



ESP Unit

Unité ESP

Operation & maintenance

Manuel d'opération & maintenance

Version : V2.1

Contact us/ Nous joindre

Design, pricing, sales, technical support,
maintenance and cleaning
sales@cadexair.com

Conception, estimation, ventes,
soutien technique, entretien et nettoyage
ventes@cadexair.com

www.cadexair.com

Head office/ Siège social
3020-B, Rte Marie-Victorin
Varenes, QC Canada J3X 0J5

T 450-652-0668

T 1 800 461-0668

Foreword

Thank you very much for your trust on Cadexair ESP unit. Before a proper installation and operation of the ESP, please carefully read this manual, where detailed installation, operation and maintenance guidelines are given.



Special Explanation

- 1) This manual is written for the standard model of ESP unit.
- 2) Due to a policy of continuous product improvement, Cadexair reserves the right to change specifications and appearance without notice.
- 3) If there is anything incorrect or misleading, please contact us directly and inform us of the product serial number imprinted on the name plate and the manual serial number printed on the lower right corner of the corner.
- 4) Without the written permission of Cadexair any copy or adaptation of all or part of the contents of this manual would be considered a serious violation.



Special Announcement

User should choose the appropriate model and install it according to the manual, and should have qualified and trained personnel to operate the ESP Unit and keep it in normal working condition. The manufacture shall not be held responsible for any damages or losses caused by the user's failure to observe the precautions and provisions stated in this manual.

The products meet the standards



Security Certificate

ISO9001 2008 Certificate

Certified UL-710

Cadexair

3020-B Boulevard Marie-Victorin Varennes QC Canada J3X 0J5

TEL 450-652-0668

1-800-461-0668

Website www.cadexair.com

Security Symbol

Symbols are applied to highlight some of the precautions and provisions stated in this manual that have something to do with the safety and soundness of the operator and the equipment.



Danger

Warning: potential risks of persona! or property losses!



Requirement

Caution: potential influence on the persona! or property safety if the requirements are not observed strictly!



Remind

Advise: more attentions to pay or more clarifications to make.

Contents

1 Introduction.....	2
1.1 Application.....	2
1.2 Basic Features	2
1.3 Parameters & Specifications.....	2
1.4 Environmental Requirements.....	2
2 Structure.....	3
2.1 Working Principe.....	4
3 Installation	4
3.1 General Installation Guidelines	4
3.2 Installation Location.....	5
3.3 ESP Mainframe Installation	6
3.4 Duct Connection.....	7
3.5 Power Supply Connection.....	7
4 Debugging	8
4.1 Inspection before Power-up.....	8
4.2 Power Supply Inspection	8
4.3 Airflow Adjust	8
4.4 Commissioning	9
5 Operation	9
5.1 Control Panel Introduction	9
5.2 Operation Guidelines	10
5.3 Operation of Power on Start-up and Fan Linkage Start-up	10
5.4 Notes	10
6 Maintenance	10
6.1 Maintenance Checklist	11
6.2 Maintenance Guidelines	11
7 Trouble Shooting	17
7.1 Troubleshooting diagnostic code table of digital power supply	18
7.2 Notes	18
8 Miscellaneous	19
8.1 Unpacking	19
8.2 Delivery and Storage.....	19
9 Option	19
9.1 Activated Carbon Device.....	19
9.2 Structure Chart.....	20
9.3 Installation.....	20
9.4 Maintenance	22
9.5 Others.....	24

1. Introduction

1.1 Application

As a specially designed cooking fume capturing and grease vapor collecting device, a Electrostatic Precipitator (ESP) or call Electrostatic Unit can always come in handy, particularly for food premises were

cooking fume and grease vapor is more likely to be generated, such as restaurants with wok burners, or western restaurants with deep-fryers, broilers, griddles, and grills. Processed air should be vented out into well-ventilated open areas. Do not use the catering electrostatic precipitator to purify the industrial oil mist which is normally combustible, corrosive or explosive.

1.2 Basic Features

- High Efficiency in electrostatic precipitation of cooking fume and oil mist. Nice performance in Deodorization with the actived carbon filter option.
- User friendly instruction and malfunction self-diagnosing system, ensuring the ease of operation and maintenance for users.
- Modular design, ensuring easy assembly of our Electrostatic Precipitator for total operation and easy removal of the electric fields and other major components for maintenance and cleaning.

