across them becomes excessive or whenever the air flow through the face of the booth falls below that specified in Table 240.07-B. (7-1-97)

i. Means for heating make-up air to any spray booth or room, before or at the time spraying is normally performed, shall be provided in all places where the outdoor temperature may be expected to remain below fifty-five (55) degrees Fahrenheit for appreciable periods of time during the operation of the booth except where adequate and safe means of radiant heating for all operating personnel affected is provided. The replacement air during the heating seasons shall be maintained at not less than sixty-five (65) degrees Fahrenheit at the point of entry into the spray booth or spray room. When otherwise unheated make-up air would be at a temperature of more than ten (10) degrees Fahrenheit below room temperature, its temperature shall be regulated as provided in ANSI Z9.2. (7-1-97)

j. As an alternative to an air replacement system complying with the preceding subsection, general heating of the building in which the spray room or booth is located may be employed provided that all occupied parts of the building are maintained at not less than sixty-five (65) degrees Fahrenheit when the exhaust system is in operation or the general heating system supplemented by other sources of heat may be employed to meet this requirement. (7-1-97)

k. No means of heating make-up air shall be located in a spray booth/room. (7-1-97)

l. Where make-up air is heated by coal or oil, the products of combustion shall not be allowed to mix with the makeup air, and the products of combustion shall be conducted outside the building through a flue terminating at a point remote from all points where make-up air enters the building. (7-1-97)
m. Where make-up air is heated by gas, and the products of combustion are not mixed with the make-up air but are conducted through an independent flue to a point outside the building remote from all points where make-up air enters the building, it is not necessary to comply with subsection 240.06.i. of this section. (7-1-97)

n. Where make-up air to any manually operated spray booth or room is heated by gas and the products of combustion are allowed to mix with the supply air, the following precautions shall be taken: The gas must have a distinctive and strong enough odor to warn workers in a spray booth or room of its presence if in an unburned state in the make-up air. The maximum rate of gas supply to the make-up air heater burners must not exceed that which would yield in excess of two-hundred (200) p.p.m. (parts per million) of carbon monoxide or two-thousand (2,000) p.p.m. of total combustible gases in the mixture if the unburned gas upon the occurrence of flame failure were mixed with all of the make-up air supplied. A fan must be provided to deliver the mixture of heated air and products of combustion from the plenum chamber housing the gas burners from the spray booth or room. (7-1-97)

o. Inlet or supply ductwork used to transport makeup air to spray booths/rooms or surrounding areas shall be constructed of noncombustible materials. (7-1-97)

p. If negative pressure exists within inlet ductwork, all seams and joints shall be sealed if there is a possibility of infiltration of harmful quantities of noxious gases, fumes, or mists from areas through which ductwork passes. (7-1-97)

q. Inlet ductwork shall be sized in accordance with volume flow requirements and provide design air requirements at the spray booth. (7-1-97)

r. Inlet ductwork shall be adequately supported throughout its length to sustain at least its own weight plus any negative pressure which is exerted upon it under normal operating conditions. (7-1-97)

s. Electric motors driving exhaust fans shall not be placed inside booths or ducts. (7-1-97)

t. Belts shall not enter the duct or booth unless the belt and pulley within the duct or booth are thoroughly enclosed. (7-1-97)

u. Exhaust ducts shall be constructed of steel and shall be substantially supported. Exhaust ducts without dampers are preferred; however, if dampers are installed, they shall be maintained so that they will be in a full open position at all times the ventilating system is in operation. (7-1-97)

v. Exhaust ductwork shall be adequately supported throughout its length to sustain its weight plus any normal accumulation in its interior during normal operating conditions and any negative pressure exerted upon it. (7-1-97)

w. Exhaust ductwork shall be sized in accordance with good design practice which shall include consideration of fan capacity, length of duct, number of turns and elbows, variation in size, volume, and character of materials being exhausted. (7-1-97)
x. Exhaust ducts shall be protected against mechanical damage and have a clearance from unprotected combustible construction or other combustible material of not less than eighteen (18) inches. (7-1-97)

