Development Services

From Concept to Construction

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APPEAL SUMMARY

Status: Decision Rendered - Reconsideration of ID 20135

Appeal ID: 20260	**Project Address:** 2508 NW 29th Ave
Hearing Date: 4/17/19	**Appellant Name:** peter nylen
Case No.: M-002	**Appellant Phone:** 5039978770
Appeal Type: Mechanical	**Plans Examiner/Inspector:** Kent Hegsted
Project Type: commercial	**Stories:** 1 **Occupancy:** F-1 **Construction Type:** IV, B
Building/Business Name: Co2 Dynamics	**Fire Sprinklers:** Yes - throughout
Appeal Involves: Reconsideration of appeal,occ Change from B to F-1	**LUR or Permit Application No.:** 17-226488-MT
Plan Submitted Option: pdf [File 1] [File 2] [File 3]	**Proposed use:** CO2 cannabis extraction

APPEAL INFORMATION SHEET

Appeal item 1

Code Section	5703.1.1 Classified Locations for Flammable Liquids
Requires	Areas where flammable liquids are stored, handled, dispensed or mixed shall be in accordance with Table 5703.1.1
Proposed Design	NOTE ADDED FOR RECONSIDERATION Appeal 20135 (a reconsideration of appeal 18560) was granted on March 20th, 2019 and is copied here in its entirety. Any additional text added for the current reconsideration will be clearly indicated. The appeal makes reference to a requirement on pg 26 of the Analysis Report (attached) submitted by BEA Consultants LLC, stating “Ventilation systems shall be connected to emergency power, so that the ventilation system will still operated for 90 minutes in the event of normal power failure.” This is no longer required by the city of Portland for this use and occupancy but may have been at the time the report was prepared (October 17, 2017). As it is no longer a requirement of the code, we are removing it from the text of this appeal for your reconsideration. Additionally, the EOR will amend the submitted report to indicate it is not a requirement Appeal 18560 was denied October 17, 2018. It upheld the plans examiners requirement that electrical equipment in the post-processing area meet the requirements of a class 1, division 2 location. We request that appeal ID 18560 be reconsidered and the alternative protection technique provided by the ventilation system be allowed. The appeal reconsideration also removes item 2 contained in the original appeal. Proposed Design

Co2 Dynamics has (2) Eden CO2 extractors and will have a new state of the art exhaust system, and a gas detection system for both CO2 and ethanol that will be connected to emergency power. Ethanol detection will be by a Honeywell Sensepoint XCD gas detector (or equal) set to 1000 ppm. Exhaust fans will be installed providing continuous 900 CFM (1 CFM per SF) air flow and 2700 CFM (3 CFM per SF) if and when alarms are activated. Audible alarms and strobes, interconnected with the detectors, will also be installed. The entire space will be under negative pressure, either under normal operation (1 CFM per SF) or when gas detection system alarms are activated (3CFM per SF), so any heavier than air evaporative ethanol vapor is designed to be contained and exhausted via the low wall exhausts through a spark resistant rooftop exhaust fan system. NOTE ADDED FOR RECONSIDERATION The sensors, alarms and controls of the exhaust system will be connected to emergency power so they will still operate for 90 minutes in the even of a normal power failure. The building is fully sprinkled and has a maximum travel distance of 52 feet.

Reason for alternative

500.7.L of the 2017 OESC states that “other protection techniques used in equipment identified for use in hazardous (classified) locations...shall be acceptable protection…” Please refer to the attached Ventilation Requirement Report from BEA consulting engineers showing the ventilation rate to be well in excess of minimum requirements considering a worst case spill (3 liters total in use) and using a factor of safety of 5.

Section 5703.1.1 of the Oregon Fire Code allows that ...“ The extent of the classified area is allowed to be reduced, or eliminated, where sufficient technical justification is provided to the fire code official that a concentration in the area in excess of 25 percent of the lower flammable limit (LFL) cannot be generated.”

Ethanol has an LFL of 3.3% in air at room temperature. This corresponds to 33,000 ppm and so 25% of the LFL of Ethanol is 8,250 ppm. The TLV (Threshold Value Limit) for ethanol is 1000 ppm, set by various safety agencies. OSHA has a PEL (Permissible Exposure Limit) of 1000 ppm.

CO2 will install an ethanol gas sensor (see above), which will trigger emergency ventilation in the event that ethanol levels exceed 1000 ppm. The calculated air changes per hour will be 22 ½ , or one air change approximately every 2 ½ minutes. This system will ensure a maximum air saturation of less than 1/8th of the 25% LFL threshold set in the code.

Additionally, consider that NFPA 497 says the following about unclassified locations:

5.5.1 Experience has shown that the release of ignitable mixtures from some operations and apparatus is so infrequent that area classification is not necessary. For example, it is not usually necessary to classify the following locations where combustible materials are processed, stored or handled:
Locations that have adequate ventilation, where combustible materials are contained within suitable, well-maintained, closed piping systems
Locations that lack adequate ventilation, but where piping systems are without valves, fittings, flanges, and similar accessories that may be prone to leaks
Locations where combustible materials are stored in suitable containers
Locations where the use of combustible liquids, or flammable liquids or gasses, will not produce gas or vapor sufficient to reach 25 percent of the lower flammable limit (LFL) of that combustible material

Lastly, see the attached UL Certificate of compliance showing the rotary evaporators’ compliance with safety standards for such equipment, which do not include requirements for Class 1, Division 2 wiring.

APPEAL DECISION

Omission of emergency power for ventilation systems within the cannabis processing area: Granted as proposed.

The Administrative Appeal Board finds that the information submitted by the appellant demonstrates that the approved modifications or alternate methods are consistent with the intent of the code; do not lessen health, safety, accessibility, life, fire safety or structural requirements; and that special conditions unique to this project make strict application of those code sections impractical.

Pursuant to City Code Chapter 24.10, you may appeal this decision to the Building Code Board of Appeal within 180 calendar days of the date this decision is published. For information on the appeals process and costs, including forms, appeal fee, payment methods and fee waivers, go to www.portlandoregon.gov/bds/appealsinfo, call (503) 823-7300 or come in to the Development Services Center.

ANALYSIS REPORT

October 17, 2017

TO:	Daniel Gevurtz
COMPANY:	
PHONE:	FAX:
EMAIL:	daniel@co2dynamics.com
PROJECT:	CO2 Dynamics – Mechanical Engineering Services
PROJECT NO:	217C1103A
SUBJECT:	Eden Extractor Analysis

FROM:	Steffen U. Brocks, P.E.
CC:	
RFC:	
MAIL ORIGINAL:	
PAGE:	1/27

Revised November 10, 2017

Daniel-

Following is the analysis based upon our review of the Eden CO2 Extractor that we have reviewed at your facility located at 2508 NW 29th Ave in Portland, OR.

The facility has (2) Eden CO2 extractors and will have a new state of the art exhaust system and gas detection system that will be connected to emergency power.

Intent of Analysis:

The intent of this report is that it is stand alone and addresses code sections PFC 104.7.2. This report provides an analysis of the fire safety properties of the extraction procedures, equipment and facility:

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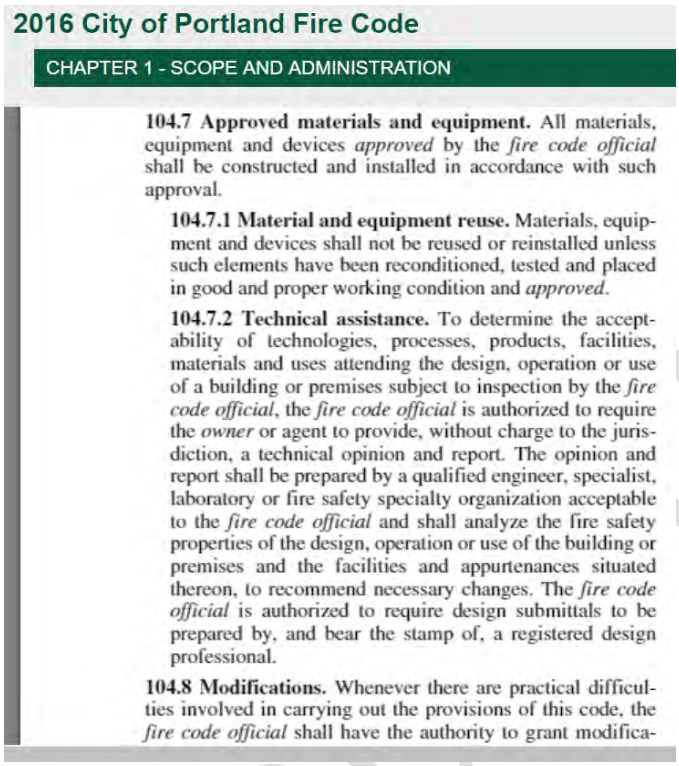

2016 City of Portland Fire Code

CHAPTER 1 - SCOPE AND ADMINISTRATION

104.7 Approved materials and equipment. All materials, equipment and devices *approved* by the *fire code official* shall be constructed and installed in accordance with such approval.

