CODE COMPLIANCE GUIDELINES FOR CANNABIS EXTRACTION FACILITIES

***Informational Note**: The content and guidance contained within this guideline is largely sourced from the Jackson County, Oregon guide on cannabis extraction facilities, which provides a deep background description of the hazards and mitigations thereof in cannabis extraction.*

This reference document is provided solely for the convenience of the reader to help clarify how the International Fire Code (IFC) and International Building Code (IBC) are applied to marijuana extraction processes and equipment at commercial facilities. This guideline addresses the general concepts of the cannabis processes and is based upon the 2018 Editions of the IFC and IBC, and the official Code and Commentary publications. Jurisdictional entities are permitted to adopt/enforce interpretations such as those represented in this guideline under authority of IBC and IFC Sections 104.1.

The intent of this guideline is not to identify or discuss every code requirement applicable and it is not intended to be used as a direct regulatory document. This document serves in an advisory capacity only. It is the responsibility of the persons performing these processes and/or otherwise responsible for the design or construction of extraction rooms, equipment, and operations to follow all applicable Codes and Standards as adopted by the State or Local Jurisdictional Authority.

Cannabis extraction employs several concepts that are common to solvent extraction; however, the scale of cannabis extraction is magnitudes smaller than a traditional solvent extraction facility. The hazards and code requirements for industrial-scale extraction (e.g. coffee decaffeination) are different from those associated with cannabis extraction. A similar comparison can be made to small, craft beer breweries vs. globally-known brewing companies.

Technical Assistance Reports and Equipment Review Reports

Technical Assistance Report:
The IFC contains language in Section 104.7.2 that allows the fire code official to require a Technical Assistance Report for the proposed cannabis extraction process and facility. Due to the unique nature and hazards associated with cannabis extraction using hazardous materials, a Technical Assistance Report is generally required by most fire code officials. Many Jurisdictions do not have the required staffing, resources, experience, or technical expertise to perform an all-inclusive review of cannabis extraction, and therefore require experienced professionals and subject matter experts to review the manufacturing processes and to provide code compliance recommendations.

Equipment Review and Report:
In addition to the optional Technical Assistance Report, IFC Sections 3904.2 and 3904.3 require specific equipment reviews and reports for each piece of extraction equipment to be used, due to the lack of current Listing procedures to ensure personnel and process safety. These equipment-specific reviews and reports are required to be developed and stamped by a Mechanical Engineer Licensed in the state of practice (i.e. “Registered Design Professional”), and accompanied by a site inspection of each piece of equipment by the individual or company who produced the equipment report.

Whereas the requirement of the Technical Assistance Report in Section 104.7.2 for the facility and process as-a-whole is at the discretion of the fire code official, the Registered Design Professional’s review and report of the extraction equipment itself *is directly required by Section 3904.2.*

Part 1 – Extraction Process Equipment

Extraction equipment, including equipment used for winterization or other oil refining or distillation processes that uses hazardous materials (i.e. flammable / combustible liquids, Carbon Dioxide (CO_2), butane, propane, hexane, pentane, etc.), are required to be listed with quantities and storage method in the submittal documents. As this section deals with just the equipment, see also information on submittal requirements below for occupancy factors, plans, and report requirements.

1.1 Extraction with Hydrocarbons, Flammable Liquids, and Carbon Dioxide

Because there is currently no *listing* (such as UL, ETL, etc.) available for compressed-gas or flammable liquids extraction systems, extraction equipment review and approval is required by the local Authority Having Jurisdiction (AHJ) and the IFC.

To obtain equipment approval, an engineering report must be signed and sealed by a licensed Mechanical Engineer in the state of practice (a "Registered Design Professional"), and must be submitted for approval to the AHJ in accordance with IFC Sections 3904.2 and 3904.3. Due to the variations or modifications that often occur between the original equipment design and equipment installation, each piece of extraction process equipment must be reviewed during a site inspection from the same Registered Design Professional or firm employing an "approved professional" which authored the equipment report in accordance with IFC Section 3904.4. The site inspection reviews the on-site equipment installation and configuration prior to startup of any processes. It is prohibited to initiate production prior to this site inspection and final Approval by the local AHJ.

In addition to the engineering report, an owner's operation manual must be submitted with specific instructions regarding proper use of the equipment and any safety provisions identified. Equipment submitted will only be approved either by a Manufacturer's Engineering Report, a Site-Specific Engineering Report or by an approved third-party testing / certification agency. In addition to this equipment and system engineering report approval process, if the extraction equipment uses electrical components, a National Recognized Testing Laboratory (NRTL) listing is also required in addition to the engineering report certifying that the electrical components are compliant with appropriate electrical standards.