1.3 Parameters & Specifications

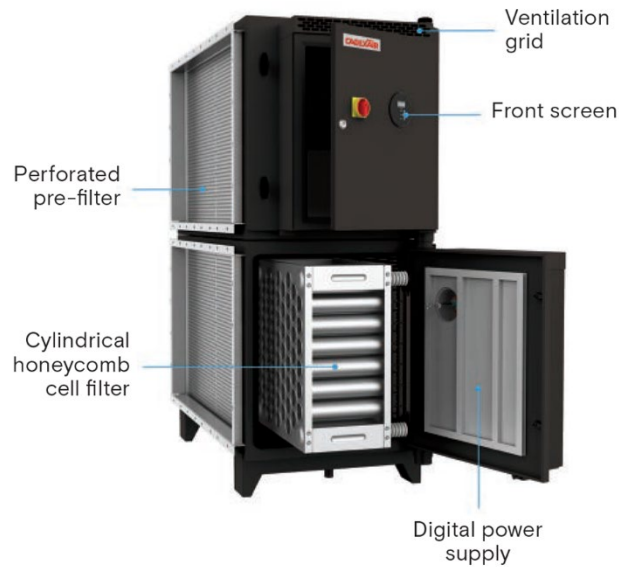
A. Purification Efficiency: (rated airflow at 60°C)
Efficiency 90%

1.4 Environmental Requirements

- Temperature: +10~+40°C
- Humidity: 20~90%
- Height above sea level: <1000M
- Temperature of the fume: <70°C (keep the system away from combustible, corrosive or Explosive environment)

2. Structure

Structure illustration



Item	Function Description
Cylindrical honeycomb Filter Cell	Consists of the ionizing and collection sections, to capture cooking grease particles
Perforated Pre-filter	Pre-filter section to remove large particles, aid in even air stream distribution across the filter cell
Ventilation grid	ventilation of components
Digital Power Supply	CADEXAIR Patented High-voltage High-frequency type
Front screen	Display the working status of the ESP

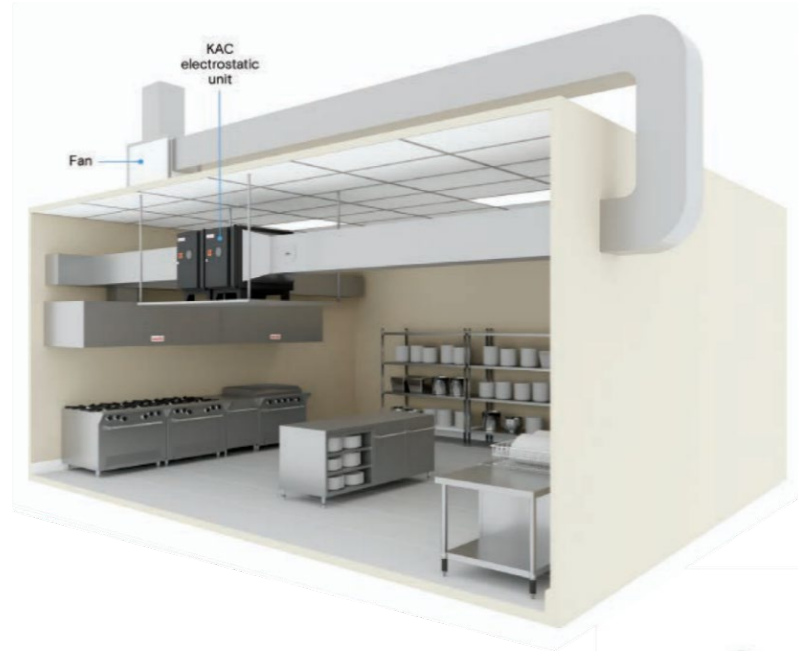
2.1 Working Principle

As indicated in Figure 3-1, when grease-laden exhaust air enters the ESP Unit under the pressure of the suction fan, grease vapors would get captured by filter cells and precipitated on the inner surface of the anode tubes, and processed air would come out clean. The excess grease and dust that does not adhere to the filter cells may run down the collection surface, where they can be collected by the grease drip channel and periodically drained.