104.7.1 Material and equipment reuse. Materials, equipment and devices shall not be reused or reinstalled unless such elements have been reconditioned, tested and placed in good and proper working condition and *approved*.

104.7.2 Technical assistance. To determine the acceptability of technologies, processes, products, facilities, materials and uses attending the design, operation or use of a building or premises subject to inspection by the *fire code official*, the *fire code official* is authorized to require the *owner* or agent to provide, without charge to the jurisdiction, a technical opinion and report. The opinion and report shall be prepared by a qualified engineer, specialist, laboratory or fire safety specialty organization acceptable to the *fire code official* and shall analyze the fire safety properties of the design, operation or use of the building or premises and the facilities and appurtenances situated thereon, to recommend necessary changes. The *fire code official* is authorized to require design submittals to be prepared by, and bear the stamp of, a registered design professional.

104.8 Modifications. Whenever there are practical difficulties involved in carrying out the provisions of this code, the *fire code official* shall have the authority to grant modifica-

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Credentials:

Steffen Brocks, P.E. is an expert in the field for evaluating the equipment listed in this report. He has evaluated natural gas fired equipment on numerous projects in the City of Portland, and commissioned such equipment in Oregon, Washington, California and Hawaii. In this industry, he has also evaluated extraction equipment in Oregon and Washington.

- GoldenX Extracts, Eugene, Oregon – Provide design for extraction and post processing facility.
- ABCS Labs, Springfield, Oregon - Provide design for extraction and post processing facility.
- Precision Alchemy, Portland, Oregon - Provide design for extraction and post processing facility.
- BizzyBee Extractors, Seattle, Washington – Provide engineering consultation for CO2 extractor design

Steffen Brocks, P.E. will serve as third party or engineer in record to evaluate and verify the installation with report and testing method (the testing method outline is not part of this review) upon final acceptance.

Proposed Eden CO2 Extractors:

- Eden CO2 Extractors as shown and listed as follows:

Photo Detail 1 – Eden Extractor

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Photo Detail 2 – Eden Extractor

Photo Detail 3 – Eden Extractor

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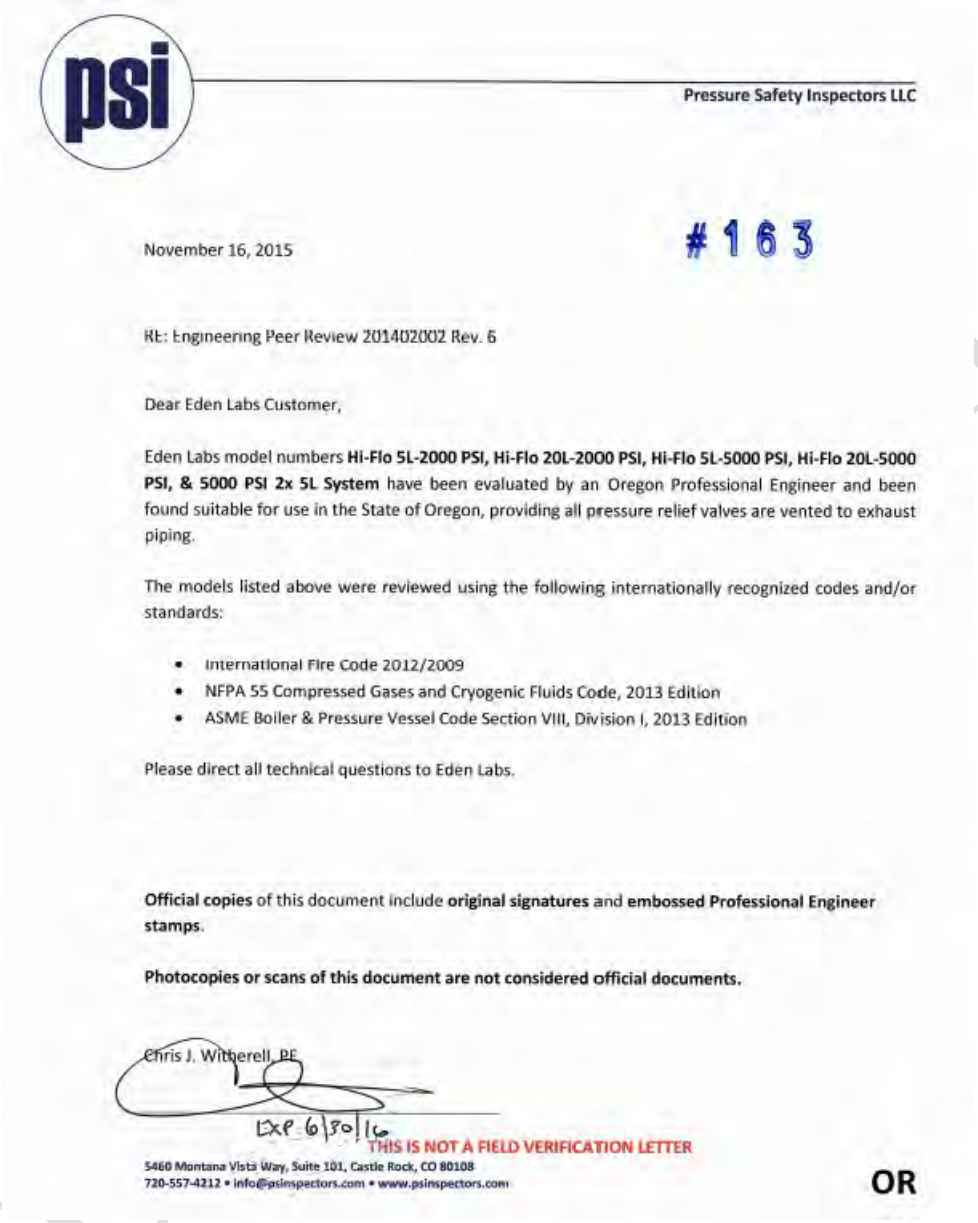

psi

Pressure Safety Inspectors LLC

November 16, 2015

#163

RE: Engineering Peer Review 201402002 Rev. 6

Dear Eden Labs Customer,

Eden Labs model numbers **Hi-Flo 5L-2000 PSI, Hi-Flo 20L-2000 PSI, Hi-Flo 5L-5000 PSI, Hi-Flo 20L-5000 PSI, & 5000 PSI 2x 5L System** have been evaluated by an Oregon Professional Engineer and been found suitable for use in the State of Oregon, providing all pressure relief valves are vented to exhaust piping.

The models listed above were reviewed using the following internationally recognized codes and/or standards:

- International Fire Code 2012/2009
- NFPA 55 Compressed Gases and Cryogenic Fluids Code, 2013 Edition
- ASME Boiler & Pressure Vessel Code Section VIII, Division I, 2013 Edition

Please direct all technical questions to Eden Labs.

Official copies of this document include **original signatures** and **embossed Professional Engineer stamps**.

Photocopies or scans of this document are not considered official documents.

