

MARIJUANA EXTRACTION GUIDELINE FOR COMMERCIAL / LICENSED FACILITIES

The information contained within this guideline is provided solely for the convenience of the reader to help clarify how the Denver Fire Code (DFC) applies to marijuana extraction processes and equipment at commercial facilities licensed by the Denver Department of Excise and Licenses. Because every process and building differs, this guideline is not intended to identify or discuss every code requirement applicable and it is not intended to be a regulatory document; therefore, 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 City and County of Denver. This guideline is based upon the 2016 Denver Fire Code.

Part I – Extraction Process Equipment

Extraction equipment, including equipment used for winterization or other oil refining processes, that use hazardous materials (i.e. flammable / combustible liquids, Carbon Dioxide (CO₂), liquefied petroleum gases (i.e. butane), etc) are required to be listed or approved per DFC Section 2703.2.3.

I.A Liquefied Petroleum Gas (LPG) and CO₂ Extraction Equipment

Only closed-loop type LPG extraction equipment is permitted. Open blasting extractions or equipment that releases butane to the atmosphere during the extraction process is strictly prohibited.

Because there is no listing (such as UL, ETL, etc) available for compressed-gas extraction systems using hazardous materials, extraction equipment approval is required from the Denver Fire Department for use in the City and County of Denver. To obtain equipment approval, an engineering report (signed and sealed by a licensed Colorado engineer) must be submitted for approval. This approval report is required by DFC Section 104.7.2. It is the responsibility of the engineer to justify how the system meets the Denver Fire Code and any other national standards as a basis of design, including an analysis / description of every component of the system. Thus far, approved LPG (i.e. butane or propane) only closed-loop systems have been designed to applicable sections of NFPA 58. Open-blast LPG extractions are prohibited. In addition to the engineering report, an owners operation manual must be submitted with specific instructions regarding proper use of the equipment and any safety provisions identified. Equipment may be submitted / approved either by a Master Engineering Report or a Site Specific Engineering report. Engineering reports can be submitted in hard copy, signed and sealed by the licensed design professional, at 745 W Colfax, attention Brian Lukus.

In addition to this 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.

Site Specific Engineering Report: Site specific engineering reports can be submitted which approve extraction equipment exclusively to a location and specific equipment. A Plant Extraction Systems Operational Permit will be issued for final approval of the extraction equipment and use. Any modification of the equipment or relocation of equipment to a new address voids the equipment approval.

Master Engineering Report – For manufacturers of extraction equipment, a Master Engineering Report can be submitted for approval in lieu of submitting Site Specific reports for every address. Once approved, the report is retained by the Denver Fire Department. Site specific approval letters are then provided by the report Engineer of Record certifying (by location address and serial number) that the equipment on-site meets the approved Master Engineering Report on file. Once this letter is received (and all other extraction room safety provisions are met), a Plant Extraction Systems Operational Permit will be issued for final approval of the extraction equipment and use. Any modification of the equipment or moving addresses voids the equipment approval. See *Extractor Approval List* document on the Denver Fire Department website for a list of manufacturers with approved Master Engineering reports.

I.B 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 are required to be listed by a NRTL for their intended use and are required to be operated within the manufacturer's guidelines. Equipment such as rotary evaporators are typically listed for distillation processes. Where distillation stills or heated evaporation processes are performed, the heating source shall 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 during construction permitting review.

I.C Vacuum Ovens

Vacuum ovens shall not be used to process volatile gases (i.e. alcohol/oil mixtures, oil containing off-gassing LPG, other flammable liquids, etc) unless the vacuum oven is 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 volatiles. All vacuum ovens shall be listed by a NRTL.

I.D Refrigerators

Refrigerated storage or processing of flammable liquids including oil-laden with flammable liquids must only use refrigerators/freezers rated to store flammable liquids. At minimum, a "Lab-Safe" or "Flammable Safe" rated refrigerator/freezer must be used. Residential type refrigerators are not rated by the manufacturer for flammable liquid storage or processing. See NFPA 45 for further information regarding refrigerators used for flammable liquid storage.

Part II – Extraction Room Construction, Gas Detection, Exhaust, & Electrical Systems

II.A Room Construction

Extraction rooms are required to be located in a room dedicated to the extraction process. There must be no other equipment within the room (i.e. refrigerators, cooking appliances, electrical panels, computers, cell phones, etc) that is not associated with the extraction process. Additionally there must be no penetrations into the room that are not essential for the extraction process (i.e. gas lines, HVAC systems, plumbing, etc.)