y. If combustible construction is provided with the following protection applied to all surfaces within eighteen (18) inches, clearances may be reduced to the distances indicated: (7-1-97)

i. Twenty-eight (28) gage sheet metal on one-fourth (1/4) inch cement mill board - twelve (12) inches; (7-1-97)

ii. Twenty-eight (28) gage sheet metal on one-eighth (1/8) inch cement mill board space out one (1) inch on noncombustible spacers - nine (9) inches; (7-1-97)

iii. Twenty-two (22) gage sheet metal on one (1) inch rockwool batts reinforced with wire mesh or the equivalent - three (3) inches. (7-1-97)

iv. Where ducts are protected with an approved automatic sprinkler system, properly maintained, the clearance required in sub-section 240.06.s. of this section may be reduced to six (6) inches. (7-1-97)

z. Longitudinal joints in sheet steel ductwork shall be either lock-seamed riveted, or welded. For other than steel construction, equivalent securing of joints shall be provided. (7-1-97)

aa. Circumferential joints in ductwork shall be substantially fastened together and lapped in the direction of air-flow. At least every fourth joint shall be provided with connecting flanges, bolted together, or of equivalent fastening security. (7-1-97)

bb. Unless spray booth exhaust duct terminal is from a water-wash spray booth, the terminal discharge point shall be not less than six (6) feet from any combustible exterior wall or roof nor discharge in the direction of any combustible construction or unprotected opening in any noncombustible exterior wall within twenty-five (25) feet. (7-1-97)

c. Where ductwork passes through a combustible roof or wall, the roof or wall shall be protected at the point of penetration by open space or fire-resistive material between the duct and the roof or wall. When ducts pass through firewalls, they shall be provided with automatic fire dampers on both sides of the wall, except that three-eighth (3/8) inch steel plates may be used in lieu of automatic fire dampers for ducts not exceeding eighteen (18) inches in diameter. (7-1-97)

dd. Air exhaust from spray operations shall not be directed so that it will contaminate makeup air being introduced into the spraying area or other ventilating intakes, nor directed so as to create a nuisance. Air exhausted from spray operations shall not be recirculated. (7-1-97)

e. Ductwork used for ventilating and processes covered in this section shall not be connected to ducts ventilating any other process or any chimney or flue used for conveying any products of combustion. (7-1-97)
ff. When necessary to facilitate cleaning, exhaust ducts shall be provided with an ample number of access doors. Inspection or clean-out doors shall be provided for every nine (9) to twelve (12) feet of running length for ducts up to twelve (12) inches in diameter, but the distance between clean-out doors may be greater for larger pipes. A clean-out door or doors shall be provided for servicing the fan, and where necessary, a drain shall be provided. (7-1-97)

gg. Air intake openings to rooms containing spray finishing operations shall be adequate for the efficient operation of exhaust fans and shall be so located as to minimize the creation of dead air pockets. (7-1-97)

hh. Freshly sprayed articles shall be dried only in spaces provided with adequate ventilation to prevent the formation of explosive vapors. In the event adequate and reliable ventilation is not provided such drying spaces shall be considered a spraying area. (7-1-97)

07. Velocity and Air Flow Requirements: (7-1-97)

a. Except where a spray booth/room has an adequate air replacement system, the velocity of air into all openings of a spray booth/room shall be not less than that specified in Table 240.07-A for the operating conditions specified. An adequate air replacement system is one which introduces replacement air upstream or above the object being sprayed and is so designed that the velocity of air in the booth/room cross section is not less than that specified in Table 240.07-A when measured upstream or above the object being sprayed. (7-1-97)

<table>
<thead>
<tr>
<th>Operating conditions for objects completely inside booth</th>
<th>Design</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crossdraft, f.p.m.</td>
<td>50</td>
<td>50 - 75</td>
</tr>
<tr>
<td>Electrostatic and automatic airless operation contained in booth without operator</td>
<td>100</td>
<td>75 - 125</td>
</tr>
<tr>
<td>Air operated guns, manual or Up to 50</td>
<td>100 large booth</td>
<td>75 - 125</td>
</tr>
</tbody>
</table>

