

## Memorandum

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**Subject** Flammable Solid Storage Strategy at 39 Jackson Rd

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### 1.1 Project Overview

VulcanForms is fitting out a new space at 39 Jackson Road, Devens, MA to house their third 3D printing facility. The building at 39 Jackson is approximately 72,000 sf and the space is designed in accordance with the 10<sup>th</sup> Edition of the Massachusetts State Building Code (780 CMR), Massachusetts Comprehensive Fire Safety Code (527 CMR 1.00), and referenced NFPA standards. The building is a fully sprinklered Type IIB unlimited-area facility.

The Phase 1 fitout scope entails fitting out an approximately 30,000 sf footprint portion of the 39 Jackson Rd building with a mix of manufacturing space for 3D printers, storage for raw material (titanium powder), and supporting office/lobby space. This memorandum addresses Phase 1 only.

### 1.2 Hazardous Material

The building's hazardous materials strategy will utilize a mix of control area approach and Group H occupancy. As the building will be utilized for 3D printing operations, the primary hazardous materials expected within the building are flammable solids (titanium powder) and inert gases (argon). Inert gas (e.g., argon) quantities are not limited per MBSC Table 307.1(1).

The maximum allowable quantities (MAQs) for a single first floor control area for flammable solids in a fully sprinklered building are as follows (below). Note that the aggregate of all in-use and storage amounts cannot exceed the MAQ for storage.

- When stored in approved storage cabinets: 500 lbs storage; 250 lbs closed use; 50 lbs for open use
- When not stored in approved storage cabinets: 250 lbs storage; 250 lbs closed use; 50 lbs for open use

In order to support 3D printing operations, the quantity of titanium powder, a flammable solid, in storage is expected to be approximately 20,000 lb for Phase 1. As the quantities of flammable solids storage will exceed the MAQ, a Group H-3 occupancy room (approximately 380 sf in area) will be utilized for storage. The features of the Group H-3 occupancy storage room are further described in the next section.

### 1.3 Group H-3 Flammable Solid Storage Room Features

The 39 Jackson Rd Group H-3 flammable solids storage room will be constructed to meet the following code requirements.

#### 1.3.1 Allowable Material Classes

The Group H-3 storage room at 39 Jackson will be used solely for the storage of flammable solids in amounts greater than the MAQ. Materials incompatible with titanium powder are not permitted to be stored within the same room unless they are stored in listed cabinets [MFSC §60.5.1.12].

Storage of the following materials in quantities that exceed the MAQ are also permitted be within a High-Hazard Group H-3 occupancy:

- Combustible or flammable liquids, where stored in closed containers or in systems with pressures of 15 psi or below
- Flammable solids
- Cryogenic fluids, oxidizing
- Organic peroxides – Class II and III
- Oxidizers – Class 2
- Oxidizers – Class 3, where stored in closed containers or in systems with pressures of 15 psi or below
- Unstable reactive materials – Class 2
- Water reactive materials – Class 2

Any hazardous materials that are not listed above must be reviewed further before being stored in a Group H-3 occupancy room.

**No other hazardous materials are anticipated for storage in the Group H-3 room as part of the Phase 1 fitout.**

#### 1.3.2 Group H-3 Construction

Group H-3 occupancies are required to be separated from adjacent occupancies by rated fire barriers in accordance with **Table 1** [MSBC Table 508.4]. Where a Group H-3 room height does not extend to the building ceiling, a 1-hour fire-rated ceiling is required to separate the space vertically from the rest of the building.

**Table 1: Group H-3 Fire Rated Separations**

Occupancy	Group H-3 Minimum Required Separation (hrs)
Group B, S-1, F-1	1
Group S-2	2
Group A	2

**The Group H-3 storage room will be separated from the adjacent Group F-1 occupancy area by a 1-hour fire rated separation. The room will be partial-height (14-ft) within the full height Group F-1 shell warehouse space, so a 1-hour fire-rated ceiling will be provided.**

#### Group H-3 Area Limitation

39 Jackson is a Type IIB unrated noncombustible building with primary use under Group F-1 occupancy. The building is fully sprinklered and is one (1)-story with a mezzanine. Under the 10<sup>th</sup> edition of MSBC §507.4, the building is classified as an Unlimited Area, Type IIB.

Group H occupancies are permitted in Unlimited Area buildings containing Group F or S occupancies. When located on the perimeter of a building, with not less than 25% of the perimeter as an exterior wall, the allowable area for Group H occupancies is limited by the smaller of the following two criteria [MSBC §507.8]<sup>1</sup>:

- The aggregate floor area of all Group H occupancy spaces do not exceed 10% of the area of the building. 39 Jackson has a building footprint of 72,000 sf; 10% of the building area is 7,200 sf;
- The area limitation of Group H occupancies in MSBC §506 based on the building’s Construction Type. For a Type IIB building, the allowable area for a Group H-3 occupancy is 14,000 sf without frontage increase per MSBC §506.

Accordingly, the maximum allowable area for Group H-3 occupancies located on the perimeter of the 39 Jackson building is 7,200 sf, governed by the 10% building-area limitation.