Chris J. Witherell, PE

EXP 6/30/16

THIS IS NOT A FIELD VERIFICATION LETTER

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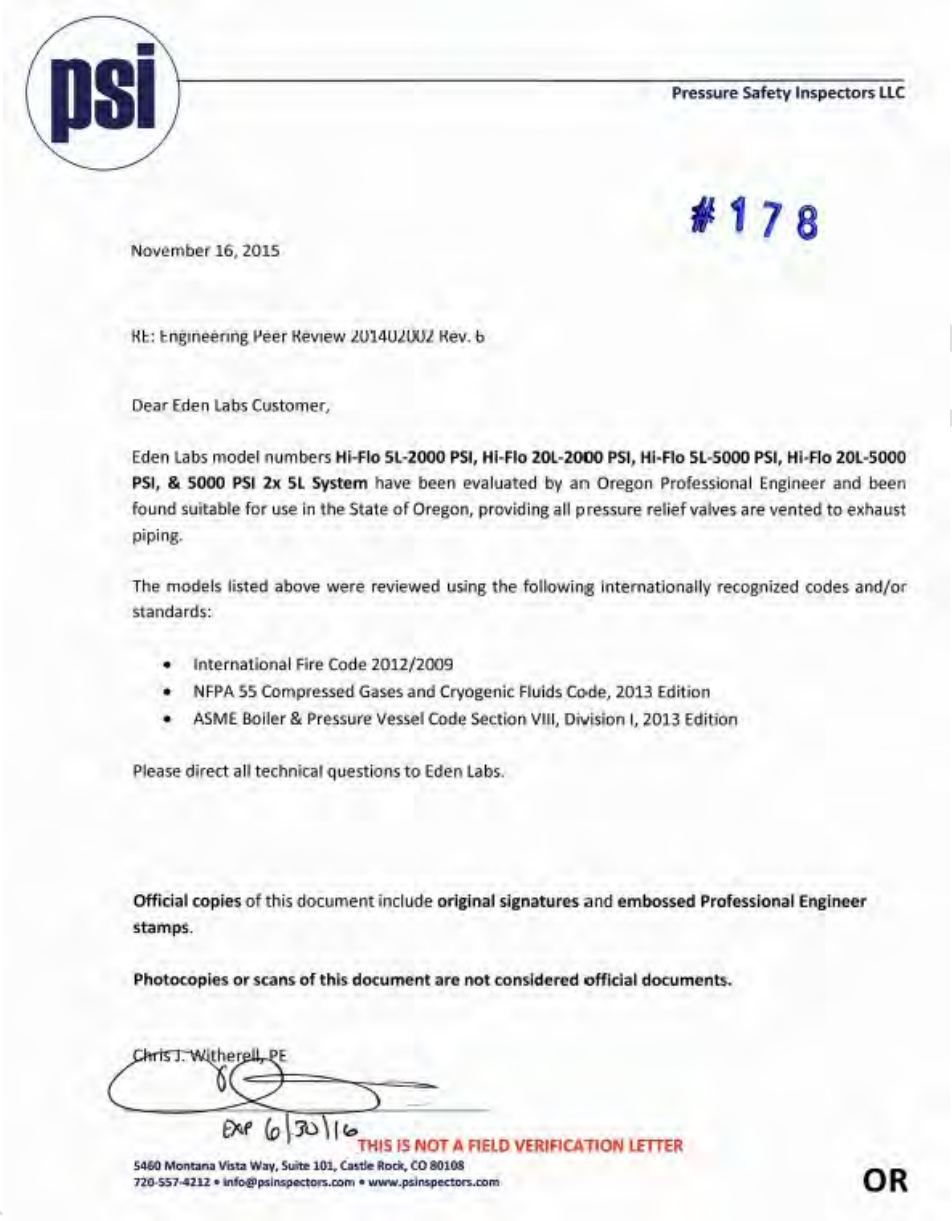
720-557-4212 • info@psinspectors.com • www.psinspectors.com

OR

Detail 4 – Eden Extractor CO2 #162 evaluation letter



psi

Pressure Safety Inspectors LLC

#178

November 16, 2015

RE: Engineering Peer Review 20140202 Rev. b

Dear Eden Labs Customer,

Eden Labs model numbers **Hi-Flo 5L-2000 PSI, Hi-Flo 20L-2000 PSI, Hi-Flo 5L-5000 PSI, Hi-Flo 20L-5000 PSI, & 5000 PSI 2x 5L System** have been evaluated by an Oregon Professional Engineer and been found suitable for use in the State of Oregon, providing all pressure relief valves are vented to exhaust piping.

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Please direct all technical questions to Eden Labs.

Official copies of this document include **original signatures** and **embossed Professional Engineer stamps**.

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Chris J. Witherell, PE

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OR

Detail 5 – Eden Extractor CO2 #178 evaluation letter

- These extractors have been approved for CO2 extraction in the State of Oregon, Pennsylvania, California, Colorado, Maryland and Nevada, with the Engineering Peer Review sealed by a Professional Engineer registered in each State.

- The unit is well constructed with powder coated sheetmetal. Corners of the unit are rounded off and no sharp edges are present, and meets the intent of the Code and OMSC 105.2

- Parts are connected via stainless steel machine screws with washers.

    - Tubing in the unit is hard piped copper tubing with brass fittings.

    - Burners are constructed of brass w/stainless steel.

    - Wiring is constructed appropriately with shielding, wiring protection and wiring connectors.

    - Overall, the materials for the unit as modified per this report appear to be constructed well and meets the intent of the code and section OMSC 105.2.

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Code Analysis:

Applicable Codes include the following:

- International Fire Code
- National Fire Protection Association (NFPA) 55, Compressed Gases and Cryogenic Fluids Code, 2013
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2013

Process Description for Eden CO2 Extraction:

This procedure defines the standard procedure for operation of the Eden 157 Extractor (excerpted from CO2 Dynamics process description – document Pro-001-001).

1.0 Safety and equipment check list prior to start up.

1.1 At start of day, check CO_2 detectors to determine carbon dioxide levels in the room. At start up the levels are typically between 500ppm and 800ppm. Levels must be below 1300ppm to start run. If the levels are higher at start of run, contact your supervisor before running the equipment.

1.2 Note where the eye wash station is located.

1.3 Check the extraction vessel for used plant material. If there is plant material in the extraction vessel, vacuum out the spent material.

1.4 Check and close all valves.

1.5 Check receptacle at bottom of Separator 2. The locking nut must be fully tightened prior to charging the extractor with gas. Check the quick release water fittings on the receptacle of Separator 2.

1.6 Turn on power to the chiller. Within twenty minutes the temperature of the chiller should reach 40 to 41 degrees F. If temperature does not fall to this range contact your supervisor.

1.7 Plug in the power cords for the pumps for the water baths for the extractor vessel, and for Separators 2 and 3. Check the water flow by lifting the lids on both water baths. If water is not flowing, check the quick release fittings attached to the receptacle of Separator 2 for proper attachment. If water still does not flow, contact your supervisor.

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1.8 Plug in power cords for the heaters for both baths. Check the temperature setting for both baths. The extraction water bath must be set at approximately half way between 75 degrees F and 100 degrees F. The temperature for the bath connected to Separator 2 and 3 must be set at 150 degrees F. Note that approximately 30 minutes are needed to heat the baths and the connected water jackets to the proper temperature before beginning a run. See Table I for the proper running temperature of the water baths.

Table I

Bath	Vessel	Temp dial setting	Read out temp
1	Extractor	87 to 88 F	95 to 98F
2	Separator 1	Use under special setup	Use under special setup
3	Separator 2 and 3	150 F	125 to130 F

1.9 Check scale readout for both tanks of carbon dioxide. The larger cylinders are empty between 135 lbs and 145 lbs. The smaller ranks are empty around 65 to 68 lbs. Replace any empty tanks using the cylinder cart. **Always strap the cylinders to the extractor or to the extra cylinder wall bracket.**

1.10 Go to the compressor room. Check the oil level in the compressor. If necessary fill the compressor with fresh oil. Bleed the compressor of water by opening the water release valve on the bottom right of the compressor. It is a red valve. Permit water to run out of the compressor for 30 seconds or so, and then close the valve.

2.0 Grinding plant material

2.1 To increase the exposed surface area and reduce the water content of plant material to loaded into the extraction vessel, all plant material needs to be ground in the Ninja Grinder prior to loading.

2.2 Place the rotor in the plastic Ninja grinder, and fill it with plant material. Place the grinder vessel on the Ninja Grinder stand securing it in place. Place the lid on top of the grinder vessel. The lid goes on in only one way and a security button must be locked in place prior to turning on the power.

2.3 Pulse the power button on the grinder until all the plant material is pulverized. Then empty the plant material into the weighing pan. Repeat this process until the required amount of plant material has been ground. A standard loading is 908 grams. This may vary depending on the amount of material to be processed.

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3.0 Loading the extraction vessel

3.1 Examine the top surfaces of the extraction vessel for nicks and for anti-seize lubricant. Wipe all lubricant from the top surfaces of the extraction vessel with a paper tower. Examine the inner surface of the extraction vessel near the top. Wipe all anti seize lubricant with a paper towel if lubricant is found there. (Dispose of any soiled towels in the waste baskets located in the extraction room.

