

Finishing Processes

Rule 20-400 Scope - Rules 20-402 to 20-414 apply where paints, lacquers, or other flammable finishes are regularly or frequently applied by spraying, dipping, brushing, or by other means, and where volatile flammable solvents or thinners are used or where readily ignitable deposits or residues from such paints, lacquers, or finishes may occur.



There may be cases where the paints, lacquers or other finishes, solvents or thinners are all non-flammable but they would be rare. Where this is the case and you want to use the standard wiring method and equipment, don't be surprised if the Inspector requests a letter from the owner and operator stating that no flammable paints, thinners etc. will ever be used in the location.

The most difficult part of an installation in a hazardous location is to determine where the hazards are and how serious they are. When determining these boundaries we should bear in mind that the regulations are concerned not only with flammable vapours but also with highly combustible spray residues. It is a simple problem to design a fixture that can cope with the flammable vapours present in finishing areas but it is altogether another matter to design a fixture that will maintain its cool after it has several layers of paint applied to it. Some residues can be ignited at very low temperatures. It is possible that the normal temperature rise on an explosion proof motor or light fixture would be sufficient to ignite some residue. For this reason it is important that the boundaries of these hazards and the proper location of electrical equipment be firmly established before any electrical work commences.

Rule 20-402 Hazardous Locations

(1)The following areas shall be considered to be Class I, Zone 1 locations:

Subrule 20-402(1)(a)Where adequate ventilation is provided, the interiors of spray booths and their exhaust ducts;



***Spray Booth** - Subrule (a) was revised in this edition of the Code. This subrule now calls for adequate ventilation in the spray booth, any spray booth, in order to reduce the hazard level to Class 1, Zone 1. It does not say so, but it can be deduced that without ventilation any spray booth becomes a Class 1, Zone 0 location. This becomes then, a very serious situation, because there is no electrical equipment available for a Zone 0 location except for intrinsically safe component parts. Adequate ventilation must be provided in every spray booth before any electrical wiring is considered*

Adequate ventilation is defined in Rule 18-002.

Subrule 20-402(1)(b)All space within 6 m horizontally in any direction, extending to a height of 1 m above the goods to be painted, from spraying operations more extensive than touch up spraying and not conducted within the spray booth and as otherwise shown in Diagram 5;