It is the responsibility of the design engineer to justify how the extraction system meets the IBC, the IFC, and any other national standards as a basis of design, including an analysis / description of every component of the system. Thus far, for an approved LP-Gas system (i.e. butane or propane), only closed-loop systems have been designed to applicable Codes and Standards. Open blasting of hydrocarbons is both illegal and highly dangerous.

1.1.1 Site-Specific Engineering Report

Site specific engineering reports are generally the most common, and are submitted for specific approval for an exclusive location and a specific piece of equipment. These reports contain the specific address of where the equipment is to be used, and the exact serial number of each piece of equipment.

If the equipment is modified at any time, or if the equipment is moved to a new address, the associated equipment approval is voided. New field inspections and equipment verification will be required for approval.

1.1.2 Manufacturer's Engineering Report

For manufacturers of extraction equipment, a Manufacturer's Engineering Report can be submitted for approval in lieu of submitting the Site-Specific Report. Once approved, the report may be referenced and included at other specific locations provided the Engineer of Record certifies that the location address and serial number of the equipment on site meets the approved Manufacturer's Engineering Report. Care must be taken when citing Manufacturer's Engineering Reports, given the process evolution that equipment goes through over time.

If the equipment is modified at any time, or if the equipment is moved to a new address, the associated equipment approval is voided. New field inspections and equipment verification will be required for approval.

1.1.3 Extraction using LP-Gas (i.e. Butane, Propane, or mixtures thereof)

Only closed-loop type LP-Gas extraction equipment is permitted. Open blasting extractions or equipment that releases butane to the atmosphere during the active extraction process is extremely dangerous and is prohibited per the IFC.

Under certain circumstances and specific ignition source controls, LP-Gas can be slowly released via off-gassing, such as when opening the reaction chamber after the extraction process has completed, and the spent plant material needs to be removed. This part of the process is similar to clothes washing machines, wherein after the wash cycle has completed and the water has been pumped out, the clothes remain damp and the water begins to evaporate. Although the scope of NFPA 58 as-a-whole does not apply to cannabis extraction using LP-Gas, Chapter 7.3 is specifically adopted in the Exception to IFC Section 3903.7. The intent of NFPA 58 Chapter 7.3 is for LP-gas "releases" and not the slow, unpressurized off-gassing.

1.1.4 Extraction using Flammable Liquids (Ethanol, Hexane, Pentane, etc.)

Only closed-loop type flammable liquids extraction is permitted. Transferring flammable liquids via open-pouring from one vessel to another is considered use-open and must be performed in a properly ventilated enclosure or area specifically designed for these operations.

1.2 Flammable Liquid Distillation or Evaporative Process Equipment

There are numerous methods to perform distillation or evaporative extraction / refinement processes. In general, electrified equipment used in these processes is required to be listed by an NRTL for the intended use and is required to be operated within the manufacturer's guidelines.

Common solvent recovery equipment such as rotary evaporators are typically listed for distillation processes, and more specifically when processing flammable liquids. Where distillation stills or heated evaporation processes are performed, the heating source must be listed as explosion-proof (i.e. rated for the electrically classified location) unless it can be shown that the equipment has been tested during its listing to heat flammable liquids without the explosion-proof classification. Approval of the proposed process equipment must be submitted as part of the permitting review, in the overall equipment list to be submitted on each drawing set.

1.3 Vacuum Ovens

Vacuum ovens that process flammable or combustible hazardous materials (i.e. alcohol/oil mixtures, oil containing off- gassing LP-Gas, other flammable liquids, etc.), must be rated to process these vapors (typically an explosion-proof classification). It is the responsibility of the extraction process operator to ensure the material being introduced into the oven does not contain volatile chemicals. All vacuum ovens shall be listed by an NRTL, such as a Listing to UL Standard 61010-1.

1.4 Refrigerators, Freezers, and Winterization Processes

Refrigerated storage of flammable liquids - typically during winterization or raw ethanol storage - including oil dissolved into flammable liquids must use refrigerators and freezers rated to store flammable liquids. Only "Lab-Safe" or "Flammable Safe" refrigerators and freezers can be used. Refrigerators or freezers listed for use in hazardous environments are also acceptable. Residential type refrigerators are not rated by the manufacturer for flammable liquid storage or processing, and present a significant explosion hazard.

Although NFPA 45 *Standard for Laboratories Using* Chemicals is not usually adopted in Jurisdictions that adopt the ICC family of Codes, it provides excellent information on refrigerators and freezers used for flammable liquid storage.