Rooms are to be of continuous, noncombustible, and smooth construction, and room finish should also consider Department of Health requirements for cleaning purposes. Booths constructed in compliance with flammable finish requirements of DFC Section 24 will be accepted as meeting these construction requirements. Acoustic-type drop ceilings that could conflict with large LPG extraction exhaust systems will not be permitted. Hand sinks and eye wash stations (if required by other Codes) can be located in the room.

Doors to the extraction room using hazardous materials (i.e. CO₂, LPG, or flammable liquids) must swing in the direction of egress, be self-closing/latching, and be provided with panic hardware.

Post oil processing typically uses small volumes of flammable liquids and may be performed outside of a dedicated extraction room. This process can typically be performed under a bench-top chemical fume hood.

II.B Suppression Systems

An LPG extraction room, booth, or hood is required to be provided with an automatic fire suppression system in accordance with DFC Chapter 9. A suppression system is also required in a flammable liquid extraction room, booth, or hood where vapors are released exceeding 25% of the LFL (lower flammable limit). No suppression systems are required in CO₂ extraction rooms. Where the building is required to be sprinklered, the sprinkler system shall be extended to the room, booth, or hood. Where the building is not required to be sprinklered, an alternative suppression system must be provided in accordance with DFC Section 904.

These extraction room requirements are not applicable to water extractions, kief production rooms, food-based extractions, or other extraction processes not using hazardous materials.

II.C LPG Extraction Process Gas Detection Systems

There are two forms of flammable gas detection required in LPG extraction areas: fixed continuous flammable gas detector serving the room, hood, or booth and a portable flammable gas detector. The intent of these types of flammable gas detection systems within LPG extraction areas is twofold: for alerting the extraction process operator(s) that the area is at or above 10% of the lower flammable limit and for the extraction process operator(s) to specifically identify potential leaks during the extraction and additionally to determine when

oil and spent plant material is finished off-gassing and is safe to be removed from the extraction area.

The fixed 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. Fixed detection is to alarm at 10% of the lower flammable limit. 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.

II.D LPG Extraction Exhaust Systems

A hazardous exhaust system is required to be installed in accordance with the Mechanical Code for extraction processes using LPG. 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; however, no one system is dictated by the Fire Code. The engineer of record must design and/or specify a system to meet the minimum requirements of a hazardous exhaust system.

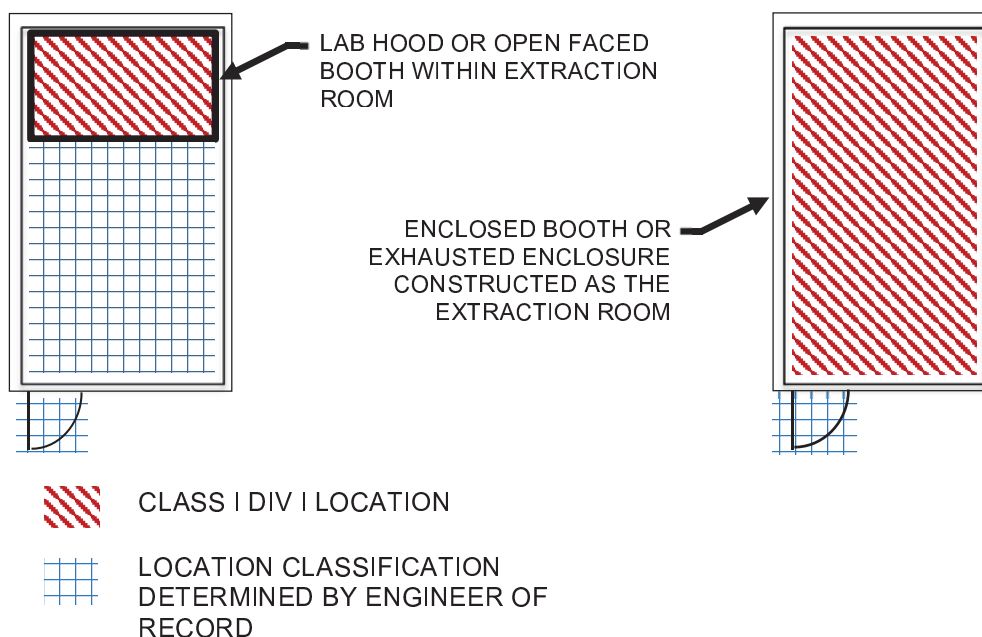
The intent of the exhaust system provided is to be designed with capture and containment velocities across the work area (IMC 510.5.4) as typically seen with other industrial or laboratory processes using hazardous materials. There are several work areas that must be considered in this design and may be different for each extraction equipment manufacturer. The extraction process equipment location, the location of oil retrieval, and the location of LPG-laden plant material removed from the extraction equipment for degassing 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 LPG 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.