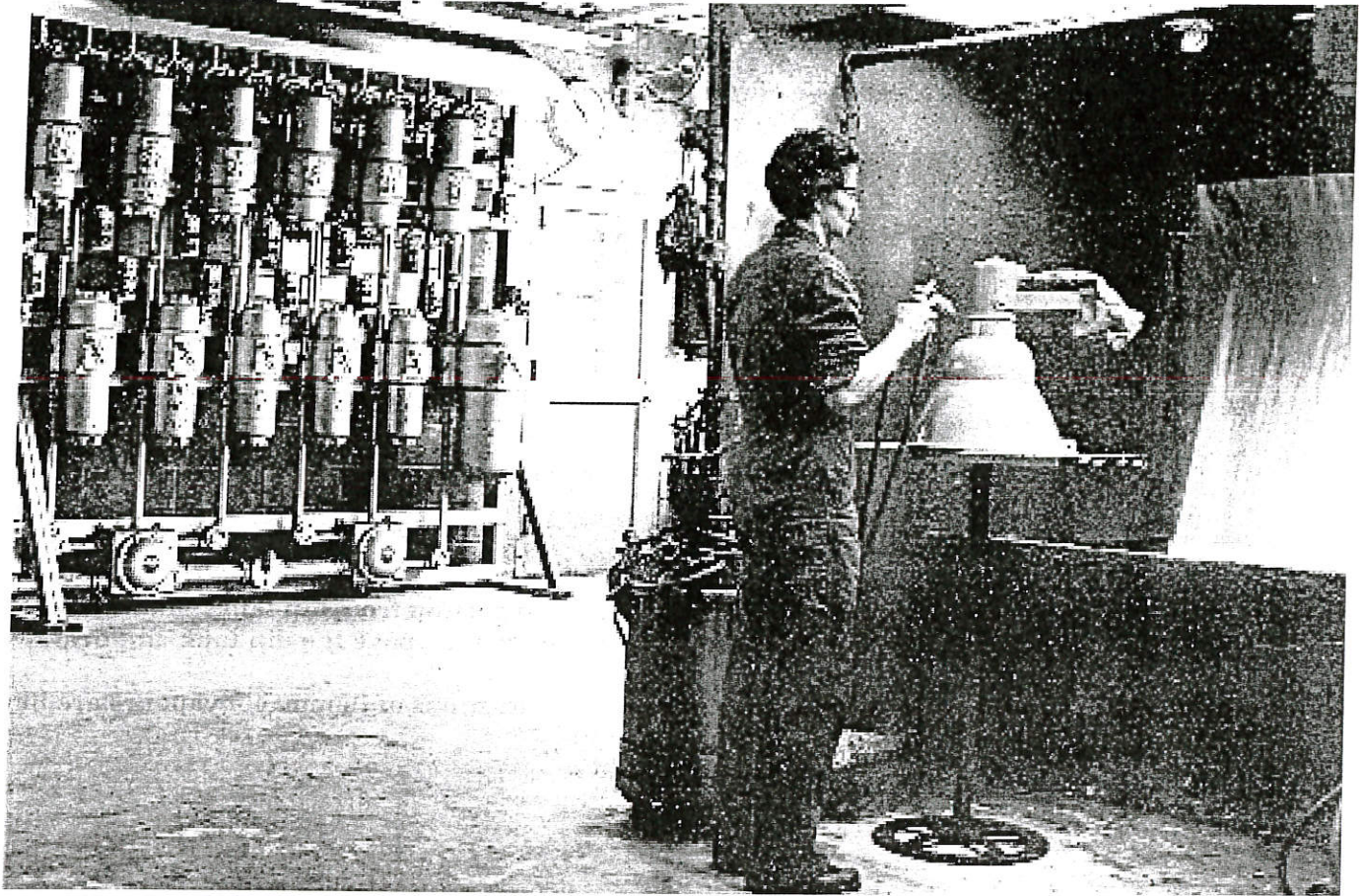


***Open Area Spraying** - Where spray painting is being done regularly or just frequently in an open area (not in a paint spray booth) the code requirements are a little drastic - 6 m (19 ft. 8 in.) in all directions horizontally and 1 m (39 in.) higher than the object being painted is Class I, Zone 1 and beyond this, all the rest of the space in the room, every cubic inch of it, is considered Class I, Zone 2 location, Subrule (4).*

Subrule (b) suggests this operation is taking place in an open floor area in a large plant, not in a paint booth and there is no mention of any ventilation for this operation. It might be difficult to convince the owner of a 40,000 square foot open plant that all of his floor area is a Zone 2 location just because there is a spray painting operation somewhere on that open floor space. Spray painting can be dangerous and this subrule makes the point eloquently.

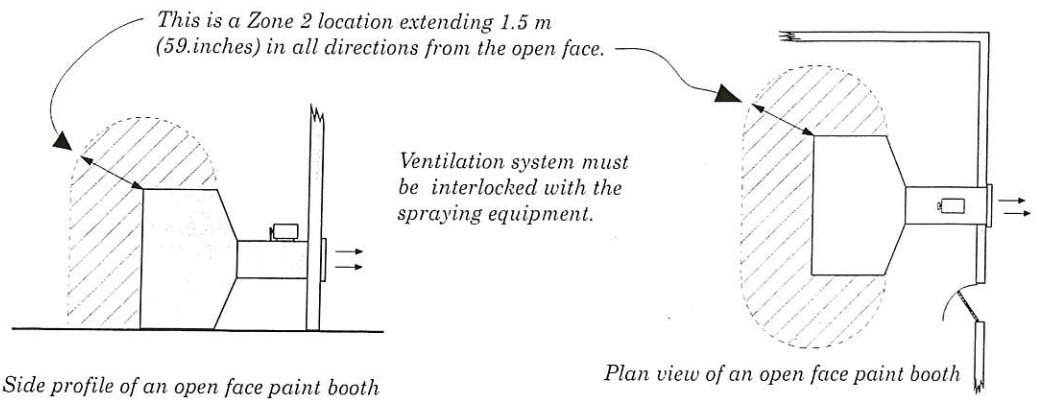
This is illustrated below.