The main point to be mindful of, is that there are currently no freezers *listed* for the storage of flammable liquids, where the freezer is rated for temperatures colder than -25°C. Most extraction facilities desire to freeze ethanol to -40°C or -80°C. Currently, any freezer used that is rated below -25°C is not *listed for the storage of flammable liquids.*

Many industrial freezer manufacturers are currently working with NRTLs to obtain *listing* for such use; however, as of August 1, 2019, none have received such *listing.*

Part 2 – General Facility Requirements

Occupancy Classification, Alternative Methods or Materials, Extraction Room Construction, Exhaust, Ventilation & Electrical Systems Requirements

The cannabis extraction process is a complex system of solvents, specialty equipment, hazards and mitigations unique to the industry, primarily to the rapid growth and expansion of cannabis extraction. Large industrial-scale oil extraction processes (such as coffee decaffeination) carry additional requirements and safeguards that are beyond the scope of this guidance document. The intent as noted previously, is to provide general guidelines to the small-scale or limited-production cannabis extraction processes.

2.1 Occupancy Classification

The Use and Occupancy Classification of cannabis business functions are found in Chapter 3 of the IBC as with any Use or Occupancy. Commentary on the Occupancy Classifications of the various operations is as follows:

2.1.1 Group F Occupancies

Factory / industrial occupancies include buildings used for processing and packaging of cannabis. Buildings for processing hemp products are classified as moderate-hazard factories, or F-1 in IBC Section 306.2. Hemp and Marijuana are members of the sativa family of cannabis.

- Group F-1 Occupancy Classification is the appropriate classification for cannabis extraction facilities where the Maximum Allowable Quantities (MAQs) of hazardous materials as noted in IBC Table 307.1(1) are not exceeded. This is substantiated in the Code Commentary to IFC Section 3903.1 as follows:
  - "*The Occupancy classification will be F1 or H based on whether the MAQ have been exceeded. If the MAQ are exceeded, it is possible to have a Group H-2 or H-3 Occupancy classification."*
- The presence and quantity of materials that exceed the allowable MAQs will require a Group H (high- hazard) Occupancy Classification, which carries significant construction and fire protection requirements.
- The Group F-1 Occupancy classification is further substantiated in the Official Code Commentary to the International Building Code (IBC), which serves as the model language for the IBC as follows:
  - *"...Section 307.1 acknowledges that a building is not classified as a high-hazard occupancy unless the maximum allowable quantities per control area as prescribed in Tables 307.1(1) and 307.1(2) are exceeded, subject to the applicable control area provisions of Section 414.2. […] Therefore, a building containing less than the maximum allowable quantities specified in Tables 307.1(1) and 307.1(2) would not be classified as a Group H occupancy but rather as the occupancy group it most clearly resembles…."*

- **Carbon Dioxide** is also a hazardous material due to its asphyxiant properties. There is currently no MAQ listed for asphyxiants in the IBC or IFC; however, the location of storage cylinders and other associated asphyxiation hazards are noted in IFC Chapter 5307 and other areas.
  - Note: California Fire Code (CFC) Chapter 5307 specifically changed effective July 1,

2018 to include a complete rewrite and updating to accommodate/ address CO_2 processes including CO_2 enrichment for cultivation as well as extraction.

- NFPA 45 *Standard for Laboratories Using Chemicals* is not adopted in California; however, it does contain several useful safety guidelines in Chapter 5.4 "Means of Access to an Exit."

2.1.2 Group H Occupancies

Hazardous occupancies include those areas where the MAQ of hazardous materials are exceeded.

- LP-Gas or other liquefied flammable gas (LFG) operations exceeding the MAQ are classified as Group H-2 Occupancies, per IBC Table 307.1(1).
- LP-Gas is not specifically listed in IBC Table 307.1(1) for MAQ; however, it is considered a flammable gas (liquefied) as defined by 46 CFR 188.10-43.
    - If the MAQ for flammable gas (liquefied) is exceeded, the proper occupancy is a Group H-2.
- LP-Gas is specifically regulated in Chapter 61 of the IFC, in addition to the general requirements noted in IFC Chapter 50; however. IFC Chapter 61 does not apply to cannabis extraction and processing.
    - Care should be exercised when attempting to apply IFC Chapter 61, as it intends to apply to LP-Gas in DOTn cylinders and for applications as a heating or cooking fuel, as substantiated by the Code Commentary and Code language relating to "portable cylinders" and the International Fuel Gas Code. The cylinders used on third-party reviewed extraction assemblies are typically fixed ASME cylinders and not portable DOTn cylinders, therefore making most of IFC Chapter 61 not applicable.
    - Further, the 300 lb. limit noted in Section 6109 is specifically noted to apply to cylinders either awaiting resale (e.g. cylinder exchange for a bar-b-que, or for fuel cylinders on forklifts). **This limit is not intended to apply to cannabis extraction. The MAQ limits of IBC Table 307.1(1) and IFC Table 5003.1.1(1) apply instead.**
- Similarly, NFPA 58 *Liquefied Petroleum Gas Code* also specifically is exempted from applying to cannabis extraction facilities in **Chapter 1.3.2 Nonapplication of Code**, paragraph (4)
    - *This Code shall not apply to the following: (4) Chemical plants were specific approval of construction and installation plans is obtained from the authority having jurisdiction.*
- Flammable liquids operations exceeding the MAQ are either classified as Group H-2 or Group H-3 occupancies, contingent upon the pressurization level of the flammable liquids. Generally, where operations involve pressurized flammable liquids in excess of 15 psig, those operations are considered Group H-2 due to the potential for a pressurized spray of flammable liquids leading to "accelerated burning" as noted in IBC Section 307.4.
- The ability to contain the pressurized spray of ethanol via double containment, piping sleeves or other alternative methods may allow the use of a Group H-3 Occupancy, and must be approved by the local fire code official and building code official.