TABLE 240.07-A

MINIMUM MAINTAINED VELOCITIES INTO SPRAY BOOTHs
<table>
<thead>
<tr>
<th>automatic</th>
<th>Air operated guns, manual or automatic</th>
<th>Up to 100</th>
<th>150 small booth</th>
<th>125 - 175</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>150 large booth</td>
<td>125 - 175</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>200 small booth</td>
<td>150 - 250</td>
</tr>
</tbody>
</table>

NOTES: 1. Attention is invited to the fact that the effectiveness of the spray booth is dependent upon the relationship of the depth of the booth to its height and width. 2. Cross drafts can be eliminated through proper design and such design should be sought. Cross drafts in excess of 100fpm (feet per minute) should not be permitted. 3. Excessive air pressures result in loss of both efficiency and material waste in addition to creating a backlash that may carry over-spray and fumes into adjacent work areas. 4. Booths should be designed with velocities shown in the column headed "Design". However, booths operating with velocities shown in the column headed "Range" are in compliance with this standard.

(7-1-97)

b. In addition to the requirements sub-section 240.07.a. of this section, the total air volume exhausted through a spray booth shall be such as to dilute solvent vapor to at least twenty-five (25) percent of the lower explosive limit of the solvent being sprayed. An example of the method of calculating this volume is given below. EXAMPLE: To determine the lower explosive limits of the most common solvents used in spray finishing, see Table 240.07-B. Column 1 gives the number of cubic feet of vapor per gallon of solvent and column 2 gives the lower explosive limit (LEL) in percentage by column of air. Note that the quantity of solvent will be diminished by the quantity of solids and nonflammables contained in the finish. To determine the volume of air in cubic feet necessary to dilute the vapor from one (1) gallon of solvent to twenty-five (25) percent of the lower explosive limit, apply the following formula: Dilution volume required per gallon of solvent = 4 (100-LEL) (Cubic feet of vapor per gallon) ÷ LEL. Using toluene as the solvent, LEL of toluene from Table 241.18-B, Column 2, is one-point-four (1.4) percent; cubic feet of vapor per gallon from Table 241.18-B Column 1, is thirty-point-four (30.4) cubic feet per gallon; dilution volume required = 4 (100-1.4) 30.4 ÷ 1.4 = 8,564 cubic feet. To convert cubic feet per minute of required ventilation, multiply the dilution volume required per gallon of solvent by the number of gallons of solvent evaporated per minute. (7-1-97)
<table>
<thead>
<tr>
<th>Solvent</th>
<th>Column 1</th>
<th>Column 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>44.0</td>
<td>2.6</td>
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<tr>
<td>Amyl Acetate (iso)</td>
<td>21.6</td>
<td>1.0</td>
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<tr>
<td>Amyl Alcohol (n)</td>
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<tr>
<td>Benzene</td>
<td>36.8</td>
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<td>Butyl Alcohol (n)</td>
<td>35.2</td>
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<td>24.8</td>
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<td>Cellosolve</td>
<td>33.6</td>
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<td>Cellosolve Acetate</td>
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<td>Cyclohexanone</td>
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<td>1.1 Dichloroethylene</td>
<td>42.4</td>
<td>5.9</td>
</tr>
<tr>
<td>1.2 Dichloroethylene</td>
<td>42.4</td>
<td>9.7</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>32.8</td>
<td>2.5</td>
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<tr>
<td>Ethyl Alcohol</td>
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<td>4.3</td>
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<tr>
<td>Ethyl Lactate</td>
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<td>Methyl Acetate</td>
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<td>3.1</td>
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<tr>
<td>Methyl Alcohol</td>
<td>80.8</td>
<td>7.3</td>
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<tr>
<td>Methyl Cellosolve</td>
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<tr>
<td>Methyl Ethyl Ketone</td>
<td>36.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Methyl n-Propyl Ketone</td>
<td>30.4</td>
<td>1.5</td>
</tr>
<tr>
<td>Naphtha (VM&amp;P) (76 Naphtha)</td>
<td>22.4</td>
<td>0.9</td>
</tr>
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</table>
\begin{table}
\begin{tabular}{|l|c|c|}
\hline
Naphtha (100 Flash) Safety Solvent - Stoddard Solvent & 23.2 & 1.0 \\
Propyl Acetate (n) & 27.2 & 2.8 \\
Propyl Acetate (iso) & 28.0 & 1.1 \\
Propyl Alcohol (n) & 44.8 & 2.1 \\
Propyl Alcohol (iso) & 44.0 & 2.0 \\
Toluene & 30.4 & 1.4 \\
Turpentine & 20.8 & 0.8 \\
Xylene (o) & 26.4 & 1.0 \\
\hline
\end{tabular}
\end{table}

