



## **FEMA Recommendations for Protection of Curtained Limited Finishing Workstations using UL 1254 Listed Pre-engineered Dry Chemical Systems**

### **FEMA Recommendations are based upon Live Fire Testing of Prep Stations Utilizing One Or More Vinyl Curtain Walls**

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#### **I) SUMMARY:**

The proliferation of automobile Limited Finishing Workstations using vinyl curtains (as opposed to fixed walls) requires us to re-evaluate dry chemical fire suppression coverage. There appears to be a lack of clear guidance or agreement in applicable standards, such as UL 1254 “Pre-Engineered Dry Chemical Extinguishing System Units”, or NFPA 17 “Standard for Dry Chemical Extinguishing Systems”. First we will examine the requirements for automatic fire protection systems in NFPA 33 – Standard for Spray Application Using Flammable or Combustible Materials – 2003 Edition.

#### **NFPA 33 2003 Edition Requirements**

**“3.3.1.3\* Spray Area.** Any area in which dangerous quantities of flammable or combustible vapors, mists, residues, dusts or deposits are present due to the operation of spray processes. It can be either enclosed or unenclosed and includes: (a) any area in the direct path of a spray application process: (b) the interior of any exhaust plenum an any exhaust duct leading from the spray process: (c) the interior of any limited finishing workstation, spray booth, or spray room, as herein defined: (d) the interior of any recirculation particulate filter, solvent concentrator unit, solvent distillation (recovery) unit, or recirculation air supply unit.”

Limited Finishing Work Stations are therefore considered to be a spray area as defined by NFPA 33.

**Chapter 9 Protection - “9.1\* General.** Spray areas, which include by definition any associated exhaust plenums and exhaust ductwork, any particulate filters, any solvent concentrator units, any recirculation air supply units, and mixing rooms shall be protected with an approved automatic fire protection system.”

Since Limited Finishing Workstations are defined as a spray area, they require an automatic fire protection system. Further requirements are found in later in the Standard.

#### **Chapter 14 Miscellaneous Spray Operations**

**“14.3 Limited Finishing Workstations.** A limited finishing workstation shall be designed and operated in accordance with the requirements of 14.3.1 through 14.3.9.”

**“14.3.1** A limited finishing workstation shall be designed and constructed to have the following:

- (1) A dedicated make-up air supply and air supply plenum
- (2) Curtains or partitions that are noncombustible or limited combustible, as defined in NFPA 220, or that can successfully pass Test Method 2 of NFPA 701
- (3) A dedicated mechanical exhaust and filtration system
- (4) An approved automatic extinguishing system that meets the requirements of Chapter 9”

“**14.3.2** The amount of material sprayed in a limited finishing workstation shall not exceed 3.8L (1 gal) in any 8 hour period.”

“**14.3.3** The limited finishing workstation shall meet all applicable requirements of Chapter 4 through Chapter 10 and Chapter 18 of this standard.”

“**14.3.4** Curtains or partitions shall be fully closed during any spray application operations.”

Under Chapter 14, we see that NFPA 33 requires an automatic fire extinguishing system for Limited Finishing Workstations, the amount of sprayed material is severely limited and that the curtains are to be closed during spray operations. The amount of material being sprayed and the closure of the curtains can be very difficult for a local authority to enforce.

Various devices are appearing in the marketplace as curtained “prep stations” leading end users and some local authorities to believe that these “prep” stations do not require an automatic fire extinguishing system, even though spraying operations are occurring within these “prep stations”. NFPA 33 addresses this issue as well.

“**14.2 Preparation Workstations.** If spraying finishing operations are performed at or in a preparation workstation, the preparation workstation shall be considered an unenclosed spray area and shall meet all of the requirements of an unenclosed spray area.

*Exception: A preparation workstation that is designed and operated in accordance with Section 14.3 shall be considered a limited finishing workstation and not an unenclosed spray area.”*

If spray finishing operations are occurring in a curtained “prep station” that has a dedicated make up air supply or air supply plenum, is using curtains and has a dedicated mechanical exhaust system, then it is not a “prep station” but in fact is considered to be a Limited Finishing Workstation, and therefore requires an automatic fire extinguishing system.

FEMA discussed various methods of protecting these hazards including Total Flood, Local Application Overhead and combinations of both with screening nozzles. Local Application overhead was deemed unacceptable, since this application is designed for a horizontal surface fire such as fuel in depth at floor level and does not address accumulation of residue on the curtains (a vertical surface) nor does it address the possibility of a fire under a vehicle within the workstation. Total Flood was deemed unacceptable as well. While Total Flood application addresses the possibility of fire occurring on the vertical surface, it does not address what may happen with the curtains during a fire scenario, what will happen if one or more curtains are left open or the possibility of a fire occurring under a vehicle within the workstation.