2.1.3 Group M Occupancies

Mercantile occupancies include any building for the display and sale of merchandise, including drug stores, markets, and retail or wholesale stores.

2.1.4 Group S Occupancies

Storage occupancies include any building used for storage that is not Group H.

2.1.5 Group U Occupancies

Buildings and structures of an accessory character and miscellaneous structures not classified in any specific occupancy. This can be applied to greenhouses; however, not all greenhouses will apply due to the sizes and operations that are generally associated with large-scale cultivation facilities. Each facility must be reviewed on a case-by-case basis.

The table below is a guideline for occupancy classification associated with cannabis operation uses within a specified use designation.

Occupancy Classifications for Facilities

Building/ Land Use	Growing	Processing	Storage	Sale
Commercial / Industrial	U	F-1	S-1	M
Agricultural, Non-Exempt	U-Agricultural	F-1	S-1	M
Commercial / Industrial	U	F-1	S-1	M

2.2 Extraction and Post-Production Processing Room Construction

The following guidelines apply generally to the construction and fire protection features of the rooms and areas where extraction and post-production operations are performed. This is not an all-inclusive list, and is intended to merely highlight the cannabis extraction specific concepts. General fire protection and life safety features such as egress, fire extinguisher placement, emergency lighting, etc. are general concepts that apply to all occupancies.

2.2.1 LP-Gas or Flammable Gas (liquefied) Extraction Rooms

Section 3903.3 of the IFC requires all hydrocarbon extraction (i.e. LP-gas) to be located in a room dedicated to the extraction process. Generally, this involves a commercially available or purpose-built extraction room designed and constructed with substantial passive and active fire protection measures. These measures include, but are not limited to: electrically classified equipment, constant exhaust, emergency ventilation exhaust, flammable gas detection, associated alarms, etc. Chapter 38 of NFPA 1, though not adopted in California, provides additional guidance on safe operation of cannabis extraction and may prove worthy of consideration in a local ordinance.

2.2.2 Flammable Liquid Extraction and Post-Production Processing Rooms

Section 3903.6 of the IFC requires all flammable liquids operations to be performed in an exhausted fume hood. For post-extraction processes, this generally is performed in a commercially available or purpose-built extraction room designed and constructed similar to the rooms used for hydrocarbon extraction, with the possible exception of the electrical equipment may be rated as Class I Division 2, where proven by a registered Mechanical Engineer or other professional experienced to perform the required calculations demonstrating the suitability of the electrical equipment as required in the California Electrical Code - Article 500.5.

2.2.3 Electrical Equipment and Systems

In general, all electrical equipment and systems within the extraction and post-

production areas must be electrically classified for the environment they are used within. Each extraction and post-production process differs; however, many manufacturers choose to provide Class I Division 1 electrical equipment for all areas due to the elevated safety provided. See Part 3 for process-specific electrical equipment classification requirements and recommendations

2.2.4 Ancillary Electrical Equipment in Cannabis Extraction and Post-Production Rooms

There must be no other equipment within any extraction room (i.e. refrigerators, cooking appliances, electrical panels, computers, cell phones, etc.) that is not Class I Division 1 rated. Eye wash stations that are required by other Codes or Standards must be suitable for the room. Within any Class I Division 1 location, there must be no penetrations into the room that are not essential for the extraction process (i.e. gas lines, HVAC systems, plumbing, etc.), and must all be sealed for airflow and (where appropriate) with a UL Listed firestopping system.