\footnote{At 212 Fahrenheit}

(7-1-97)

c. When an operator must position himself in a booth/room downstream of the object being sprayed, an air-supplied respirator or other type of respirator approved by NIOSH or the Bureau of Mines, U. S. Department of the Interior or specified in ANSI Z88.2 for the material being sprayed should be used by the operator. Where down-draft booths/rooms are provided with doors, such doors shall be closed when spray painting. (7-1-97)

\textbf{08. Flammable and Combustible Liquids - Storage and Handling:} (7-1-97)

a. Conformance. The storage of flammable or combustible liquids in connection with spraying operations shall conform to the requirements of section 220 of this standard, where applicable. (7-1-97)

b. The quantity of flammable or combustible liquids kept in the vicinity of spraying operations shall be the minimum required for operations and should ordinarily not exceed a supply for one (1) day or one (1) shift. Bulk storage of portable containers of flammable or combustible liquids shall be in accordance with the requirements for flammable combustible liquid storage of section 220 of this standard. (7-1-97)

c. Original closed containers, approved portable tanks, approved safety cans or a properly arranged system of piping shall be used for bringing flammable or combustible liquids into spray finishing room. Open or glass containers shall not be used. (7-1-97)

d. Except as provided in sub-section 240.08.e. of this section, the withdrawal of flammable and combustible liquids from containers having a capacity of greater than sixty (60) gallons shall be by approved pumps. The withdrawal of flammable or combustible liquids from containers and the filling of containers, including portable mixing tanks, shall be done only in a suitable mixing
room or in a spraying area when the ventilating system is in operation. Adequate precautions shall be taken to protect against liquid spillage and sources of ignition. (7-1-97)

e. Containers supplying spray nozzles shall be of closed type or provided with metal covers that are kept closed. Containers not resting on floors shall be on metal supports or suspended by wire cables. Containers supplying spray nozzles by gravity flow shall not exceed ten (10) gallons capacity. Original shipping containers shall not be subject to air pressure for supplying spray nozzles. Containers under air pressure supplying spray nozzles shall be of limited capacity, not exceeding that necessary for one (1) day's operation; shall be designed and approved for such use; shall be provided with a visible pressure gage; and shall be provided with a relief valve set to operate in conformance with the requirements of the ASME Boiler and Pressure Vessel Code. Containers under air pressure supplying spray nozzles air-storage tanks and coolers shall conform to the standards of the ASME Boiler and Pressure Vessel Code. (7-1-97)

f. All containers or piping to which is attached a hose or flexible connection shall be provided with a shutoff valve at the connection. Such valves shall be kept shut when spraying operations are not being conducted. (7-1-97)

g. When a pump is used to deliver products, automatic means shall be provided to prevent pressure in excess of the design working pressure of accessories, piping, and hose. (7-1-97)