3.2 Place the filling funnel into the top of the extraction vessel. Gradually fill the extraction vessel with the pre-weighed plant material tamping down the material with the wooden rod after each aliquot of material
is placed in the extraction vessel.

3.3 After the required amount of plant material has been placed in the extractor, remove the funnel. Brush anti-seize lubricant across the threaded end of the extraction vessel. Wipe off any excess lubricant with a paper towel. Also wipe off excess lubricant on the black ring of the locking mechanism.

3.3 Secure the locking mechanism to the top of the extraction vessel. With the large wrench, tighten the locking mechanism securely.

3.4 Record the amount of material, the strain or type of plant material, the starting date, the customer, the process, and the extraction pressure on the travel document.

3.5 Record the start time, the amount of plant material and the proposed end time for the run on the white board near the extractor.

4.0 Charging the extractor with carbon dioxide and starting the run.

4.1 Check and close all open valves on the extractor.

4.2 Check the weights of both gas cylinders. Replace any empty tanks.

4.3 Open the screw valve of the right hand cylinder (dirty CO_2).

4.4 Open the shut off valve on the right hand cylinder.

4.5 On the back side of the extractor, open the shut off valve for CO_2 tank (Valve 3) and the accumulator shut off valve (Valve 5). Carbon dioxide will begin passively filling the accumulator. The mass of the right cylinder should gradually be reduced. Once the mass of the right tank has stabilized, turn on the

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Maximator pump.

4.6 Continue to fill the accumulator until a pressure of 800 to 900 psi has been reached. Then turn off the Maximator pump.

4.7 Check either the vent valve or use Valve 5 to determine if liquid CO_2 is flowing through the system.

4.8 Return to the backside of the extractor and close the accumulator valve (Valve 5).

4.9 Open the extractor valve (Valve 8) on the backside of the extractor.

4.10 Open Valve 13 on the front side of the extractor.

4.11 Check the positions of Valves 17 and 19. Both of these valves should be pointing upward to bypass Separator 1.

4.12 Check the turn screw valve (Valve 20) on Separator 2. It should be fully open at this time. If it is not, open the valve completely.

4.13 Open Valve 11 on the front side of the extraction vessel. Carbon dioxide will passively fill the extraction vessel and Separators 2 and 3. When a pressure of 700 psi has been reached in Separators 2 and 3, close Valve 11. Continue to passively fill the extraction vessel. When the mass on the right hand tank has stabilized, turn on the Maximator pump.

4.14 During this time, the right hand CO_2 tank may run empty. Switch to the left hand tank by closing of the shut off valve on the right hand tank first, and then opening the screw valve on the left hand, and finally opening up the shut off valve on the left hand tank. When time permits, close the screw valve on the right hand tank.

4.15 When a pressure of 1400-1600psi has been reached on the extraction vessel, turn off the Maximator pump.

4.16 Turn the screw valve (Valve 20) to a completely closed position, and then open it slightly with approximately 8 to 10 half turns.

4.17 Shut off Valve 3 on the back of the Extractor. Shut off the shut off valve on the left hand cylinder, and close the screw valve on the top of the left hand cylinder.

4.18 Open the accumulator valve (Valve 4) on the backside of the extractor.

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4.19 Open Valve 11 on the front of the extractor and turn on the Maximator pump.

4.20 Adjust the pressure in the extraction vessel to 1950 psi by adjusting Valve 20 on the top of Separator 2.
Repeat adjustments until a steady state of 1950 psi has been obtained. The extractor is now in run mode.

4.21 Record the start time on the white board and under the extraction pressure on the travel document. Calculate the end time for the run and place it on the white board.

4.22 During the run, occasionally check the pressures on the extractor vessel and make adjustments as necessary to maintain 1950 psi using Valve 20.

4.23 Check the water temperatures and water flow on the water baths. Adjust the temperature on the baths if necessary referring to Table 1.

5.0 Unloading the extractor

5.1 At the end of the run time, turn off the Maximator pump.

5.2 Record the end of run time on the white board and under the extraction pressure on the travel document.

5.3 Close the extraction vessel valve (Valve 8) on the back side of the extractor.

5.4 Close Valves 11 and 13 on the front side of the extractor.

5.5 Open Valves 9 and 15 on the front side of the extractor.

5.6 Completely open the screw valve (Valve 20) at the top of Separator 2.

5.7 Open the shut off valve and the screw valve on the right hand gas cylinder.

5.8 Open the CO_2 cylinder valve (Valve 6) on the backside of the extractor.

5.9 The right hand cylinder should now passively fill with carbon dioxide and the mass on the right hand scale should increase.

5.10 When the mass on the right hand scale has stabilized, turn on the Maximator pump.

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5.11 If and when the right hand cylinder reaches a mass of 165 lbs., stop the Maximator pump, and close the valves for the right hand cylinder. Bring the other large cylinder to the extractor, and couple the tank too the system through the manifold system on the extractor. Open the shut off valve and the screw valve completely. Finish pumping down the system.

5.12 When no more liquid carbon dioxide is being pumped, stop the Maximator pump. Typically this occurs when the pressure in Separators 2 and 3 reaches 600 psi.

5.13 Close the valves on all cylinders. Decouple extra tank if used and return and secure it to the wall bracket.

5.14 Close the accumulator valve (Valve 4) and the CO_2 valve (Valve 5).

5.15 Open the needle valve slightly at the bottom of Separator 3 to purge carbon dioxide from the system. When the pressure reaches 200 psi close the needle valve at the bottom of Separator 2.

5.16 Prepare a mason jar to capture the crude oil. The mason jar must be thoroughly washed and dried. (See Pro-001-025 for instructions on cleaning jars.) Remove the lid, weigh the empty glass jar without lid and record its mass in magic marker on both sides of the outer jar wall.

5.17 Place the jar without its lid under the needle valve of Separator 2. Turn the valve very slightly to allow crude oil to flow from Separator 2 into the jar.

5.18 When most of the crude oil has flowed from the Separator, close the needle valve. Continue to purge the system of carbon dioxide by reopening the needle valve at the bottom of Separator 3. When all pressures read 0 on the extraction vessel and Separators 2 and 3, close the needle valve on Separator 3.

5.19 Release any residual carbon dioxide in the extraction vessel by opening the release valve at the top front of the extraction vessel.

5.20 Loosen the top of the extraction vessel with the large wrench. Place the top in the holding bracket. Using the vacuum system and a wooden dowel, remove all the spent plant material from the extraction vessel.

5.21 Loosen the receptacle at the bottom of Separator 2 using the large wrench. Detach the water lines to the receptacle. Carefully remove the receptacle on Separator 2. Warning: It is heavy and the use of the wooden platform for support is recommended. Carry the receptacle to the workhorse. Using spatulas, scrape any remaining oil from the walls of the bottom of Separator 2 and from the

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receptacle. Place this oil in the mason jar with the rest of the crude oil from the run.

5.22 Weigh the jar without its lid. Record the mass on the white board. Decant any residual water into a tray found in the freezer compartment of the office freezer. Reweigh the jar without its lid. Record the final amount of crude oil, determine the mass of water recovered by difference. Record the final mass of crude oil and the residual water on the travel document.

5.23 Replace the lid on the jar and record the mass of the crude oil on the jar lid as well as the lot number and the sublot letter. Place the jar in the safe for later processing.

6.0 Preparation for the next run.

6.1 Clean the surfaces of the flanges of the Separator 2 receptacle and the bottom of Separator 2 with ethanol and paper towels. Properly dispose of the towels. Wipe any antiseize lubricant on these flanges.
Wipe excess antiseize lubricant from the top of the receptacle.

6.2 Carefully replace the receptacle on Separator 2. Tighten it securely with the large wrench. Reattach the water lines to the receptacle.

6.3 Place used spatulas in clean jar in the backroom.

6.4 Check temperatures and flows of the water baths.

6.5 Close all valves front and back on the extractor.

6.6 Repeat Steps 2.0 through 6.5.

7.0 Shutdown of the extractor

7.1 Clean the surfaces of the flanges of the Separator 2 receptacle and the bottom of Separator 2 with ethanol and paper towels. Properly dispose of the towels. Wipe any antiseize lubricant on these flanges.
Wipe excess antiseize lubricant from the top of the receptacle.

7.2 Carefully replace the receptacle on Separator 2. Tighten it securely with the large wrench. Reattach the water lines to the receptacle.

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7.3 Close all valves front and back on the extractor.