2.2.5 Post-production Processing Rooms Including Winterization and Distillation

The electrical equipment in these areas must be suitable for the environment, generally a minimum of Class I Division 2 classification and often a Class I Division 1 classification, unless otherwise proven unnecessary by a registered professional through demonstrated calculations. Many cannabis manufacturing facilities choose to design and construct the post-production areas similar to an extraction area in order to ensure maximum flexibility in future processes and to ensure maximum safety protocols are taken.

2.2.6 Mechanical Exhaust Systems

Although the extraction processes are closed-loop systems, each system must be opened to exchange extraction material (i.e. to replace the spent cannabis material once the oils have been removed). Opening the extraction chambers transitions the closed-loop system from a use-closed to a use-open category which will liberate non-pressurized flammable gas or flammable liquids vapors due to the plant material still containing a limited amount of solvent (i.e. it is “wet”).

Per IFC Section 5001.3.3.10, a ventilation/exhaust system is required to ensure that a hazardous concentration of flammable vapors or gases does not accumulate. Note that this section applies regardless of the quantities of hazardous materials present.

- The minimum constant exhaust rate as noted in the California Mechanical Code is 1 cfm/ft^2 of floor area. This may not be sufficient to achieve “capture and containment” in an emergency.
- Fire sprinklers may be required if the duct cross-section exceeds 10-inches.
- Due to the employee exposure from hazardous materials associated with opening the extraction vessel, and additional exhaust level must be provided that achieves a minimum airflow of 100 linear feet per minute (lfpm), which is generally accepted as sufficient “capture and containment” airflow.
    - **California Code of Regulations (CCR) Title 8, Section 5154.1** addresses laboratory fume hoods and their use to prevent exposure to harmful substances. The 100 lfpm rate is an international standard of airflow that is widely accepted as promoting a safe capture and containment velocity for personnel exposure.

2.2.6.1 Mechanical Exhaust System Common Settings

- Where LP-Gas extraction is performed, a gas detection system must be calibrated

specific to the material being monitored, and installed to activate an emergency ventilation system when LP-Gas is detected at or above 25% of the lower flammable limit (LFL). This "emergency exhaust" setting is typically at or above the 100 lfpm rate.

- Generally, when personnel enter the extraction rooms, they activate the "emergency exhaust" fans via switch or typical mushroom button. Many manufacturers interlock the room lights with the emergency exhaust setting, ensuring that personnel to not enter the room without first activating the required 100 lfpm minimum setting.
- All systems must be properly engineered and designed in accordance with the CMC, with additional requirements as noted in the IBC and IFC.

2.2.6.2 Duct Construction and Installation

- Contractors are required to install all metal ductwork with a minimum gauge metal thickness as outlined in the CMC Section 506.2.
- Contractors must ensure ducts and other connections are mechanically fastened and supported at intervals in accordance with the CMC. Installation of flexible air ducting is not allowed, due to the regular presence of flammable gases or vapors.
- All fans must be non-sparking, and generally Type A or Type B.

2.2.7 Interior Finishes

It is common for marijuana grow and processing facilities to use a Visqueen® or Mylar® type plastic or other sheeting to cover walls and ceilings, or to divide walk-in areas. Any use of plastic to enclose rooms or cover walls and/or ceilings must be installed in accordance with building and fire code requirements. Interior finishes must comply with flame spread ratings in accordance with the IBC for flame spread and smoke developed indexes. Hanging plastic from ceilings or suspended overhead structures to create wall dividers is typically NOT compliant with code provisions for partitions or interior finish.

2.2.8 Fire Protection Systems

In general, fire protection systems (i.e. fire sprinklers or fixed fire suppression systems) are not required by the IFC unless the MAQ are exceeded. However, many manufacturers will choose to provide a fire sprinkler system in accordance with IFC Chapter 903.3.1.1 (i.e. an NFPA 13 system) in order to increase the MAQ of associated flammable solvents. There is precedence in the IFC for an Ordinary Hazard Group 2 (OH2) level of protection; however, NFPA 13 more closely defines an Extra Hazard Group 2 (EH2) level of protection as noted in Chapter 5.4.2, for "…occupancies with *moderate or substantial amounts of flammable liquids."* See NFPA 13 Figure 11.2.3.1.

2.2.9 Additional Extraction Room Construction Recommendations and Requirements

Most extraction is performed utilizing the Control Area methodology as applied to a Group F-1 Occupancy as allowed in Section 414 of the IBC, for extraction and post-production operations where hazardous materials MAQs are not exceeded. General construction and life-safety feature recommendations include (and may be required):

- Emergency Egress Lighting / Exit Signage
- Doors swing in the direction of travel (recommended for all rooms even if not required)
- Panic Hardware (Fire Exit Hardware where appropriate, though neither are required)
- Self-closing doors (recommended, though not required)

Part 3 – Process-Specific Requirements

This section addresses in general, the unique requirements that are inherent to each common type of extraction: (1) Hydrocarbon Extraction with Butane, Propane, or mixtures thereof; (2) Flammable Liquid extraction and post-processing with Ethanol, Hexane, Pentane, etc.; and, (3) Carbon Dioxide.