II.E LPG Extraction Electrical Systems

The location of the LPG extraction process must be considered a Class I Division I location in accordance with the National Electric Code (NEC); depending on the type of exhaust system provided, this could be the entire room or the area inside of a hood or booth. This Class I Division I requirement was based on flammable gas metering of several extraction processes, all of which exceeded minimum LFLs during equipment opening for oil retrieval and removal of LPG-laden plant material in addition to other known equipment and accidental process failures releasing LPG. Flammable gasses are present during normal extraction operations, therefore this location meets the definition of a Class I Division I location per the NEC.

The location adjacent to the Class I Division I 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 II; however, the NEC does not define a required distance that an “adjacent location” must be from the Class I Division I location in order to be classified as a Class I Division II location. The NEC defines Class I Division II 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.

Typical LPG exhaust types and the associated NEC location classification is illustrated below.



Based on the Class I Division I location, all equipment in the extraction room must be rated for use in Class I Division I 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 I; 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 in.

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 NEC. This will also require the extraction equipment to be grounded/bonded.

The room lighting and room power receptacles (where provided) are required to be interlocked with the exhaust system such that the room power and lighting will not operate without the exhaust system running. Power serving room flammable gas detectors is not required to be part of this interlock requirement.

II.F Flammable Liquid Extraction & Post Oil Processing Gas Detection Systems

None Required.

II.G Flammable Liquid Extraction & Post Oil Processing 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 recollected 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 IMC Section 510 for flammable liquid processes exceeding 5 gallons. These typically include boil/evaporative processes, distillation processes, and flammable liquid plant wash processes. This 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 capture and containment velocity across the work area per IMC Section 510.5.4 and 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 using less than 5 gallons are to be performed under a 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 DFC 5705.4 are not subject to these exhaust system requirements.

II.H Flammable Liquid Extraction & Post Oil Processing 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 design professional. It is expected that this classification is 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, the process must be evaluated and the classification determination must be established by the licensed design professional. 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, and the removal of plant material saturated with flammable liquids, because these operations may have an impact on the location classification.

Also see section I.B of this guideline for further information.

II.I CO2 Extraction Process Gas Detection Systems

A fixed continuous CO2 detection system is required within CO2 extraction rooms set to alarm at 5000 ppm. This system is a local alarm only and is not required to be monitored off site. The system is intended to alert the extraction operator of a potential asphyxiation hazard. There is no requirement to alarm the building nor to have ADA compliant visual notification as typically required for fire alarm systems.

II.J CO2 Extraction Exhaust Systems & Electrical Systems

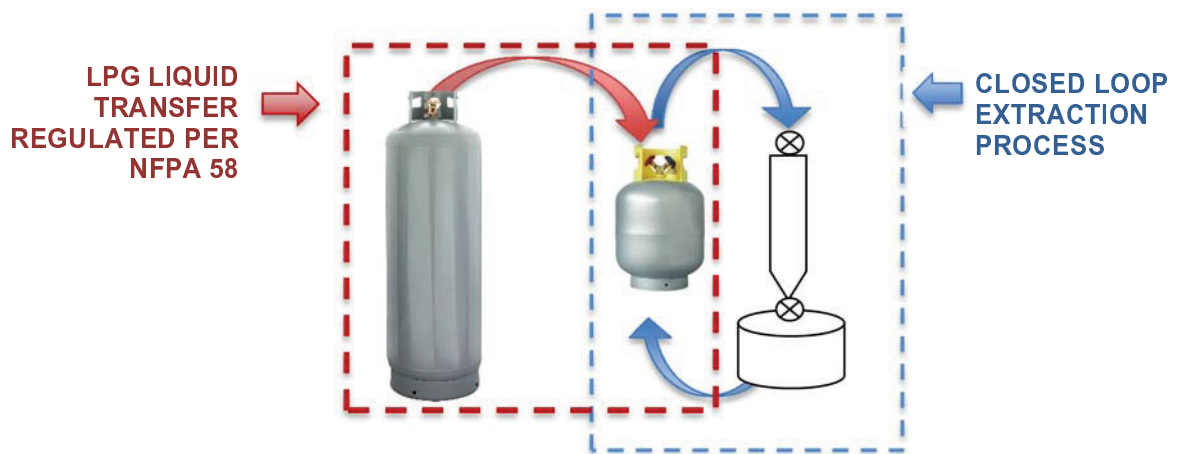
CO2 extraction equipment is required to have releases of CO2 piped to the exterior. Stored cylinders shall be secured to a fixed object to prevent falling. See DFC Chapter 53 for compressed gas storage requirements.

There are no further exhaust system or electrical requirements above ordinary requirements of the Denver Building Code.