Section 20



CLASS 1, ZONE 1 - All the space within the booth and it's exhaust ducts.

CLASS 1, ZONE 2 - All the space within 1.5 m (59 in.) of the open face of the booth in all directions.

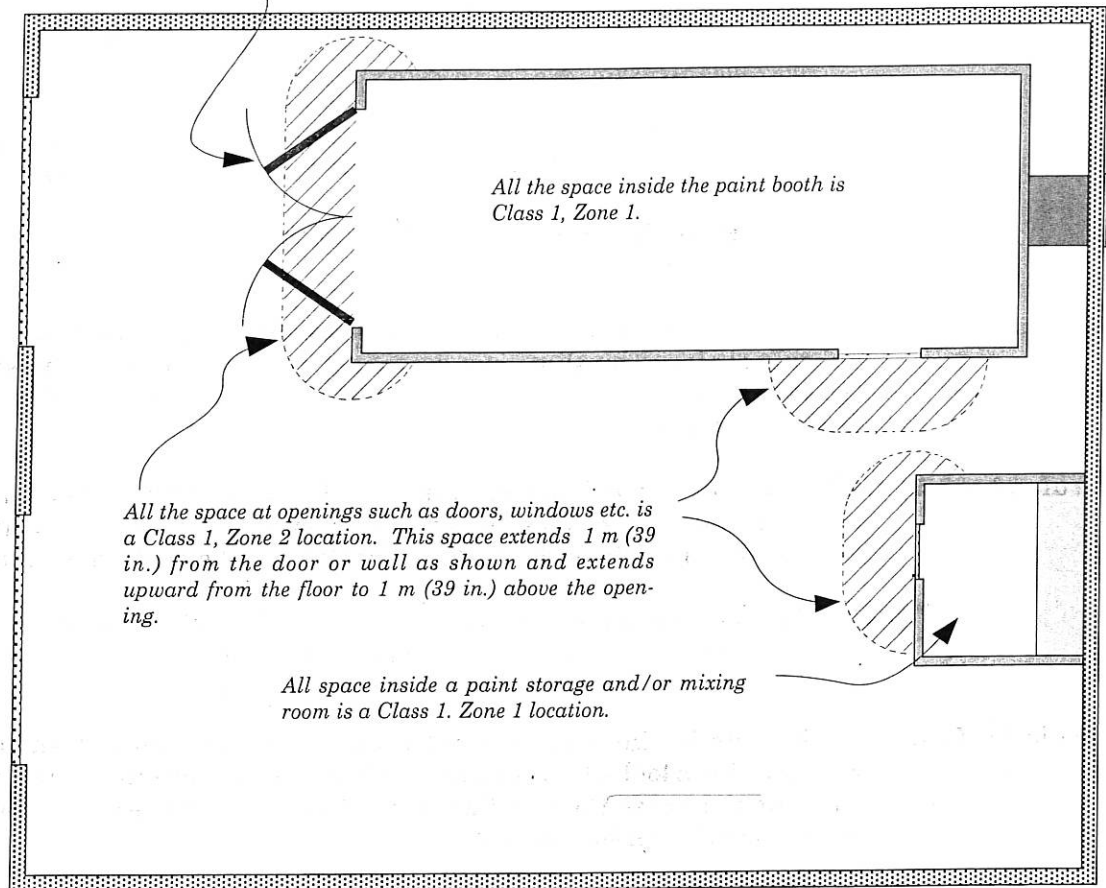


Subrule 20-402(3) For spraying operations confined within a closed spray booth or room, or for rooms where hazardous concentrations of flammable vapours are likely to occur, such as paint mixing rooms, the space within 1 m in all directions from any openings in the booth or room shall be considered to be a Class I, Zone 2 location, and as otherwise shown in Diagram 10.