3.1 LP-Gas Extraction

3.1.1 LP-Gas Detection Systems

IFC Section 3905.1 *Gas Detection* requires a Lower Flammable Limit (LFL) detector that is specifically calibrated to the solvent used and must meet applicable building, mechanical and fire code installation requirements. The system must perform three operations upon detecting LP-Gas at 25% of the LFL. IFC Section 3905.1.5 also requires all electrical equipment to be interlocked with the gas detection system.

1) Initiate a distinct and audible alarm throughout the room and area
2) Deactivate all heating systems in the extraction room
3) Activate the mechanical exhaust system (where interlocked) to the emergency ventilation setting.
    a. It is recommended to interlock the gas detection and emergency ventilation setting although it is not specifically required. The hydrocarbons used in cannabis extraction are non-odorized, and cannot be detected by the human nose.

The LEL detector must be installed in accordance with the manufacturers' guidelines and depending on the size and configuration of the room, booth, or hood, additional detectors may be required. The fixed detection alarm is a local alarm only and does not require off-site monitoring and does not require full occupant notification of the building or extraction room (including ADA visual notification) as a fire alarm system may require. The method of alerting the extraction operator (audible / visual notification) is based on the type of the gas detector chosen. Some detectors have integrated visual alarms only that can be accepted when installed within clear view of the extraction operator; i.e. at eye level with the sensor extended to the floor. Otherwise, a remote visual or audible local alarm can be accepted.

3.1.2 LP-Gas Hazardous Exhaust Systems

As noted above in Section 2.2.6, a mechanical hazardous exhaust system is required to be installed in accordance with the CMC Section 510 for extraction processes using LP-Gas. There are many different ways to design a hazardous exhaust system including fume hoods, walk-in hoods, booths, and exhausted rooms. There are manufacturers of booths and hoods that meet this requirement in a complete off-the-shelf package. Exhaust systems can also be built specifically to suit the needs of a location or process. The engineer of record must design and/or specify a system to meet the minimum requirements of a hazardous exhaust system.

The intent of the exhaust system provided is to be designed with capture and containment velocities across the work area (CMC Section 505.6) as typically seen with other industrial or laboratory processes using hazardous materials. As noted in CCR Title 8 Section 5154.1, the minimum velocity is often noted as 100 lfpm.

There are several work areas that must be considered in this design and may be different

for each extraction equipment manufacturer. The extraction process equipment location, the location of oil retrieval, and the location of LP-Gas laden plant material removed from the extraction equipment for off-gassing are all work areas that are intended to be provided with exhaust system capture and containment velocities. The assumption that a "closed-loop" system does not release LP-Gas into the atmosphere will not be accepted as a basis in the design of these exhaust systems, since all extraction systems must be opened at some point in the process with vapor released. It is recommended that the ACGIH Industrial Ventilation Handbook be consulted for exhaust system and capture and containment velocity design.

3.1.3 LP-Gas Extraction Electrical Systems

The location of the LPG extraction process must be considered a Class I Division 1 location in accordance with the CEC as noted above in Part 2.

Generally, the entire extraction room or the area inside of a hood or booth carries a Class I Division 1 requirement based on flammable gas metering done at several extraction processes of by the City of Denver, Colorado during their legalized marijuana extraction process testing. This has consistently been interpreted in a similar manner in most all Jurisdictions, with significant precedent already established. All of the extraction facilities tested in Denver exceeded minimum LFLs during equipment opening for oil retrieval and removal of LP-Gas-laden plant material in addition to other known equipment and accidental process failures releasing LP-Gas. Flammable gasses can be and are present during normal extraction operations, therefore this location meets the definition of a Class I Division 1 location per the CEC.

The location adjacent to the Class I Division 1 location must be classified by the design engineer (i.e. doors to the extraction room, hoods opening into the extraction room, etc.). This is dependent on the type of exhaust system provided and the room configuration. Normally, adjacent locations are Class I Division 2; however, the CEC does not define a required distance that an "adjacent location" must be from the Class I Division 1 location in order to be classified as a Class I Division 2 location. Article 500 of the CEC defines Class I Division 2 as a location where flammable vapors could be present from accidental rupture or breakdown of containers. Therefore, this location classification should be established on a total extraction equipment failure. This classification has been intentionally left to the determination of the responsible engineer since many factors can influence this area, such as mechanical exhaust sizing, total LPG within the extraction equipment, etc.