7.4 Turn off the chiller.

7.5 Unplug the pumps and heaters on the water baths.

7.6 Place all dirty spatulas in the cleaning jar in the backroom.

8.0 Maintenance Schedule (See the manuals for both the extractor and the chiller for details.)

8.1 Daily

8.1.1 At the beginning of each day bleed the water from the compressor.

8.1.2 Check amount of water in the water baths. The level should be no more than 1.5 inches below the return stream.

8.1.3 Check the oil level in the site glass of the compressor. Refill with oil if necessary.

8.1.4 Check the o-ring on the receptacle on Separator 2 for wear. Replace the o-ring if necessary.

8.2 Weekly

8.2.1 Clean spillage of oil on the floor below Separator 2 with paper towels and ethanol or isopropanol.

8.2.2 Empty the vacuum of spent material.

8.3 Monthly

8.3.1 Clean all surfaces of the large plastic funnel with ethanol.

8.3.2 Clean thoroughly the Ninja grinder vessel.

8.3.3 Apply a small amount of Vaseline to the o rings on the quick release water fittings on the receptacle of Separator 2.

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8.4 Intermittent maintenance

8.4.1 Clean run of the extractor. See 9.0.

8.4.2 Every six months use the carbon dioxide detector to check for leaks on the Swagelok fittings
throughout the extractor plumbing.

8.4.3 Every three months drain and replace the water in all water baths.

9.0 Clean run on the extractor

9.1 Typically when moving from one plant strain too another plant strain, a clean run will be made with the extractor. A clean run may also be needed at other times (after special runs, or after equipment malfunction or operator error.) The steps for a clean run follow.

9.2 Follow the set up procedures for a typical run, but do not fill the extraction vessel with plant material.

9.3 Set the pressure for the extraction vessel at 2200 psi.

9.3 The run time for a clean run is 2.0 hours.

9.4 At the end of the clean run remove the receptacle from Separator 2 and place it on the work bench. Thoroughly clean the flanges of the receptacle with ethanol. Inspect the o-ring on the receptacle for wear. Replace it if necessary. On the work bench place a small volume of ethanol (20 mL) in the bottom of the receptacle. The shut off valve on the receptacle is closed. Seal the receptacle by placing a sheet of plastic wrap cross the top of the receptacle. Allow the ethanol to sit in the receptacle overnight. Then drain the ethanol from the receptacle and wipe all inner surfaces with a clean paper towel.

Process Description for Winterization of Crude Oil:

This procedure defines the standard procedure for operation of the Eden 157 Extractor (excerpted from CO2 Dynamics process description – document Pro-001-002).

1.0 Safety and equipment check list prior to start up.

1.1 Ethanol and ethanol solutions are stored in the solvent cabinet or in the freezer when not in use.

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1.2 Wear safety goggles when working in the back lab area.

1.3 Note where the eye wash station is located.

1.4 Fill a water bath with water. The amount of water varies dependent on the number of jars placed in the bath. Set the dial for temperature to 3.0 to 3.5 units.

1.5 Turn on the chiller connected to the rotovap. The chiller is set at -15 degrees C. Typically the chiller temperature read out will be between -15 and -10 degrees C.

1.6 Turn on the power switch on the rotary distillation apparatus. Set its temperature to 45 □. Turn on the power switch for the pump apparatus.

2.0 Dissolution of crude oil in ethanol.

2.1 Crude oil will typically be delivered to the area in mason jars. Check the information of the travel document against the lot number and mass of oil on the lid of the jar.

2.2 No more than 150 g of raw oil will be dissolved in one 2 quart jar. If there are more than one jar for a given extractor lot number, check the lot numbers and masses of the remaining jars against the travel document.

2.3 If an amount more than 150 g of raw oil is in any jar, divide the raw oil among all jars in the lot so that each jar has a maximum of 150 g of raw oil. Excess oil can always be placed in an extra empty mason jar.

2.4 Add approximately 10mL of clean dry ethanol to each jar for every gram of oil in the jar.

2.5 Tighten lid securely.

2.6 Place the jar in the water bath. **Record mass of raw oil and time in computer log.**

2.7 After roughly an hour, check to see if all the oil has dissolved in the ethanol. A swirling shake may be used to assist the dissolution at this point. Do not shake the jar vigorously. Do not hold the jar at eye level.

2.8 When all the oil has dissolved, pull the jar from the bath. Let it cool to room temperature. Then place the jar in the freezer at -20□ for at least four hours. **Record the time the jar is placed in the freezer.**

3.0 Filtration of solids and waxes

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3.1 After being chilled, waxes and other products have solidified. The ethanol solution is now ready to be separated from the solids. Check the labeling on the jars in the freezer for the next lot to be processed, but leave it in the freezer until the filter set up is ready.

3.2 Set up a filter flask on a stand with an adapter and Buchner funnel.

3.3 Place two large coffee filters in the Buchner funnel.

3.4 Connect the vacuum line to the filter funnel. Open the valve on the vacuum line.

3.5 Take the appropriate Mason jar from the freezer. Open the jar and pour enough solution to fill the filters without overflowing. Place the jar with the remainder of the solution back into the freezer to keep it cold.

3.6 After all the ethanol solution has passed through the filters (The time required may be 30 minutes or greater.), pour additional aliquots of 60 to 100mL of cold ethanol (-20˚C) over the filtered waxes until the residual yellow oil color is removed. Close the vacuum line valve, and then remove the filters from the funnel. The filters may be placed directly on the stainless steel table top.

3.7 Place two more clean filters and repeat steps 3.4 through 3.6 until the Mason jar has been completely emptied. Rinse the Mason jar with three small aliquots of clean ethanol and pour the three aliquots one at a time into the filter funnel.

3.8 When the ethanol solution from a Mason jar has been completely filtered, turn off the vacuum valve and remove the filters. The residual waxes and solids are placed in the waste basket.

3.9 Pour the ethanol filtrant back into the Mason jar. An Erlenmeyer flask may be used if there are no mason jars available.

3.10 Cap the jar and place it in the freezer. Let it stay in the freezer for at least 4 hours. **Record the time placed in the freezer in computer log.**

4.0 Final filtration

4.1 Carefully check the lot numbers on the flasks to be processed. After a period of at least four hours, the filtered ethanolic solution is filtered again.

4.2 Set up a Buchner funnel and filter flask. Place a 2.5 µm or 1.5 µm filter disc in the funnel, and wet the disc with dry ethanol. Open the valve on the vacuum line.

4.3 Take the first flask or jar of a given lot of previously filtered ethanolic solution. Double check the labeling.

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4.4 Pour the solution into the funnel until the flask is empty. Rinse the flask with three small aliquots of dry ethanol and place these in the funnel as well.

4.5 When all the solution has passed through the filter, close the line to the vacuum and detach the flask from the vacuum line.

4.6 Set up the second Buchner funnel and filter flask. Place a second 1.5µm filter disc in the second funnel. Repeat steps 4.3 through 4.5.

4.7 The processed ethanol solution is now ready for the distillation through the rotovaporizing apparatus. Cap the jar and place it in the solvent cabinet for storage prior to the next processing step. **Record time in computer log.**

4.8 Repeat steps 4.1 through 4.7 on all subsequent quantities of solution from the same process lot.

5.0 Distillation of the ethanol from the cannabis oil

5.1 Check the computer log for the lot to be processed. Check the marking on the side of Mason jar or Erlenmeyer flask against the computer log.

5.2 The volume of approximately two Mason jars may be added to the distillation flask at a time. Disconnect the boiling flask from the rotovap unit. Place it in the cork ring support. Place a funnel in the boiling flask and pour the ethanol solution into the boiling flask through the funnel.

5.3 Turn on the vacuum pump, the rotary motor and the heater on the rotovap. Set the temperature of the bath to 45 degrees C.

5.4 On Heidolph Model G6 or G3, lower the boiling vessel into the water bath with the start button.

5.6 Attach receiving flask to the rotovap and tighten the clamp holding it to the unit. **Record time in the computer log.**

5.7 Start the rotation of the boiling flask and gradually bring the rotational speed up to 100 rpm.

5.8 When the bath temperature reaches 45 □, open the valve to the vacuum line connected to the rotovap.

5.9 Gradually increase the amount of vacuum cautiously to the point where boiling occurs in the boiling flask. Back off slightly on the vacuum so that there is a steady flow into the receiving flask without much boiling activity in the boiling flask. Do not use too high of a vacuum to prevent bumping.