Auto Body Shop Spray Booth - The illustration below is a plan view of a paint booth in an auto body shop.

This is a Class 1, Zone 2 location measured from the closed door position.



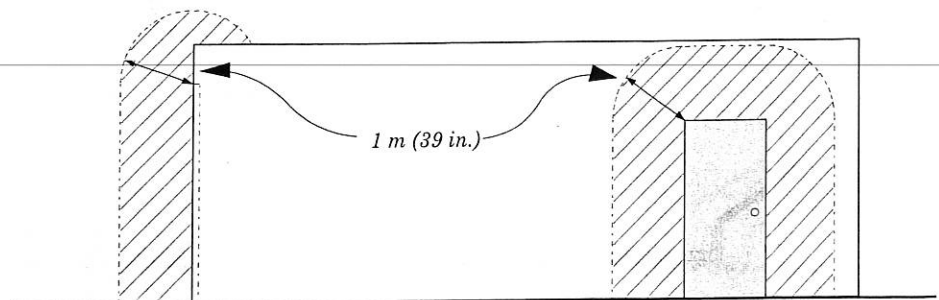
Section 20

CLASS I, ZONE 1 *All the space within the booth.*

CLASS I, ZONE 2 *The area outside of these booths is not normally considered hazardous at all except at doorways and other openings. The above illustration shows a 1 m (39in.) space in all directions from any opening is considered a Class 1, Zone 2 location. The doors leading into these booths are usually tight fitting gasketed type to make the enclosure as dust tight as possible. What's more, these doors simply may not be opened until the paint is fairly dry, at which time the hazard is greatly reduced. However, this subrule says that a 1 m space around any opening shall be considered to be a Zone 2 location.*

The side profile of the above paint booth looks like this:

Side profile of a paint booth showing the Zone 2 location extending outward from any opening in the booth enclosure.



Paint Storage and Mixing Room

Inside a paint mixing room is a Zone 1 location. These rooms are usually very small, therefore the whole room would likely be a Zone 1 location. Check the paint mixing machines to insure they are properly certified for the location. It should also be noted that there may be painting operations which do not use any hazardous paints, lacquers, mixers or solvents. If that is the case, and standard wiring is used, your Inspector will very likely want a written, signed statement from the operators before approving the installation.

Outside of the paint mixing room is a Zone 2 location only at the doorway, or at any other opening.

Subrule 20-402(4) All space within the room but beyond the limits for Class I, Zone 1 as classified in Subrule (1) for extensive open spraying, and as otherwise shown in Diagram 5, for dip tanks and drain boards, and for other hazardous operations, shall be considered to be Class I, Zone 2 locations.

Subrule 20-402(5) Adjacent areas which are cut off from the defined hazardous area by tight partitions without communicating openings, and within which hazardous vapours are not likely to be released, shall be permitted to be classed as non-hazardous.

➤ *Non-hazardous space - The space inside the large shop floor area, beyond the Zone 2 hazardous areas around the openings to the paint booth and the mixing room, shown in the auto spray booth illustration above, is non-hazardous.*