h. All pressure hose and couplings shall be inspected at regular intervals appropriate to their service. The hose and couplings shall be tested with the hose extended, and using the inservice maximum operating pressures. Any hose showing material deteriorations, signs of leakage, or weakness in its carcass or at the couplings, shall be withdrawn from service and repaired or discarded. (7-1-97)

i. Piping systems conveying flammable or combustible liquids shall be of steel or other material having comparable properties of resistance to heat and physical damage. Piping systems shall be properly bonded and grounded. (7-1-97)

j. Electrically powered spray liquid heaters shall be approved and listed for the specific location in which used (see sub-section 240.05 of this section). Heaters shall not be located in spray booths nor other locations subject to the accumulation of deposits or combustible residue. Agitators, if used, should preferably be driven by compressed air, water, or low-pressure steam. If an electric motor is used, see sub-section 240.05 of this section. (7-1-97)

k. If flammable or combustible liquids are supplied to spray nozzles by positive displacement pumps, the pump discharge line shall be provided with an approved relief valve discharging to a pump suction, a safe detached location, or a device provided to stop the prime-mover if the discharge pressure exceeds the safe operating pressure of the system. (7-1-97)

l. Whenever flammable or combustible liquids are transferred from one (1) container to another, both containers shall be effectively bonded and grounded to prevent discharge sparks of static electricity. (7-1-97)
09. Protection: (7-1-97)

a. In sprinklered buildings, the automatic sprinkler system in rooms containing spray finishing operations shall conform to the Standard for the Installation of Sprinkler Systems. NFPA 13, Provisions for Extra Hazard Occupancy, and in unsprinklered buildings where sprinklers are installed only to protect spraying areas, the installations shall conform to such standards to the extent that they may be applicable. Sprinkler installations shall also conform to the provisions of this section. Sprinkler heads shall be located to effect water distribution throughout the entire booth/room. (7-1-97)

b. Automatic sprinklers protecting each spray booth (together with its connecting exhaust) shall be under an accessibility located separate outside stem and yoke (OS&Y) subcontrol valve. (7-1-97)

c. Sprinklers protecting spraying areas shall be kept as free from deposits as practical by cleaning daily if necessary. (7-1-97)

d. An adequate supply of suitable portable fire extinguishers shall be installed near all spraying areas. (7-1-97)

10. Operations and Maintenance: (7-1-97)

a. Spraying shall not be conducted outside of predetermined spraying areas. (7-1-97)

b. All spraying areas shall be kept as free from the accumulation of deposits of combustible residues as practical, with cleaning conducted daily if necessary. Scrapers, spuds, or other such tools used for cleaning purposes shall be of nonsparking material. (7-1-97)

c. Residue scrapings and debris contaminated with residue shall be immediately removed from the premises and properly disposed. Approved metal waste cans shall be provided wherever rags or waste are impregnated with finishing material and all such rags or waste deposited therein immediately after use. The contents of waste cans shall be properly disposed of at least once daily or at the end of each shift. (7-1-97)

d. Spray finishing employee clothing shall not be left on the premises overnight unless kept in metal lockers. (7-1-97)

e. The use of solvents for cleaning operations shall be restricted to those having flash points not less than one-hundred (100) degrees Fahrenheit; however, for cleaning spray nozzles and auxiliary equipment, solvents having flash points not less than those normally used in spray operations may be used. Such cleaning shall be conducted inside spray booths and ventilating equipment operated during cleaning. (7-1-97)

f. Spray booths/rooms shall not be alternately used for different types of coating materials, where the combination of the materials may be conducive to spontaneous ignition, unless all deposits
of the first used material are removed from the booth and exhaust ducts prior to spraying with the second used material. (7-1-97)

g. "NO SMOKING" signs in large letters on contrasting color background shall be conspicuously posted at all spraying areas and paint storage rooms. (See Section 170 of this standard.) (7-1-97)