Based on the Class I Division 1 location, all equipment in the extraction room must be rated for use in Class I Division 1 locations. This includes lighting, power receptacles, vacuum pumps, recovery pumps, and any other electrical equipment in the room. The need for explosion-proof rated equipment can be minimized. Lighting located behind a vapor-tight glazing panel outside of the extraction room/booth is not required to be classified as Class I Division 1. This concept is similar to flammable finish spray booth lighting systems. Other extraction process support systems such as air compressors to drive recovery pumps, heated/ chilled water circulation pumps, vacuum air systems, etc. can all be located outside of the Class I location and piped into the process area. Where electrical equipment is needed, it must be rated for the Class I location in which it is installed. To reduce the possibility of spark from static discharge, all metal objects

including ductwork, hand sinks, water piping, etc. **must be grounded / bonded** in accordance with the CEC. This will also require the extraction equipment to be grounded/bonded.

The room lighting and room power receptacles (where provided) are recommended to be interlocked with the exhaust system such that the room power and lighting will not operate without the exhaust system running. This ensures personnel safety.

Power serving room flammable gas detectors is not required to be part of this interlock requirement. As noted above in Paragraph 3.1.1 and in IFC Chapter 3905.1.5, all equipment in the room must be interlocked turn off upon gas detection. This may create issues with emergency egress lighting and should be determined at the local jurisdiction level as to meeting the hazard mitigation and lighting needs.

3.2 Flammable Liquid Extraction and Post-Production Oil Processing

3.2.1 Flammable Liquid Extraction and Post-Production Gas Detection Systems

There are no specific requirements in the IFC for flammable liquid vapor detection.

3.2.2 Flammable Liquid Extraction and Post-Production Hazardous Exhaust Systems

For the purposes of this section, exhaust system requirements for extraction processes using flammable liquids are also required for post oil processing using flammable liquids. Post oil processing is an oil refining or winterization process occurring after the initial extraction is completed. There are many different methods available to perform flammable liquid extractions as well as a variety of equipment available; therefore, all processes cannot be described in detail within this guideline. Generally, these processes can be grouped into two categories; distillation extractions where most of the flammable solvent is collected OR a heated boil-off (evaporative) process where flammable liquid is evaporated to the atmosphere without recollection.

A hazardous exhaust system is required complying with CMC Section 510 for flammable liquid processes when the thresholds in CMC are exceeded. These thresholds are dependent on room configuration, exhaust systems used, or other operational features of the process and although there are no MAQ thresholds which would trigger the hazardous exhaust ventilation, quantities less than 5 gallons are generally considered as not requiring the hazardous exhaust system unless proved otherwise by design professional's analysis. In general, flammable liquid extraction is performed in a room constructed similarly to a room constructed for LP-Gas extraction, and is provided with the necessary protection systems (without the gas detection system). These rooms are readily available commercially, or can be purpose-built.

Flammable liquid extraction systems typically include boil/evaporative processes, distillation processes, and flammable liquid plant wash processes. The exhaust system is intended for larger processes where dispensing of flammable liquids also occurs in greater volumes, flammable liquid laden plant material is removed from equipment and/or vapors are present from heated extraction processes.

The exhaust system must provide general exhaust of 1 cfm/ft^2, as well as capture and

containment velocity of 100 lfpm across the work area where personnel may be exposed, per CCR title 8 Section 5154.1. This is typically provided in the form of a standard lab-type exhaust hood. It is suggested that the ACGIH Industrial Ventilation Handbook be consulted for exhaust system and capture velocity design. Distillation process equipment which uses less than 5 gallons is typically small in size and can be performed under a typical laboratory chemical fume hood designed to contain fumes within the hood and exhaust them to the exterior. This system does not have the duct gauge thickness and other requirements of a full hazardous exhaust system. This exhaust system is typically for smaller bench-top type of distillations and also small flammable liquid dispensing volumes. Listed solvent distillation units complying with IFC section 5705.4 are not subject to these exhaust system requirements. Additional information is available in NFPA 45, though it is not adopted in California.

Where large-scale post-production operations are performed with large equipment, larger walk-in fume hoods or additional commercially available extraction rooms are generally provided due to their ease of installation and associated Professional Engineering reviews.

3.2.3 Flammable Liquids Extraction and Post-Production Electrical Systems

For rooms, booths, or hoods containing flammable liquid extraction or post oil processes, the electrical location classification must be specified by the responsible Licensed Mechanical or Electrical Engineer in the State of California (a "Registered Design Professional"). Requirements for electrical classification are located in CEC Article 500.