FEMA contends that it is entirely possible that the many end users would utilize the Limited Finishing Workstation to paint entire vehicles. FEMA members who market and sell pre-engineered systems that are UL Listed under UL Standard 1254 for Vehicle Paint Spray Booth applications have proven that their systems are effective when a vehicle is present, particularly to the underside of the vehicle. Therefore, a determination was made that our in-house fire testing would be performed using some variation of UL-listed vehicle paint

spray booth coverage. The desire was to arrive at a method of fire suppression that was both practical and conservative in nature.

## **II) TEST METHOD:**

- a. **Test Apparatus:** A module based on a FEMA member's current vehicle paint spray booth UL listing was employed. (Typically, in most systems, four nozzles protect a 'standard' vehicle paint spray booth of dimensions 15' wide x 28' long x 10' tall.) The module ceiling was constructed of plywood. The module was surrounded on all four sides with commercially-available solid vinyl curtains carrying an NFPA 701 flame resistant rating. The curtains were installed with a 3" air gap at the ceiling, with a 6" gap at the floor level to represent "worst case scenarios" where more air is allowed into the spray area to help feed the fire and hinder extinguishment. The module of the following dimensions was created:
- b. **Module Dimensions:** 7.5' wide x 14' long x 10' tall. For the Class B Heptane can fire tests, a barrier of dimensions 3.75' wide x 10.5' long x 6' tall was constructed per UL 1254.

## **III) CONCLUSIONS:**

The behavior of the vinyl curtains when exposed to heat is evident from our testing. Although flame resistant, they will shrink away from flame, thereby leaving an opening correlating to the size and intensity of the fire. Before any rational approach to fire suppression can be adopted, certain assumptions must be made:

### Assumptions:

- a. Entire vehicles **will** be spray painted inside these prep stations.
- b. Fire can spread into the upper corners of the prep station, perhaps into any ceiling-mounted air intake filters.
- c. Some percentage (NOT 100%) of the curtain enclosure will be destroyed before detection and actuation of the system, thus allowing dry chemical to escape the perimeter of the prep station.
- d. NFPA 33 requires that the curtains be closed during any spray operations

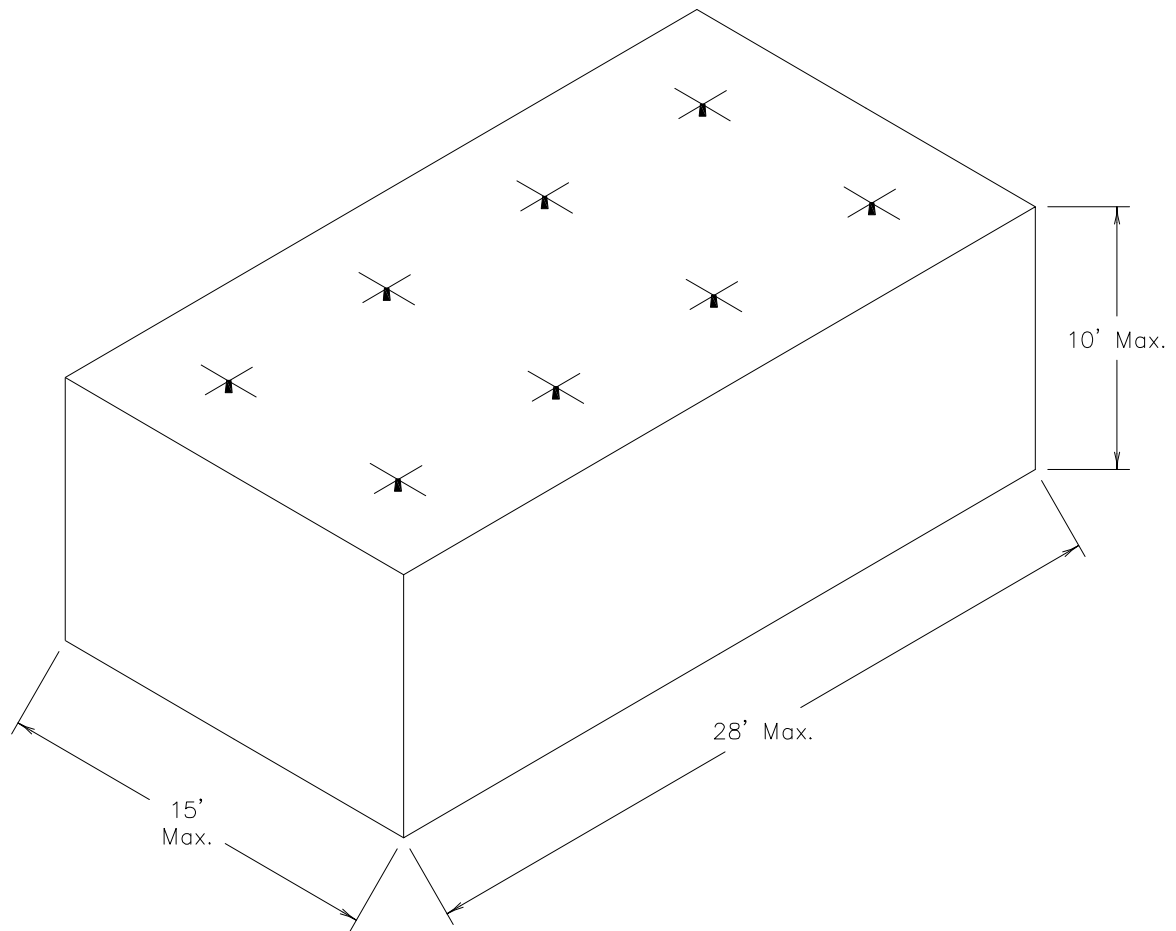
If these assumptions are accepted, then here is how we believe they should be addressed (in order):