Where a Group H-3 room is used solely for the storage of titanium powder (i.e., no flammable or combustible liquid storage), a Group H-3 room is may be located on the interior of a building provided that the Group H-3 area does not exceed 25% of the allowable area listed in MSBC Table 506 [MSBC §507.8.1.1]. This equates to the following:

- For a Type IIB building, MSBC §506 allows 14,000 sf for a Group H-3 occupancy without frontage increase. Accordingly, 25% of 14,000 sf is 3,500 sf.

In summary, the maximum allowable area of Group H-3 occupancies at 39 Jackson, based on position within the building, are presented in **Table 2**:

**Table 2: Group H-3 Allowable Area**

Location in Building	Group H-3 Allowable Area
Group H-3, located on the perimeter of the building, with at least 25% of the perimeter on an exterior wall	7,200 sf
Group H-3, located interior to the building	3,500 sf

**The Group H-3 storage room will be approximately 380 sf and therefore meets allowable area requirements.**

### 1.3.3 Exterior Wall Ratings

Exterior wall ratings are determined based on the fire separation distance (FSD) between the building and nearby adjacencies. The FSD is defined as the distance from the building face to the closest interior lot line, or, the centerline of a street, or an imaginary line between two buildings on the lot. Exterior wall ratings for Group H occupancies are as follows [MSBC Table 705.5]:

**Table 3: Exterior Wall Ratings for Group H Occupancies in Type IIB Buildings**

Fire Separation Distance = X (ft)	Fire-Resistance Rating of Exterior Group H Walls (hrs)
X < 5	3

<sup>1</sup> MSBC §415.6 and MBSC §507.8.2. Note that this provision is specific to Group H-3 occupancies that are not used for flammable and combustible liquid storage complying with NFPA 30

$5 \leq X < 10$	2
$10 \leq X < 30$	1
$X \geq 30$	0

All FSD for the 39 Jackson building are greater than 30 feet away, therefore, unrated exterior walls are compliant with MSBC §602.

### 1.3.4 Fire Suppression

Automatic sprinkler protection is required for all Group H occupancies [MSBC §415.4]. Group H-3 rooms storing flammable solids are to be designed to the minimum criteria for Extra Hazard Group 1 (EH1) per NFPA 13 for spaces containing large amounts of combustible contents [NFPA 13 §4.3.5].

**Refer to Fire Protection Engineer of Record design.**

### 1.3.5 Specialty Detection and Alarm

Where emergency alarm systems are required, they must be provided with emergency or standby power and be electrically supervised and monitored at an approved location [MSBC §415.5.4].

No specialty detection and alarm are required for the Group H-3 storage room.

### 1.3.6 Automatic Smoke Detection

Where Group H occupancies contain highly toxic gases, organic peroxides, or oxidizers, they shall be provided with an automatic smoke detection system [MSBC §907.3.5].

No material classifications listed above will be stored in the Group H-3 room, so smoke detection is not required.

### 1.3.7 Emergency Hazardous Materials Alarm

The Group H-3 room is required to be provided with an emergency hazardous material alarm manual pull station located outside the room per MSBC §415.5.1. Activation of the alarm-initiating device will sound a local alarm to alert occupants of an emergency situation involving hazardous materials inside the Group H-3 room.

### 1.3.8 Emergency Alarm for Transport

The Group H-3 room is designed as an accessory occupancy in accordance with MSBC Section 508.2. As such, requirements applicable to Group H occupancies do not apply outside the boundaries of the Group H occupancy. Emergency alarms per MSBC §415.5.2 along routes of transport are not required.

VulcanForms should provide spill kits along the routes of transport capable of addressing a spill of titanium powder along the transport route through the building.

### 1.3.9 Explosion Control

Explosion control is not required for the storage of flammable solids in amounts greater than the MAQ per MSBC Table 414.5.1.

### 1.3.10 Hazardous Electrical Classification

Unclassified electrical equipment is appropriate for rooms storing flammable solids.

### 1.3.11 Spill Control and Secondary Containment

Spill control and secondary containment are not required for the storage of flammable solids in amounts greater than the MAQ per NFPA 400 §13.2.

### 1.3.12 Ventilation

Per NFPA 400 §13.2.4, ventilation for the Group H-3 room storing titanium powder does not need to comply with ventilation requirements per NFPA 400 Chapter 6.

Ventilation design for the Group H-3 room will be in accordance with the IMC. A hazardous exhaust system per IMC §510 is not required. Mechanical exhaust ventilation is required for the room per IMC §502.8. Additional system requirements specified in IMC §502.8.1.1 are not required based on the exception for flammable solid storage areas complying with IFC §5904<sup>2</sup>.

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<sup>2</sup> IFC §5904 requires that indoor storage of flammable solids in quantities exceeding the MAQ per control area be limited to pile sizes of 1,000 ft<sup>3</sup> (28 m<sup>3</sup>) or less, with each pile separated by aisles defined per IFC §5904.2. The density of titanium powder is 4,430 kg/m<sup>3</sup>, equating to an allowable pile size of 124,040 kg before requiring aisle separation; VulcanForms does not plan to exceed 20,000 kg of titanium, stored in 10-kg drums for the scope of Phase 1, therefore the planned storage quantity for the Group H-3 room is less than a single pile as defined by IFC §5904.