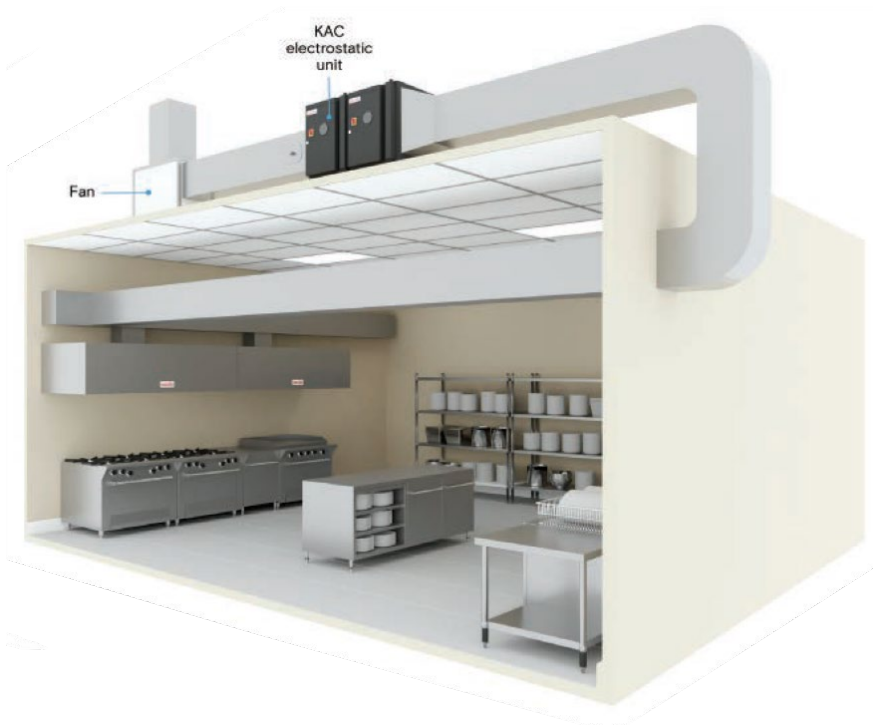
3. Installation

3.1 General Installation Guidelines

- Low Level Discharge
- Indoor Installation



- High Level Discharge
- Indoor Installation



- High Level Discharge
- Outdoor Installation



Requirements

- ✓ To guarantee the security of the equipment, users are advised to install fire protection system in the Electrostatic Cadexair ESP Unit (KAC electrostatic Unit) and carry out regular maintenance and inspection of such fire protection system.

3.2 Installation Location

The installation location should meet the following requirements:

- ★ Floor on which ESP Unit is to be installed should be leveled.
- ★ Bearing strength of floor/ground should be sufficient to support the weight of the equipment.
- ★ Servicing space between the access door and other objects should be kept be a 24 inch.
- ★ Temperature of cooking fume entering the equipment should not be higher than 70°C for maximum efficiency.
- ★ The location of the ESP unit must allow for fire protection chemical systems box (Cadexair suggest Ansul R-102 Fire suppression system) within 15' feet of distance in a location with a minimum of heating greater than 3 ° C.



Requirements

- ✓ Air leakage-proof measurement should be done at the connection points of the the 16AWG welded ducting to end sure a better purification efficiency of the ESP Unit.
- ✓ Use very smooth duct reducers at the inlet and outlet of ESP Unit and connect them with very smooth ducts with a length that is at least 4 times longer than the diameter of the reducers to ensure a better purification efficiency of the ESP Unit.
- ✓ The fan, need vibration isolator to eliminate influence of vibration on the ESP unit.
- ✓ Users should choose a fan with an airflow rate capacity that is bigger than the rated exhaust capacity of the ESP Unit. Users can use listed Cadexair damper or the VDF of fan, to make sure that the ESP unit works at the rated exhaust airflow capacity.
- ✓ Users are suggested to keep a 40"inch long straight air duct after the outlet of the fan to reduce the additional resistance.
- ✓ Users should better make sure that the ESP unit is working under the influence of the negative pressure created by the exhaust fan, which means that it should be installed in front of an exhaust fan.
- ✓ When several ESP's are put into use in a parallel connection pattern, and all of them share the same exhaust fan, make sure that the proportion among actual airflow rate distributed to each ESP Unit is similar to the proportion among rated exhaust capacity of each unit.
- ✓ UV protection roof, ex: an awning, is required for the ESP unit if it is to be installed outdoors, to maximize the service life of the unit and minimize the unnecessary maintenance fees.

3.3 ESP Mainframe Installation

- ★ Choose a suitable installation location according to requirements indicated.
- ★ Install the unit horizontally, so that the front surface of the filter cells inside the ESP Unit would be kept vertical to the flow direction of the grease-laden air stream.
- ★ To reduce the load, users can remove the filter cells before the fixation of the mainframe and fix the cells back afterwards.



Requirements

- ✓ Put spare parts away to avoid possible damage caused by trampling or collision.
- ✓ Do not pile up objects at the ESP unit, fan or ducts.

3.4 Duct Connection

- ★ To connect ESP Unit, air duct & fan.
- ★ Flange connections should be sealed against air leakage and fire resistant as required by the current NFPA96 standard.
- ★ Make sure that your duct respects the clearances to combustible, semi-combustible materials, as stipulated in the NFPA 96 standard.
- ★ Air duct should be the 16AWG welded.