11. Fixed Electrostatic Apparatus: (7-1-97)

a. Where installation and use of electrostatic spraying equipment is used, such installation and use shall conform to all other requirements contained in this section, and shall also conform to the requirements of this subsection. (7-1-97)

b. Electrostatic apparatus and devices used in connection with coating operations shall be of approved types. (7-1-97)

c. Transformers, power packs, control apparatus, and all other electrical portions of the equipment with the exception of high-voltage grids, electrodes, and electrostatic atomizing heads and their connections, shall be located outside of the spraying area, or shall otherwise conform to the requirements of sub-section 240.05 of this section. (7-1-97)

d. Electrodes and electrostatic atomizing heads shall be adequately supported in permanent locations and shall be effectively insulated from the ground. Electrodes and electrostatic atomizing heads which are permanently attached to their bases, supports, or reciprocator, shall be deemed to comply with this section. Insulators shall be nonporous and noncombustible. (7-1-97)

e. High-voltage leads to electrodes shall be properly insulated and protected from mechanical injury or exposure to destructive chemicals. Electrostatic atomizing heads shall be effective and permanently supported on suitable insulators and shall be effectively guarded against accidental contact or grounding. An automatic means shall be provided for grounding the electrode system when it is electrically de-energized for any reason. All insulators shall be kept clean and dry. (7-1-97)

f. A safe distance shall be maintained between goods being painted and electrodes or electrostatic atomizing heads or conductors of at least twice the sparking distance. A suitable sign indicating this safe distance shall be conspicuously posted near the assembly. (7-1-97)

g. Goods being painted using this process are to be supported on conveyors. The conveyors shall be so arranged as to maintain safe distances between the goods and the electrodes or electrostatic atomizing head at all times. Any irregularly shaped or other goods subject to possible swinging or movement shall be rigidly supported to prevent such swinging or movement which would reduce the clearance to less than that specified in sub-section 240.11.f. of this section. (7-1-97)

h. This process is not acceptable where goods being coated are manipulated by hand. When finishing equipment which is manipulated by hand, see sub-section 240.12 of this section. (7-1-97)
i. Electrostatic apparatus shall be equipped with automatic controls which will operate without time delay to disconnect the power supply to the high voltage transformer and to signal the operator under any of the following conditions: (7-1-97)

i. Stoppage of ventilating fans or failure of ventilating equipment from any cause; (7-1-97)

ii. Stoppage of the conveyor carrying goods through the high voltage field; (7-1-97)

iii. Occurrence of a ground or of an imminent ground at any point on the high voltage system; (7-1-97)

iv. Or a reduction of clearance below that specified in sub-section 240.11. f. of this section. (7-1-97)

j. Adequate booths, fencing, railings, or guards shall be so placed about the equipment that they, either by their location or character or both, assure that a safe isolation of the process is maintained from plant storage or personnel. Such railings, fencing, and guards shall be conducting material, adequately grounded. (7-1-97)

k. Where electrostatic atomization is used, the spraying area shall be so ventilated as to insure safe conditions from a fire and health standpoint. (7-1-97)

l. All areas used for spraying, including the interior of the booth, shall be protected by automatic sprinklers where this protection is available. Where this protection is not available, other approved automatic extinguishing equipment shall be provided. (7-1-97)

12. Electrostatic Hand Spraying Equipment: (7-1-97)

a. This sub-section shall apply to any equipment using electrostatically charged elements for the atomization and/or precipitation of materials for coatings on articles, or for other similar purposes in which the atomizing device is hand held and manipulated during the spraying operation. (7-1-97)

b. Conformance. Electrostatic hand spraying equipment shall conform with the other provisions this section, and shall also conform to the requirements of this subsection.