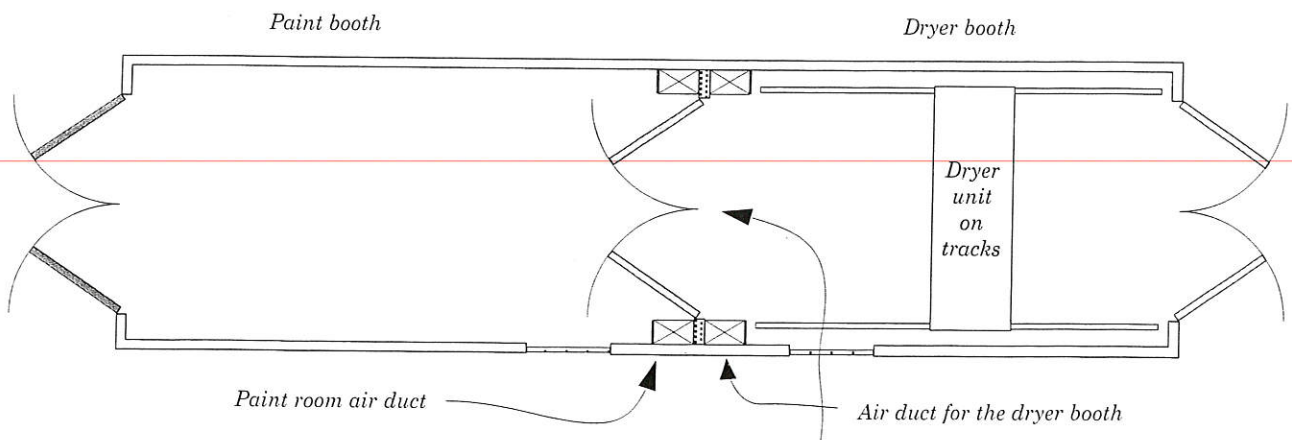
Subrule 20-402(6) Drying and baking areas provided with adequate ventilation and provided with effective interlocks to de-energize all electrical equipment not approved for Class I locations in case the ventilating equipment is inoperative shall be permitted to be classed as non-hazardous.

➤ *Dryer booth - The dryer room is not hazardous provided:*

The door between the painting and the drying rooms is a tight fitting gasketed type and interlocked to prevent painting operation until it is fully closed.

It is equipped with adequate ventilation. This term is defined by Rule 18-002 and the comments.

The dryer equipment must be interlocked with the ventilation system so that it cannot operate until the ventilating system is in fact operating. This equipment can be interlocked with a sail switch in the air stream of the fan. Properly connected into the dryer control circuit, this sail switch will prevent dryer operation until fresh air is actually flowing into the room.



At least 2 door operated switches are required here at this point. One of these must be connected into a valve in the air supply line so that painting cannot take place until these doors are fully closed and the ventilating system is in full operation. The other door operated switch is required here to disallow operation of the dryer until these doors are fully closed and the ventilation system is in full operation

- Subrule 20-402(7) Notwithstanding the requirements of Subrule (1)(b) where adequate ventilation with effective interlocks is provided at floor level and as otherwise shown in Diagram 6:
- The space within 1 m horizontally in any direction from the goods to be painted and such space extending to a height of 1 m above the goods to be painted shall be considered to be a Class I, Zone 1 location; and
 - All space between a 1 m and a 1.5 m distance above the goods to be painted and all space within 6 m horizontally in any direction beyond the limits for Class I, Zone 1 location shall be considered to be Class I, Zone 2 location.



Ventilated Paint Spraying Area -

Where the space is adequately ventilated the hazardous areas are very much smaller.