5.10 When the liquid in the boiling flask becomes opaque, remove the collection flask from the rotovap and pour the ethanol into a storage bottle marked “good”

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ethanol. First shut off the vacuum line valve, and open the vacuum control screw to bring the pressure within the system to atmospheric pressure. Now remove the receiving flask. After decanting the ethanol into the storage bottle, return the flask into its position on the rotovap. Continue the distillation process. Here either more ethanol solution from the same lot is added to the boiling flask and return to step 5.2, or continue to Step 5.11 if all ethanol solution for the lot has been already distilled.

5.11 When no more boiling or bubbling occurs, begin increasing the temperature of the water bath by increments of 5 □. With each five degree increase bubbling or boiling typically occurs. When boiling has stopped, raise the temperature five more degrees. Continue this process of increasing temperature until a temperature of 70 degrees C is reached.

5.12 At 70 □, repeat the removal of ethanol in the receiving flask as described in Step 5.11, but place this ethanol in the wet ethanol storage bottle. After the receiving flask is back in place on the rotovap, continue the distillation process.

5.13 When boiling has stopped at 70 □, continue under the same pressure and temperature conditions for at least 30 more minutes before stopping the process.

5.14 Stop the rotation of the boiling flask, and let the flask remain in the hot water bath for 10 minutes to oil to pool to the bottom of the flask.

5.15 While the oil is pooling, select a Pyrex tray for the transfer of the oil. Either weigh the tray or check the tray for a tare weight.

5.16 Elevate the boiling flask, and remove it from the rotavap. Wipe excess moisture from the outside of the boiling flask with a paper towel.

5.17 Invert the boiling flask through the ring on the ring stand so that the oil pours into the Pyrex tray. Use the heat gun set at 510 degrees F to assist the drainage of the oil into the Pyrex tray.

5.18 B**y difference calculate and record the mass of the recovered oil on tag for this batch. Also record the mass in the computer log.**

5.18 Repeat the process Steps 5.1 through 5.18 for subsequent batches of the same production lot. These additional production lots are to be poured into the same Pyrex tray with the first batch of the lot as long as the depth of the oil in the Pyrex tray is ¾ inches or less. Once the depth of ¾ inches is reached place subsequent runs of the same lot in another tray.

6.0 Distillation of residual ethanol oil and homogenization of the plated oil using the vacuum oven.

6.1 Check the production schedule and the travel documents for the next lot to be processed in the vacuum oven.

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6.2 Set the oven temperature to 175 degrees F.

6.3 When the temperature set in Step 6.1 is reached, place the Pyrex tray with the oil in the vacuum oven. Check if the starting mass of the oil on the travel tag and computer log.

6.4 Open the in line vacuum valve to the pump.

6.5 Turn the valve dial on the vacuum oven to OPEN.

6.6 Turn the vacuum release crew valve on the vacuum oven clockwise to completely closed position.

6.7 For oil coming from the RE3000 B rotavap, the pressure should now be slowly reduced in the vacuum oven. Leave the tray with the oil in the oven for at least 18 hours.

6.8 At the end of the vacuum oven treatment, turn the dial valve on the vacuum oven to the CLOSED position.

6.9 Close the in line valve to the vacuum pump.

6.10 Gradually open the relief valve on the vacuum oven to bring pressure back to atmospheric conditions.

6.11 Remove the Pyrex tray from the oven and let it cool slightly before placing it on the balance to obtain the new weight. **Record the weight on the travel tag and record the mass of the oil in the computer log.**

6.12 After the tray has reached a temperature close to room temperature, place the tray of oil in the safe.

7.0 Consolidation of trays of oil coming from the same lot of starting material.

7.1 Place all trays to be consolidated into the oven set at 175 degrees F for a minimum of 30 minutes.

7.2 Take the trays out of the oven and pour the oil into the common tray. Use a rubber spatula to scrape out residual oil during the transfer process. Stir the transferred oil with a steel spatula.

7.3 Place the consolidated oil in the vacuum oven and heat it for a minimum of 15 minutes before removing it from the oven. Stir the oil with a steel spatula. Return the tray to the oven for an additional 15 minutes. Remove the oil from the oven and stir with a steel spatula.

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7.4 Now pour the entire tray of oil into its final tared shipment container. **Record the final weight in the computer log.** After the oil has cooled, place the container in the safe for storage.

8.0 Sampling of oil for research analysis

8.1 Typically professional lab samplers do the sampling for compliance testing. If a research sample is required, heat the tray of oil to be sampled in the vacuum oven for a minimum of 30 minutes at 130 degrees F before sampling.

8.2 Using 3 mL medical grade syringes with plastic caps, pull sample volumes as needed from the tray at the five locations shown in Figure 1. Alternate sampling from top or bottom of the oil layer through the five sampling locations.

8.3 Place a plastic cap on the end of each syringe.

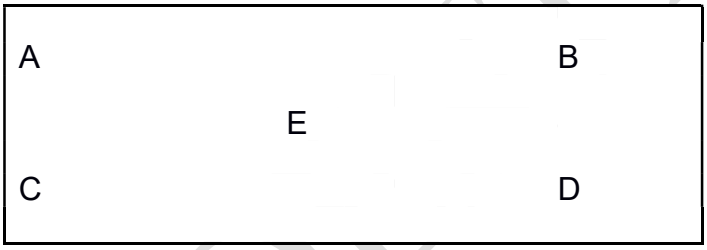

Figure 1 Positions for sampling tray of oil for homogeneity study

8.4 Secure a gummed label to identify the sample. On the label write the lot number, the date and time sampled, initials of the sampler, lot number, and OLCC number of processor.

8.5 Store syringes with samples in a beaker on top of the solvent cabinet for later delivery or pickup.

9.0 Maintenance of the systems

9.1 Daily

9.1.1 Check the oil level in the pumps and refill as necessary.

9.1.2 Clean all spatulas by end of shift.

9.1.3 Check flow of coolant in the condenser visually.

9.1.4 At the end of a run of a specific lot, place approximately 20 mL of clean dry ethanol in the boiling flask and cover the top with plastic wrap. When residual oil is redissolved in the ethanol, pour the ethanol solution in the jar marked Kitty.

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9.1.5 At the end of a specific lot, clean with soap and hot water the two filter flasks. Rinse with wet ethanol and wipe the outside of each flask with wet ethanol. Place the cleaned flasks on the wire racks.

9.1.6 Clean with soap and hot water all emptied Mason jars, Pyrex trays, and Erlenmeyer flasks. Rinse the inside of each vessel with wet ethanol and wipe the outside of the vessel with wet ethanol, and place the cleaned vessels on the wire rack.

10.2 Weekly

10.2.1 Dump and wash the water baths with soap and hot water. Rinse and fill with fresh distilled or deionized water.

10.2.3 Clean the trays in the vacuum oven with soap and hot water. Wipe with wet ethanol. Place them back in oven.

10.2.4 Rinse all Buchner funnels with wet ethanol. Then wash with soap and hot water. Rinse again with wet ethanol and wipe all outer surfaces with wet ethanol.

10.3 Bimonthly

10.3.1 Change the oil in all vacuum pumps.

10.3.2 Check vacuum valves for proper working. Replace valves as needed.

Exceptions, Recommendations and Conclusions:

- The CO2 Dynamics facility complies with Maximum Allowed Quantities (MAQ) amounts allowing the Extraction Room to be classified as a non-High Hazard facility, F1 occupancy.

- The IFC C50, applicable sections 5001 and 5003, apply to the storage and use of hazardous materials, regardless of the amount or occupancy. Among these requirements are:

    - Proper labeling and signage.
    - SDS for all hazardous materials.
    - A storage plan, if so requested by the fire department, showing types of hazardous materials and locations in tanks and on shelving.
    - Written procedures and personnel training as it relates to hazardous materials.

- It will be the responsibility of CO2 Dynamics to maintain hazardous materials amounts within the MAQ. If MAQ amounts are exceeded at any time the

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Extraction Room would be classified as an H occupancy requiring additional engineering and controls per the applicable codes and standards.

- It will be the responsibility of CO2 Dynamics to maintain the overall facility in accordance with the requirements of the codes, standards, OHA, OLCC and industry best practices.

Separate Permits that will be obtained:

Separate Permits that will be obtained include the following:

- Building Permit, including change of occupancy to F-1.
- Mechanical Permit
- Plumbing Permit

Manufacturer and Model Number of Extractions Equipment:

- Eden Hi-Flo, Serial No. 163, as described above.
- Eden Hi-Flo, Serial No. 178, as described above.