(0-0-000)

c. Electrostatic hand spray apparatus and devices used in connection with coating operations shall be of approved types. The equipment should be so designed that the maximum surface temperature of the equipment in the spraying area shall not exceed one-hundred-fifty (150) degrees Fahrenheit under any condition. The high voltage circuits shall be designed so as to not produce a spark of sufficient intensity to ignite any vapor-air mixtures nor result in appreciable shock hazard upon coming in contact with a grounded object under all normal operating conditions. The electrostatically charged exposed elements of the handgun shall be capable of being energized only by a switch which also controls the coating material supply. (7-1-97)
d. Transformers, powerpacks, control apparatus, and all other electrical portions of the
equipment, with the exception of the handgun itself and its connections to the powder supply
shall be located outside of the spraying area or shall otherwise conform to the requirements of
sub-section 240.05 of this section. (7-1-97)

e. The handle of the spraying gun shall be electrically connected to ground by a metallic
connection and to be so constructed that the operator in normal operating position is in intimate
electrical contact with the grounded handle. (7-1-97)

f. All electrically conductive objects in the spraying area shall be adequately grounded. This
requirement shall apply to paint containers, wash cans, and any other objects or devices in the
area. The equipment shall carry a prominent permanently installed warning regarding the
necessity for this grounding feature. (7-1-97)

g. Objects being painted or coated shall be maintained in metallic contact with the conveyor or
other grounded support. Hooks shall be regularly cleaned to insure this contact and areas of
contact shall be sharp points or knife edges where possible. Points of support of the object shall
be concealed from random spray where feasible and where the objects being sprayed are
supported from a conveyor, the point of attachment to the conveyor shall be so located as to not
collect spray material during normal operation. (7-1-97)

h. The electrical equipment shall be so interlocked with the ventilation of the spraying area that
the equipment cannot be operated unless the ventilation fans are in operation. (7-1-97)

i. The spraying operation shall take place within a spray area which is adequately ventilated to
remove solvent vapors released from the operation. (7-1-97)

13. Drying, Curing, or Fusion Apparatus: (7-1-97)

a. Drying, curing, or fusion apparatus in connection with spray application of flammable and
combustible finishes shall conform to the Standard for Ovens and Furnaces, NFPA 86A, where
applicable and shall also conform with other requirements of this section, and shall also conform
to the requirements of this subsection. (7-1-97)

b. Spray booths, rooms, or other enclosures used for spraying operations shall not alternately be
used for the purpose of drying by any arrangement which will cause a material increase in the
surface temperature of the spray booth, room, or enclosure. (7-1-97)

c. Except as specifically provided in sub-section 240.13.d. of this section, drying, curing or
fusion units utilizing a heating system having open flames or which may produce sparks shall not
be installed in a spraying area, but may be installed adjacent thereto when equipped with an
interlocked ventilation system arranged to: thoroughly ventilate the drying space before the
heating system can be started; maintain a safe atmosphere at any source of ignition; and
automatically shut down the heating system in the event of failure of the ventilating system. (7-1-97)
d. Automobile refinishing spray booths or enclosures, otherwise installed and maintained in full conformity with this section may alternatively be used for drying with portable electrical infrared drying apparatus when conforming with the following: (7-1-97)

i. Interior (especially floors) of spray enclosures shall be kept free of overspray deposits; (7-1-97)

ii. During spray operations, the drying apparatus and electrical connections and wiring thereto shall not be located within spray enclosure nor in any other location where spray residues may be deposited thereon; (7-1-97)

iii. The spraying apparatus, the drying apparatus and the ventilating system of the spray enclosure shall be equipped with suitable interlocks so arranged that; (7-1-97)

iv. The spraying apparatus cannot be operated while the drying apparatus is inside the spray enclosure, the spray enclosure will be purged of spray vapors for a period of not less than three (3) minutes before the drying apparatus can be energized, the ventilating system will maintain a safe atmosphere within the enclosure during the drying process and the drying process apparatus will automatically shut off in the event of failure of the ventilating system; (7-1-97)

v. All electrical wiring and equipment of the drying apparatus shall conform with the applicable sections of section 150 of this standard; (7-1-97)

vi. The drying apparatus shall contain a prominently located, permanently attached warning sign indicating that ventilation should be maintained during the drying period and that spraying should not be conducted in the vicinity that spray will deposit on apparatus. (7-1-97)