CLASS I, ZONE 1 -

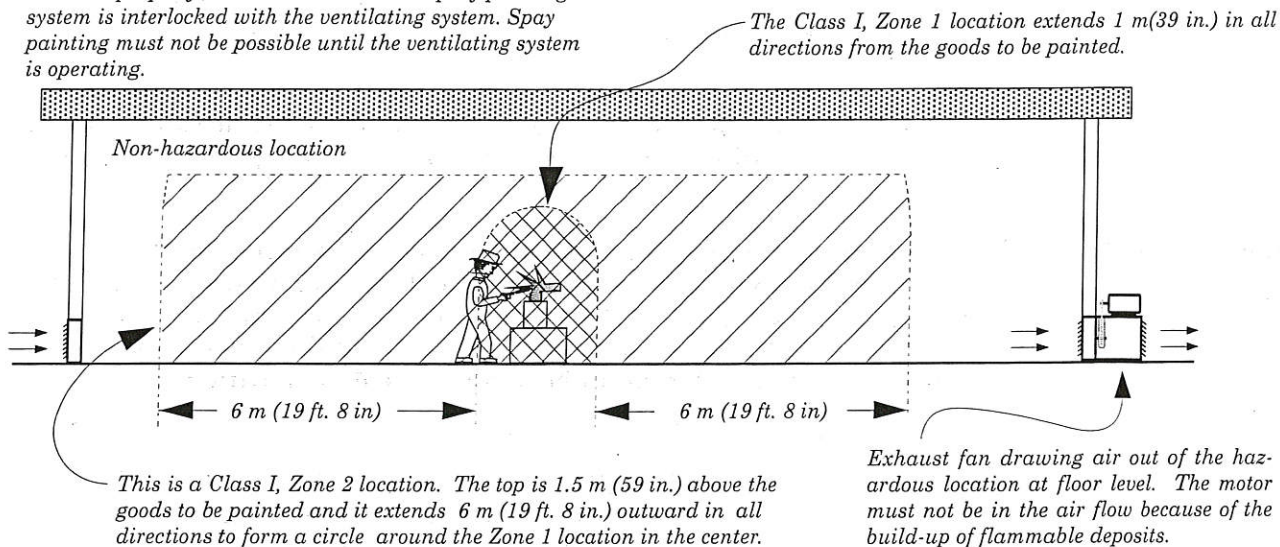
All space within 1 m (39 in.) in any horizontal direction and extending upward 1 m (39 in.) above the object being painted.

CLASS I, ZONE 2 -

All the space within 6 m (19 ft. 8 in.) horizontally in all directions beyond the Zone I location and 500 mm (19.6 in.) higher, or above, the Zone 1 location.

NOTE: For adequate ventilation, see Section 18, page 1 for definition.

This is a properly vented room where the spray painting system is interlocked with the ventilating system. Spray painting must not be possible until the ventilating system is operating.



- Subrule 20-402(8) Notwithstanding the requirements of Subrule (2), where a baffle of sheet metal of not less than No. 18 MSG is installed vertically above the front face of an open face spray booth to a height of 1 m or to the ceiling, whichever is less, and extending back on the side edges for a distance of 1.5 m, the space behind this baffle shall be considered to be a non-hazardous location.



The Class 1, Zone 2 level at an open faced spray booth extends outward in all directions from the front edge of the booth opening. As shown below, this hazardous area also wraps around the upper edge of the booth and extends at least 1.5 m (59 in.) back from the front edge. This means that the normal location for a light fixture mounted on the roof of the booth is a Zone 2 location requiring an expensive light fixture.

To get around this, the Subrule permits a baffle at least 1 m (39.3 in.) high installed above the front edge of the booth as shown below.

Paint booths are not normally constructed on site but there is nothing to prevent that. Most paint booths installed today are manufactured units which are prewired. All that is required on site is assembly and connection to a power supply. The above is shown to illustrate use of standard fixtures to illuminate a hazardous location.

- Subrule 20-406(4) Portable electric lamps or other utilization equipment shall:**
 (a) Not be used within a hazardous area during operation of the finishing process;
 (b) Be of a type specifically approved for Class I locations when used during cleaning or repairing operations.

➤ *Equipment operating in the paint booth during operation of the finishing process is likely to become coated with paint and become overheated to the point where it will ignite the paint deposit. Because portable lamps are perhaps the most vulnerable to overspray and subsequent overheating they are given special mention in this subrule.*

It is relatively easy to manufacture Class 1 electrical equipment but it is not possible to manufacture equipment that can operate safely when blanketed with layers of hazardous paint residue.