Engineer Peer Review:

An equipment evaluation prepared by a registered Oregon engineer shall be provided (OFC 5003.2.3), and included with this report submission.

Source of the Carbon Dioxide:

- CO2 gas is provided via CO2 cylinders that are located outside the building, at the South East corner in a locked cylinder storage cage.
- CO2 cylinders are restrained via chains/unistrut.

Carbon Dioxide Gas Detection and Alarm Systems NFPA 55, 13.10.4.2.:

- Continuous gas detection is required and provided for all areas where CO2 gas can accumulate.O2 gas is provided via CO2 cylinders that are located outside the building.

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GAS MONITOR/CONTROLLER/SENSOR/ALARM SCHEDULE		
TAG NO.	DESCRIPTION	NOTES
CO2	TITAN CONTROLS - ATLAS 4 ROOM CO2 MONITOR/CONTROLLER, OR EQUAL, CONTROLS CO2 FROM 600 TO 2,000 PPM, MONITORS CO2 FROM 500 TO 5,000 PPM. INCLUDES REMOTE ROOM SENSOR. MOUNT SENSOR LOW ON WALL. APPX. 14" AFF. ELECTRICAL - 120V/1P, 10 AMPS. INSTALL AND CALIBRATE PER MANUFACTURER'S INSTRUCTIONS.	
ETH	HONEYWELL SENSEPOINT XCD GAS DETECTOR, OR EQUAL, CONTROLS ETHANOL FROM 500 TO 1,000 PPM. INCLUDES REMOTE ROOM SENSOR. MOUNT LOW ON WALL, APPX 14" AFF. ELECTRICAL - 24V DC W/3 WIRE 4-20 MA W/RELAYS - PROVIDE 120V/1P/24V DC TRANSFORMER. INSTALL AND CALIBRATE PER MANUFACTURER'S INSTRUCTIONS.	
STR	COOPER NOTIFICATION HAZARDOUS LOCATION STROBE MODEL XB11, OR EQUAL, WALL MOUNTED STROBE/SOUNDER W/29 CANDELA STROBE AND INTEGRAL AUDIBLE ALARM FEATURE. RATED FOR HAZARDOUS LOCATIONS. UL LISTED WITH GLASS REINFORCED POLYESTER BODY AND GLASS LENSE. INSTALL AND CALIBRATE PER MANUFACTURER'S INSTRUCTIONS.	
NOTES:		

Carbon Dioxide Warning Signs (OFC Ch. 50, NFPA 55):

- Warning signs are posted at the entrance of the building, room and all confined areas where CO2/hazardous materials, cylinders, piping and equipment are located.
- The Extraction Room shall have a sign that states “Caution – Carbon Dioxide in use” and shall include the appropriate NFPA 704 placard.
- The signage location shall be shown on the Architectural Drawings that are being submitted for permit.
- The signage must be at least 8 inches wide and 6 inches high.

Emergency Shut Off Valves for CO2:

- An emergency shut-off valve shall be provided in the room to shut-off flow from the CO2 container.
- This shut-off valve shall be solenoid operated, connected to emergency power and shall fail in the normally closed position.

Ventilation of Extraction Room:

- Extraction room shall be vented continuously at 1 CFM/sf and shall be vented at 3CFM/sf in the event of CO2 levels above 1,200 ppm.

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- Ventilation systems shall be connected to emergency power, so that the ventilation system will still operated for 90 minutes in the event of normal power failure.

- Ventilation systems shall have low wall exhausts to exhaust CO2 effectively, as it has a higher density than air.

SEQUENCE OF OPERATIONS

TAG NO.	NO.	SEQUENCE	NOTES
EXHAUST FANS	1	EF-1 SHALL RUN CONTINUOUSLY. SPEED TO BE SET TO 900 CFM INITIALLY (1 CFM/SF). LOUVERS SHALL BE AT FAN LOW SPEED POSITION.	
	2	SENSORS SHALL DISPLAY ROOM PPM AT ALL TIMES	
	3	CO2 ALARM LEVEL SHALL BE SET AT 2000 PPM INITIALLY.	
	4	WHEN ANY LEVELS REACH ALARM LEVEL, EF-2 SHALL ENERGIZE, MOTORIZED DAMPERS FOR EF-1/EF-2 SHALL SEQUENCE AND DAMPERS TO AIR INTAKES SHALL OPEN TO 100% AND FAN SHALL OPERATE AT 2700 CFM. EF-2 SHALL RUN UNTIL LEVELS DROPS TO REQUIRED PPMS (ADJUSTABLE) WHEN EF-2 SHALL TURN OFF AND EF-1 SHALL ENERGIZE.	
	5	FAN SWITCH AT EXHAUST HOOD WILL ALLOW OPERATOR TO OPERATE FAN MANUALLY BETWEEN LOW SPEED AND HIGH SPEED, BUT AUTOMATIC CONTROL SHALL OVERRIDE MANUAL OPERATION IN AN ALARM CONDITION.	
	6	AUDIBLE ALARM AND STROBES SHALL ENERGIZE IN THE EVENT THAT AN ALARM CONDITION IS TRIGGERED AND FAN SYSTEM IS AT HIGH SPEED. ALARM AND STROBE SHALL NOT ENERGIZE WHEN OPERATOR HAS ONLY MANUALLY ENGAGED EXHAUST HOOD IN HIGH SPEED MODE.	
	7	FAN COILS SHALL OPERATE NORMALLY BASED UPON TIME OF DAY SCHEDULES/THERMOSTAT.	
(E) HP & FCs	1	HP AND FCs SHALL OPERATE BASED ON TIME OF DAY SCHEDULES.	
LOUVERS/ROOFCAPS	1	OUTSIDE AIR OPENINGS SHALL BE INTERLOCKED WITH EXHAUST FANS. MINIMUM OF 160 CFM OUTSIDE AIR SHALL BE PROVIDED WHILE SPACE IS OCCUPIED, TO MEET VENTILATION REQUIREMENTS.	

NOTES:

BEA CONSULTING LLC 10/17/17 5:15 PM

Hazardous Materials Inventory Statement per OFC CH 50 and Appendix H102 for all chemicals used in the process:

Extraction Room		F1 Occupancy												
Product	CAS#	Criterion			Basis for Classification (	Storage			Use-Closed			Use-Open		
		1	2	3		lbs	Gal	CF	lbs	Gal	CF	lbs	Gal	CF
Carbon Dioxide	124-38-9	NH			HMEX	1000			1000					
Isopropyl Alcohol	67-63-0	FL-1B	IRR		HMEX(72)		1						0.1	

Post Processing		F1 Occupancy												
Product	CAS#	Criterion			Basis for Classification (	Storage			Use-Closed			Use-Open		
		1	2	3		lbs	Gal	CF	lbs	Gal	CF	lbs	Gal	CF
Isopropyl Alcohol	67-63-0	FL-1B	IRR		HMEX(72)		1						0.1	
Ethanol 95%ABV	64-17-5	FL-1B	IRR	OHH	HMEX(63F)		20			10				

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Provisions for field verification of extraction equipment:

Once the extraction equipment is installed it shall be inspected by a third party mechanical engineer. An independent commissioning report signed and sealed by the mechanical engineer who performed the inspection shall be submitted prior to final inspection. The letter shall confirm that the equipment onsite meets the approved equipment specifications submitted with the technical opinion report.

Please call if you have any questions or require additional information.

Regards-

Steffen U. Brocks, P.E.
BEA CONSULTING LLC

END OF ANALYSIS

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Ventilation Requirement Report – CO2 Dynamics Facility

Objective:

To determine ventilation sizing requirement to maintain non-hazardous zoning as per NEC 500 / IEC 60079 in CO2 Dynamics extraction room located in their NW Portland Facility. Airflow and exchange rate must be so that the degree of ventilation shall be considered *High,* and the availability of ventilation shall be considered *Good* (continuous). Exchange rate shall be sufficient to maintain an explosive vapor concentration 25% of the LFL given the calculated *max rate of release.* Max rate of release shall be determined using boundary conditions and assumptions that produce the most conservative (largest) value.