14. Automobile Undercoating in Garages: (7-1-97)

a. Automobile undercoating spray operations in garages, conducted in areas having adequate natural or mechanical ventilation, are exempt from the requirements pertaining to spray finishing operations, when using undercoating materials not more hazardous than kerosene (as listed by Underwriters' Laboratories in respect to fire hazard rating 30-40) or undercoating materials using only solvents listed as having a flash point in excess of one-hundred (100) degrees Fahrenheit. Undercoating spray operations not conforming to these provisions are subject to all requirements of this section, and shall also conform to the requirements of this subsection pertaining to spray finishing operations. (7-1-97)

15. Powder Coating. (7-1-97)

a. Electrical equipment and other sources of ignition shall conform to the requirements of section 150 of this standard, the National Electric Code, this section, and shall also conform to the requirements of this sub-section. (7-1-97)

b. In addition to the provisions of sub-sections 240.06. and 240.07. of this section where applicable, exhaust ventilation shall be sufficient to maintain the atmosphere below the lowest
explosive limits for the materials being applied. All non-deposited air-suspended powders shall be safely removed via exhaust ducts to the powder recovery cyclone or receptacle. Each installation shall be designed and operated to meet the foregoing performance specifications. (7-1-97)

c. Powders shall not be released to the outside atmosphere. (7-1-97)

d. The provisions of the Standard for ovens and furnaces, NFPA No. 86A shall apply where applicable. (7-1-97)

e. All areas shall be kept free of the accumulation of powder coating dusts, particularly such horizontal surfaces as ledges, beams, pipes, hoods, booths, and floors. (7-1-97)

f. Surfaces shall be cleaned in such manner as to avoid scattering dust to other places or creating dust clouds. (7-1-97)

g. "NO SMOKING" signs in large letters on contrasting color background shall be conspicuously posted at all powder coating areas and powder storage rooms. (7-1-97)

h. The provisions of sub-section 240.11 and other sub-sections of this section shall apply to fixed electrostatic equipment, except that electrical equipment not covered therein shall conform to sub-section 240.15.a. of this section. (7-1-97)

i. The provisions of sub-section 240.12 and other sub-sections of this section shall apply to electrostatic handguns when used in powder coating, except that electrical equipment not covered therein shall conform to sub-section 240.15.a. of this section. (7-1-97)

j. Electrostatic fluidized beds and associated equipment shall be of approved types. The maximum surface temperature of this equipment in the coating area shall not exceed one-hundred-fifty (150) degrees Fahrenheit. The high voltage circuits shall be so designed as to not produce a spark of sufficient intensity to ignite any powder-air mixtures nor result in appreciable shock hazard upon coming in contact with a grounded object under normal conditions. (7-1-97)

k. Transformers, power-packs, control apparatus, and all other electrical portions of the equipment, with the exception of the charging electrodes and their connections to the power supply shall be located outside of the powder coating area or shall otherwise conform to the requirements of sub-section 240.15.a. of this section. (7-1-97)

l. All electrically conductive objects within the charging influence of the electrodes shall be adequately grounded. The powder coating equipment shall carry a prominent, permanently installed warning regarding the necessity for grounding these objects. (7-1-97)

m. Objects being coated shall be maintained in contact with the conveyor or other support in order to insure proper grounding. Hangers shall be regularly cleaned to insure effective contact and areas of contact shall be sharp points or knife edges where possible. (7-1-97)
n. The electrical equipment shall be so interlocked with the ventilation system that the equipment cannot be operated unless the ventilation fans are in operation. (7-1-97)

16. Organic Peroxides and Dual Component Coatings: (7-1-97)

a. All spraying operations involving the use of organic peroxides and other dual component coatings shall be conducted in approved sprinklered spray booths meeting the requirements of this section. (7-1-97)

b. Smoking shall be prohibited and "NO SMOKING" signs shall be prominently displayed and only nonsparking tools shall be used in any area where organic peroxides are stored, mixed, or applied. (7-1-97)