Subrule 20-406(5) Notwithstanding Subrule (2):

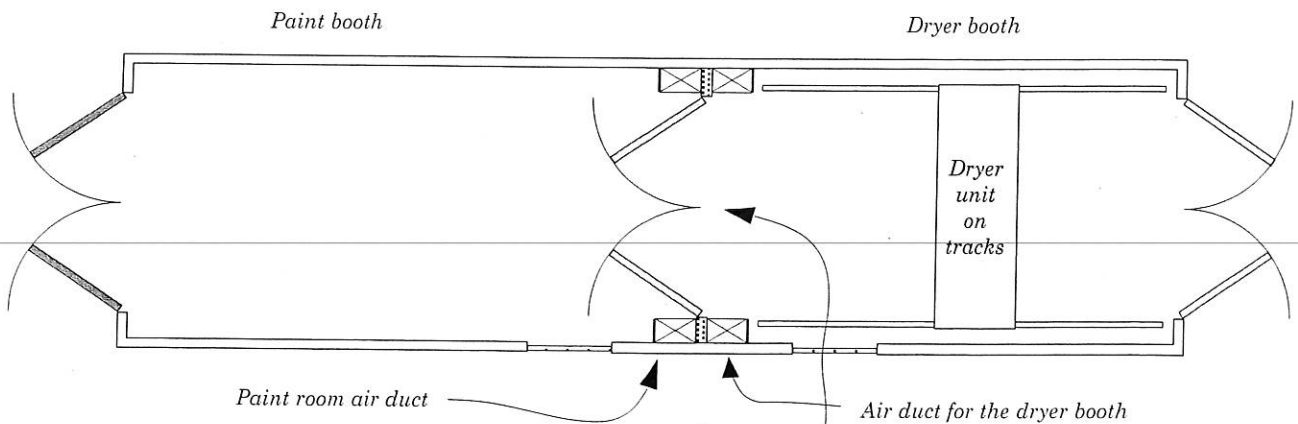
Subrule 20-406(5)(a) Totally enclosed and gasketed lighting shall be permitted to be used on the ceiling of a spray room where adequate ventilation is provided; and

➤ *Adequate ventilation for a spray room is an engineering problem that requires careful consideration of a number of important factors. Once installed and operating such ventilation system will, according to this subrule, allow non-explosionproof but totally enclosed and gasketed lighting fixtures to be mounted on the ceiling, no dimensions given. Note that this subrule refers to a spray room, not a spray booth. There is a big difference.*

This Subrule stands somewhat unique. Contrary to all the other points made in Sections 18 and 20 regarding the dangerous condition existing in a paint spray room. The emphasis here must be placed on ventilation, adequate ventilation.

Subrule 20-406(5)(b) Infra-red paint drying units shall be permitted to be utilized in a spray room if the controls are interlocked with those of the spraying equipment so that both operations cannot be performed simultaneously, and if portable, the paint drying unit shall not be brought into the spray room until spraying operations have ceased.

➤ *The illustration below shows what is required by this subrule.*



At least 2 door operated switches are required here at this point. One of these must be connected into a valve in the air supply line so that painting cannot take place until these doors are fully closed and the ventilating system is in full operation. The other door operated switch is required here to disallow operation of the dryer until these doors are fully closed and the ventilation system is in full operation

Rule 20-408 Fixed Electrostatic Equipment - Electrostatic spraying and detearing equipment shall conform to the following:

- (a) No transformers, power packs, control apparatus, or other electrical portion of the equipment except high-voltage grids and their connections shall be installed in any of the hazardous areas defined in Rule 20402, unless of a type specifically approved for the location;
- (b) High-voltage grids or electrodes shall be located in suitable noncombustible booths or enclosures provided with adequate ventilation; shall be rigidly supported and of substantial construction; and shall be effectively insulated from ground by means of non-porous, noncombustible insulators;
- (c) High-voltage leads shall be effectively and permanently supported on suitable insulators; shall be effectively guarded against accidental contact or grounding; and shall be provided with automatic means for discharging any residual charge to ground when the supply voltage is interrupted;
- (d) Where goods are being processed:
 - (i) They shall be supported on conveyors in such a manner that minimum clearance between goods and high-voltage grids or conductors cannot be less than twice the sparking distance; and
 - (ii) A conspicuous sign indicating the sparking distance shall be permanently posted near die equipment;
- (e) Automatic controls shall be provided which will operate without time delay to disconnect the power supply and to signal the operator in case of:
 - (i) Stoppage of ventilating fans; or
 - (ii) Failure of ventilating equipment; or
 - (iii) Stoppage of the conveyor carrying goods through the high-voltage field; or
 - (iv) Occurrence of a ground or of an imminent ground at any point on the high-voltage system; or
 - (v) Reduction of clearance below that specified in Subrule (d);
- (f) Adequate fencing, railings, or guards which are electrically conducting and effectively bonded to ground shall be provided for safe isolation of the process; and signs shall be permanently posted designating the process area as dangerous because of high voltage.

Rule 20-410 Electrostatic Hand Spraying Equipment - Electrostatic hand spray apparatus and devices used therewith shall conform to the following:

- (a) The high-voltage circuits shall be intrinsically safe and not produce a spark of sufficient intensity to ignite any vapour-air mixtures, nor result in appreciable shock hazard upon coming in contact with a grounded object;
- (b) The electrostatically charged exposed elements of the hand gun shall be capable of being energized only by a switch which also controls the paint supply;
- (c) Transformers, power packs, control apparatus, and all other electrical portions of the equipment, with the exception of the hand gun itself and its connections to the power supply, shall be located outside the hazardous area;
- (d) The handle of the spray gun shall be bonded to ground by a metallic connection and be so constructed that the operator in normal operating position is in intimate electrical contact with the handle in order to prevent build-up of a static charge on the operators body;
- (e) All electrically conductive objects in the spraying area shall be bonded to ground and the equipment shall carry a prominent permanently installed warning regarding the necessity for this bonding feature;
- (f) Precautions shall be taken to ensure that objects being painted are maintained in metallic contact with the conveyor or other grounded support, and shall include the following:
 - (i) Hooks shall be regularly cleaned; and
 - (ii) Areas of contact shall be sharp points or knife edges; and (iii) 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;

- (g) The spraying operation shall take place within a spray area which is adequately ventilated to remove solvent vapours released from the operation and the electrical equipment shall be so interlocked with the ventilation of the Spraying area that the equipment cannot be operated unless the ventilation system is in operation.

Rule 20-412 Wiring and Equipment Above Hazardous Areas

- (1) All fixed wiring above hazardous areas shall conform to Section 12.
- (2) Equipment which may produce arcs, sparks, or particles of hot metal, such as lamps and lampholders for fixed lighting, cutouts, switches, receptacles, motors, or other equipment having make-and-break or sliding contacts, where installed above a hazardous area or above an area where freshly finished goods are handled, shall be of the totally enclosed type or so constructed as to prevent the escape of sparks or hot metal particles.



Because this wiring is entirely above the hazardous location one, or more, of the wiring methods listed in Section 12 will be acceptable. These methods are described in Section 12.

Subrule (2) points to enclosed electrical equipment but that is the normal practice, we no longer use open switches, junction boxes, relays, starters, etc. There are, however, at least two areas that still need special attention. First, lighting fixtures must be of the fully enclosed type so that hot particles from the fixture, cannot fall into the hazardous location below. Simple coverings that will keep these particles from falling to floor level is all that is required, Second, the question of motors with a starting switch or with brushes must be covered to prevent hot particles falling into the hazard level. Note that motors and all other electrical equipment must be above or out of the hazardous location or be certified for the hazard level in which it must function.

Section 20

Rule 20-414 Bonding - All metal raceways and all non-current-carrying metal portions of fixed or portable equipment, regardless of voltage, shall be bonded to ground in accordance with Section 10.



These basic requirements are described in Section 10. There is one point which must be stressed regarding the bonding return path from the hazardous location back to the supply panel. This return bonding path must be assured according to Rule 10-614.