Part III – Filling LPG Extraction Equipment

III. A Filling LPG Extraction Equipment

Although manufacturers may use different terminology, extraction equipment includes an LPG solvent tank (i.e. a local system supply tank) which is filled with LPG and supplies the extraction equipment and this same tank is also used to reclaim LPG after the extraction. The approval for closed loop LPG extraction equipment discussed in Part I of this document approves only the closed loop system. Filling the LPG solvent tank from a bulk tank (i.e. typically a 100# tank) is not included in the extraction equipment approval and is regulated per NFPA 58 as LPG liquid transfer. This delineation is depicted below.



Filling the solvent tank is regulated as LPG liquid transfer under NFPA 58 and must be conducted outdoors. Indoor filling and/or indoor filling from piped LPG liquid systems may be conducted indoors where the room and process has been designed in accordance with NFPA 58, notably Chapter 10; the requirements of this chapter are stringent and will not be discussed herein due to their complexity. Where performed, this process is included in the Plant Extraction Systems operational permit issued; information on LPG liquid transfer must be included at this time of permit application.

LPG liquid transfers using lighter refill-type containers using can taps or other puncture equipment is prohibited.

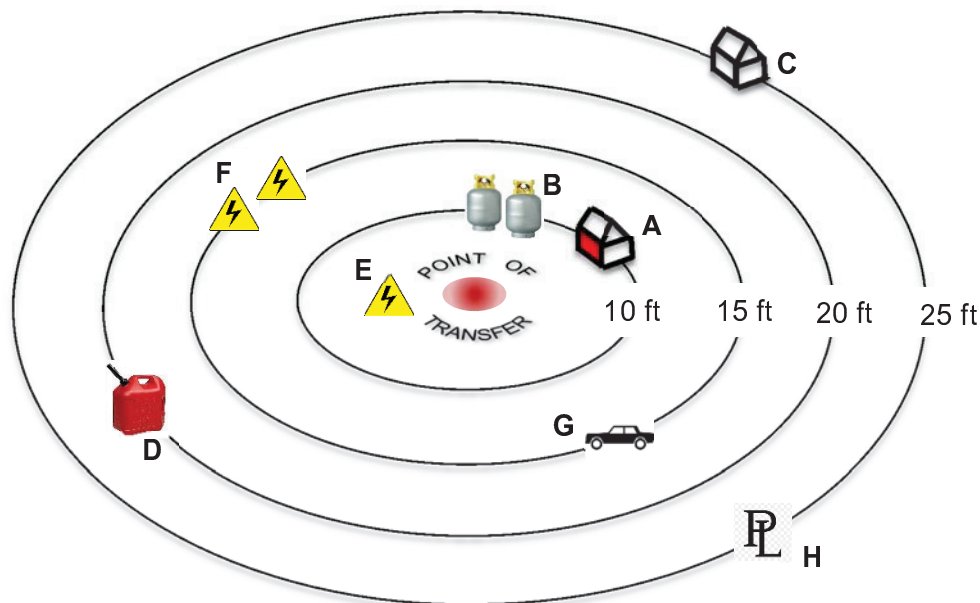
The following is a summary of requirements from NFPA 58:

- i. Personnel conducting liquid transfer operation shall be trained in LPG filling (recertified every 3 year). Documentation of training shall be available (NFPA 58-7.2.1)
- ii. Public access to the filling location must be restricted (i.e. fenced area)
- iii. The filling location must be located 15' from combustion engine use; i.e. vehicle parking. All ignition sources shall be shut off. The location may be located against a noncombustible building wall without openings

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- iv. Electrical equipment is required to be Class I Division I within 5' and Class I Division II within 15' of filling operations.
- v. Where heating blankets are used, they must be listed for use in explosive environments. An electrical permit is required for any circuits being extended to the filling location.
- vi. Where scales are used for weighing containers, they shall be Class I Division I listed or be of the mechanical type.
- vii. Smoking, portable lighting, portable electric tools, etc shall not be in use within 25' of the filling operation.
- viii. Purging of tanks may be performed at the tank filling location in accordance with NFPA 58. The tank must be rapidly dispersed in the atmosphere, where environmental conditions do not allow rapid dispersal (i.e. wind conditions, site conditions such as neighboring buildings on lot lines not allowing adequate natural ventilation, etc). LPG must be flared using a method in compliance with NFPA 58.

The NFPA 58 separation distances from the transfilling location are illustrated below.



- A. Buildings with 1HR fire rated exterior wall
- B. LPG Containers in Storage
- C. Buildings with non-fire rated exterior wall or building openings
- D. Flammable / combustible liquid storage
- E. Class I Division I electrically classified area within 5' of transfer
- F. Class I Division II electrically classified area
- G. Vehicle traffic
- H. Property Line that can be built upon

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