Generally, flammable liquids processing requires Class I electrical equipment, with Division 1 or Division 2 applied depending on the process and the likelihood of flammable vapors being present. Many manufacturers choose to provide Class I Division 1 electrical equipment for all extraction (hydrocarbon and flammable liquid) to allow for future flexibility in the processing.

The electrical classification must be included on building permit drawings and that supporting information is submitted justifying how the location classification was determined. Because there are numerous methods of performing flammable liquid extractions and post-production, the process must be evaluated and the classification determination must be established by the Professional Engineer. Note that the licensed design professional must consider not only the process equipment, but also the dispensing (i.e. filling and removal) of flammable liquids, soaking (i.e. plant wash) material in open containers, oil-laden flammable liquids being processed, and the removal of plant material saturated with flammable liquids. All of these operations may have an impact on the location classification.

3.3 CO_2 Extraction and Cultivation/Enrichment Systems

3.3.1 CO_2 Extraction and Cultivation/Enrichment Gas Detection Systems

Carbon Dioxide is an asphyxiant gas commonly used within marijuana cultivation and in the extraction process. Extraction processes using CO_2 are less popular than hydrocarbon or flammable liquids extraction; however, they are still regularly employed.

Chapter 53 of the IFC was updated in July 1, 2018 to include significant revisions to

Section 5307 *Compressed Gases Not Otherwise Regulated* to address the hazards of CO_2 used in cannabis cultivation and extraction. Cylinders and dewars of compressed CO_2 are used within the grow operation to enrich the atmosphere with CO_2 to assist in plant growth, as well as to perform high-pressure extraction operations. Similarly, cylinders of CO_2 are used where CO_2 is the solvent for extraction. Though not explicitly stated for extraction, IFC Section 5307.5 includes CO_2 extraction due to the indoor presence of *"…tanks, cylinders, piping and equipment…"*

Most of the 2018 Updates address the hazards of CO_2 used in the cultivation enrichment process, and not the extraction process. Those requirements are included in this document for reference.

3.3.1.1 Application of IFC Section 5307

The revisions to IFC Section 5307 are intended to include Carbon Dioxide enrichment systems (new Section 5307.4), and through legacy language in Section 5307.5 are applicable to extraction equipment (i.e. "…rooms or areas containing carbon dioxide storage tanks, cylinders, piping and fittings…").

3.3.1.2 Gas Detection for CO_2 Enrichment Systems

Gas detection systems are required for CO_2 **enrichment** per IFC Section 5307.4, where more than 100 lbs of CO_2 may be located within the room, or where a remote-fill connection is used. Additionally, either gas detection or ventilation is required for CO_2 extraction.

There are two set points for detection and alarms/actions:

1) A low-level alarm is required for a concentration of 5,000 ppm or greater. This alarm level requires the flow of CO_2 to be halted, activation of emergency mechanical exhaust, and activation of a local audible and visible supervisory alarm.
2) A high-level alarm is required for a concentration of 30,000 ppm or greater. This alarm level requires the flow of CO_2 to be halted, activation of emergency mechanical exhaust, and activation of evacuation alarms.

3.3.1.3 Gas Detection for CO_2 Extraction Systems

Gas detection ***or*** exhaust systems are required for CO_2 **extraction** per IFC Section 5307.5, due to the presence of carbon dioxide containing equipment. The main difference between IFC Section 5307.5.1 and 5307.5.2, is subject to local interpretation:

1) Section 5307.5.1 requires ventilation for the space unless a gas detection system in accordance with Section 5307.4.3 is provided.
    a. Detection in accordance with Section 5307.4.3 requires the two alarm set points (5,000 ppm and 30,000 ppm).
    b. Section 5307.4.3.1 requires exhaust ventilation. IFC Section 5307.5.1 directs the reader to Section 5307.4.3, which *could carry the intent* of applying Section 5307.4.3.1 as well. This would then also require exhaust.
2) Section 5307.5.2 only requires a low-level alarm for a concentration of 5,000 ppm or greater, and that the gas detection be installed in accordance with new IFC Section 916 (July 2018).

3.3.1.4 CO_2 Extraction Systems, Exhaust Systems & Electrical Systems

CO2 extraction equipment is similar to other extraction equipment to be a "closed loop professional grade system." The systems must also be reviewed and provided with a Technical Report per IFC Sections 3904.2 and 3904.3, with all additional requirements of IFC Chapter 39. There are no specific requirements for electrical classification equipment used in CO2 extraction or enrichment.

All other gas cylinder storage requirements apply, including storage and restraint of cylinders, emergency shutoffs, etc. General compressed gas storage requirements are noted in IFC Chapter 53, and applicable sections of NFPA 55.

It is worthy of note that additional requirements for cannabis cultivation and processing are applicable, and are not discussed in this document.