- 1) Some form of vehicle paint spray booth protection should be adopted ensuring adequate protection underneath the vehicle.
- 2) Local application by itself is inadequate to extinguish fires in the upper reaches of the prep station.
- 3) In all but the most catastrophic of conditions, there will be enough enclosure remaining to allow for sufficient build-up of dry chemical.

Expanding further on point 3): The largest hole produced in the vinyl curtain was due to the crib fires, 12" from the curtain (the same distance tested by UL for solid walls). The area of the burn opening was approximately 21 ft<sup>2</sup>. The total burn area of two cribs would then account for less than 3% of the total area of the maximum possible prep station size. It is also important to remember that the pre-burn period for crib fires is 2 minutes. Any thermal detector of appropriate temperature rating should respond well before 2 minutes.

Based on this argument and the test results, FEMA believes that doubling the amount and flow rate of dry chemical into a prep station over an equivalently sized vehicle paint spray booth is conservative fire protection. Therefore, for any prep station of maximum dimensions of 15' wide x 28' long x 10' tall, two rows of four nozzles would be required.

This would apply to any number of vinyl-curtained walls, as long as a ceiling exists. See **Figure C**. All other parameters for vehicle paint spray booth coverage should apply, including temperature limitations and maximum nozzle offsets.



**Figure C**

UL Listed nozzle coverages for standard (automobile) sized vehicle paint spray booths may vary slightly from one manufacturer to another. FEMA recommends that the listed coverage, regardless of the system manufacturer being used, should be doubled when protecting Curtained Limited Finishing Work Stations. Only overhead (or “center of module”) nozzle locations should be used for this application. Listed “sidewall” or “centerline” nozzle placement is not considered by FEMA to be appropriate for this application based upon the situation and live fire testing.

Duct and plenum protection would be used according to the individual system’ listed Design, Installation and Maintenance manual.

Based upon the live fire tests conducted, it is FEMA’s opinion that this approach will provide superior and conservative fire protection for this unique hazard.

#### **IV) Update for NFPA 33 2016 Edition**

The 2016 edition NFPA 33 addresses the proliferation of membrane enclosures by redefining the term “spray area” and in a newly written Chapter 18. NFPA 33 2016 defines a “spray area” as follows:

**3.3.2.3\* Spray Area.** Any fully enclosed, partly enclosed, or unenclosed area in which dangerous quantities of flammable or combustible vapors, mists, residues, dusts, or

deposits are present due to the operation of spray processes, including (1) any area in the direct path of a spray application process; (2) the interior of a spray booth, spray room, or limited finishing workstation, as herein defined; (3) the interior of any exhaust plenum, eliminator section, or scrubber section; (4) the interior of any exhaust duct or exhaust stack leading from a spray application process; (5) the interior of any air recirculation path up to and including recirculation particulate filters; (6) any solvent concentrator (pollution abatement) unit or solvent recovery (distillation) unit; and (7) the inside of a membrane enclosure. The following are not part of the spray area: (1) fresh air makeup units; (2) air supply ducts and air supply plenums; (3) recirculation air supply ducts downstream of recirculation particulate filters; and (4) exhaust ducts from solvent concentrator (pollution abatement) units.

Chapter 18 addresses the construction and processes within membrane enclosures. The membrane enclosure process usually involves erecting scaffolding or other support structure around a workpiece. A plastic membrane is then wrapped around the scaffolding creating an enclosure. Operations other than painting take place inside of the membrane enclosure including prep work, grinding, hot work, etc. though these operations are not to take place during painting. This process was developed for large workpieces that are difficult or impossible to transport such as water towers, yachts, bridges, locomotives, etc. NFPA 33 recognizes the unique nature of these enclosures and limits the installation of membrane enclosures to 180 days and finishing operations to the single workpiece for which the enclosure was constructed.

The FEMA study and conclusions do not address membrane enclosures as defined in NFPA 33 2016. It should be further noted that fire protection for similar membrane type collapsible booths is not addressed. This study addresses curtained workstations with a hard top and curtains in the closed or operating position. Chapter 18 fire protection requirements exclude pre-engineered extinguishing systems from membrane enclosures, unless specifically listed for that purpose.