Processing Room Conditions:

- Max Temp – 32 C
- Minimum Room Pressure – 30.0”Hg
- Max RH – 100%
- Min RH – 0%
- *Openness* – Sheltered
- *Ventilation type* – Artificial
- Area – 900 ft.sq

System:

- Largest Opening Size – 8’ x 3’ (containment for table)
- Maximum amount of in use ethanol – 3L
- *Grade of Release* – Secondary

Solvent Properties

- Solvents:
    - Ethyl Alcohol
        - *Relative Vapor Density* – Heavier than Air
        - *Lower Flammability Limit (LFL)* – 3.3%bv
        - *Normal Boiling Point* – 78°C

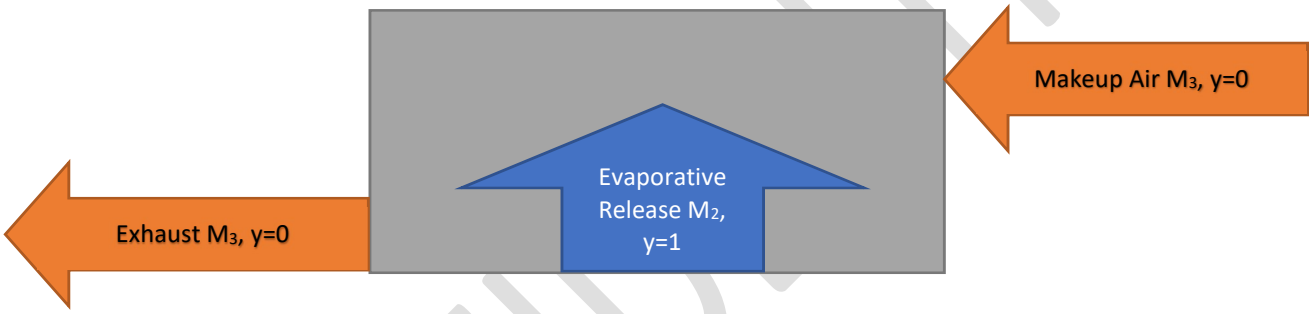
Process Narrative:

With 2 rotary evaporators each containing 1.5 L ethanol, 3 liters is the maximum amount of liquid ethanol that could reasonably said to be be at risk of spilling. A shallow stainless steel pan the size of the table will be added to contain any spill should it occur.

Gas detection equipment will be continuously monitoring solvent air concentrations, and will be used to control exhaust fan speeds.

A worst case scenario for accidental ethanol vapor release was developed to determine a conservative ventilation requirement. The proceeding calculations consider a physical situation where two solvent filled extraction vessels have been left open, allowed to reach ambient temperatures, and are subjected to convective evaporation inside of the room.

Block Flow Diagram:



Where, M1=M2+M3 in Kg/s, y= volume fraction of solvent

Calculation Assumptions:

- Well Mixed
- Volume fraction of solvent in makeup air = 0
- Isochoric, Isobaric, and Isothermal
- Steady State
- Ideal Gas

Accidental Release Source Term (maximum rate): Evaporation of a non-boiling liquid pool (Stiver and Mackay's Method)

$$E = \frac{k \cdot P \cdot M}{R \cdot T_A}$$

where:

E = evaporation flux, (kg/s)/m² of pool surface

k = mass transfer coefficient, m/s = 0.002 ***u***

T_A = absolute ambient temperature, K

M = pool liquid molecular weight, dimensionless

P = pool liquid vapor pressure at ambient temperature, Pa

R = the universal gas law constant = 8314.5 Pa·m³/(kmol·K)

u = windspeed just above the liquid surface, m/s

Stiver and Mackay's Method		
Ambient (Solvent) Temperature, Ta	90	°F
	305	K
Ethanol Vapor Pressure, P	17232	Pa
Molecular Weight of Ethanol, M	46.1	g/mol
Ideal Gas Constant, R	8314.4	$m^3Pa/kmol/K$
Assumed Air Speed, u	0.5	m/s
Mass Transfer Coefficient, k	0.0010	m/s
Evaporation Flux, E	0.0003	$kg/s/m^2$
Tank Diameter	66	in (equivalent)
Number of Tanks	1	
Open Surface Area	2.21	m^2
Evaporation Rate (0.77 kg/m^3)	0.0007	kg/s
	54	mL/min
Ventilation Calculation		
Minimum Ambient Pressure	30.0	inHg
	101422	Pa
Dry Air Molecular Weight	29	kg/kmol
Minimum Air Density, ρ_a	1.2	kg/m^3
Ethanol Partial Pressure	17232	Pa
Initial Ethanol Concentration	0.31	kg/m^3
	17%	bv
Ethanol LFL	3.3%	bv
25% LFL, y_1	0.8%	bv
Evaporation Ratem, M_{e2}	0.0007	kg/s
	0.002	m^3/s
Required Ventilation, Q_1	0.072	m^3/s
	153	CFM
Room Area	900	sf
Factor of Safety	5	
Minimum Requirement	**0.9**	**CFM/sf**
	765	**CFM**
Actual Mean Air Speed	0.0043	m/s

*Ethanol Vapor pressure as calculated using Antoine's Equation.

Ethanol material balance:

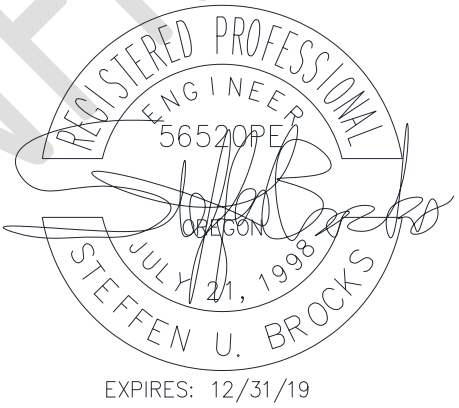
$$M_{e1} = M_{e2} + M_{e3} \xrightarrow{M_{e3}=0} Q_1 y_1 \rho_a = M_{e2} \longrightarrow Q_1 = \frac{M_{e2}}{y_1 \rho_a}$$

- M_{e1} Ethanol mass flow in exhaust stream, kg/s
- M_{e2} Ethanol mass flow in evaporation (calculated prior), kg/s
- M_{e3} Ethanol mass flow in makeup air (assumed zero), kg/s
- Q_1 Exhaust volumetric flow, m^3/s
- y_1 Ethanol %bv in exhaust stream (25%LFL), m^3/m^3
- ρ_a Minimum air density, kg/m^3

Conclusion:

The above calculated minimum ventilation requirement of 0.9 CFM/sf for the room has a factor of safety of 5, and will keep total exhausted concentrations well below 25% of the LFL. This calculation is conservative in that the assumed air speed is much larger than the calculated air speed (x250) which will result in a lower evaporation rate than calculated.

Selected exhaust fans shall be sized by the Mechanical HVAC Engineer to meet the minimum CFM requirement at design static pressure. Exhaust registers shall be located less than 1-foot from the ground. The minimum airflow provided shall be larger than the minimum requirement calculated above as necessary to accommodate exhaust fan speed turndown capabilities. The maximum exhaust rate will be approximately 3 CFM/SF to meet statutory requirements, which is much greater than the required 0.9 cfm/sf (at safety factor of 5).



CERTIFICATE OF COMPLIANCE

Certificate Number	2016-12-21-E486210
Report Reference	E486210-D1000-1/A0/C0-UL
Issue Date	2016-12-21
Issued to:	Heidolph Instruments GmbH & Co. KG
Applicant Company:	Walpersdorfer Str. 12, 91126 Schwabach Germany
Listed Company:	Same as Applicant
This is to certify that representative samples of	Rotary Evaporator Modular System (Equipment for heating of materials) Hei-VAP Value Series, Hei-VAP Advantage Series, Hei-VAP Precision Series and Heizbad Hei-VAP (Heating bin). Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.
Standard(s) for Safety:	UL 61010-1, 2nd Edition, 2013-07, CAN/CSA-C22.2 No. 61010-1, 2nd Edition, 2008-10
Additional Standards:	IEC 61010-2-010:2003(ed.2) - Part 2-010; Particular Requirements for laboratory equipment for heating of materials and CAN/CSA-C22.2 No. 61010-2-010-04 - Part 2-010; Particular Requirements for laboratory equipment for heating of material.
Additional Information:	See the UL Online Certifications Directory at www.ul.com/database for additional information.

Only those products bearing the UL Certification Mark should be considered as being covered by UL's Certification and Follow-Up Service.

Look for the UL Certification Mark on the product.

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements.

Bruce Mahrenholz, Assistant Chief Engineer, Global Inspection and Field Services, UL LLC
Joseph Hosey, General Manager, Director of Sales – Canada, UNDERWRITERS LABORATORIES OF CANADA INC.