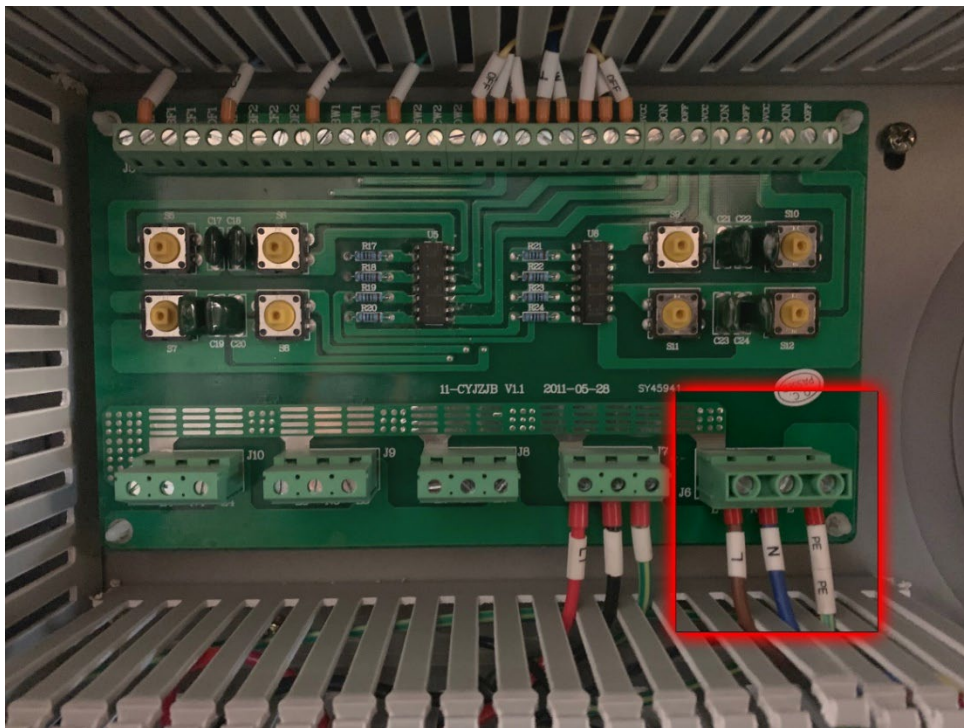
- ★ Install vibration isolator at the support rack if you have a utility or in-line fan.
- ★ No combustible item is allowed to be put at the outlet of the fan.

 **Requirements**

- ✓ If direct drainage is to be applied to a ESP unit, this treatment should be as required by all local and national codes.
- ✓ The height of the drain line to be connected to the drain outlet of the ESP Unit, if any, should be lower than the height of drain outlet, and the less el bows/bending of the drain line, the more smooth the drainage effect would be.
- ✓ A fire protection system should be installed inside each section the ESP unit (Cadexair suggest Ansul R-102 Fire suppression system).
- ✓ Each section of the air ducts should incorporate an access door permitting access for cleaning and servicing as required by NFPA96 standard.
- ✓ The perforated pre-filter should be placed at the air inlet of the ESP unit.

3.5 Power Supply Connection

If the ESP unit is with power wire, please connect single phase 200-240/1/60, 15 Amps power supply.





Requirements

- ✓ The design and installation of the ESP unit should be handled by qualified professionals or Cadexair certified installer.
- ✓ Do not power up the ESP unit before the completion of the system installation. There is extremely high voltage generated inside ESP unit when it is in full operation.
- ✓ Do not install the ESP unit near any facility that produces flammable or explosive gases.
- ✓ An electrical leakage protection device should be installed between the main power supply line and the power source to eliminate risks of electrical shock.
- ✓ The ground lead should be reliable, and the resistance should be less than 0.50.
- ✓ The Cadexair ESP unit should be kept in a stably horizontal position during the whole process of installation.
- ✓ A maintenance platform with an appropriate height and guard rails should be built for the security of the maintainer.
- ✓ If a drainage line is installed outside, heat insulation measurement should be done on the exposed drain lines.

4 Debugging

4.1 Inspection before Power-up

Check each instruction stated above to see if there is any discrepancy between the system described in the guidelines and the system installed. If so, improvement should be done to make sure, that every requirement is met before the debugging. Make sure that each part/ accessory has been installed correctly and firmly before power-up.

4.2 Power Supply Inspection

Before power on, please use the volt meter to check if the power supply meets the specifications indicated on the nameplate of the ESP unit and exhaust fan, and make sure that the earth resistance of the ground lead is less than 0.50.

4.3 Airflow Adjustment

Power up, switch on the exhaust fan and make sure that its rotation direction is correct. Adjust the airflow rate to the extent that the actual airflow rate through each pass is equal to or smaller than the rated exhaust capacity by using airflow rate measuring device and airflow rate controlling device. Meanwhile, check if there is any air leakage from the ducts and take leak-mending measures when necessary.

4.4 Commissioning

Refer to Chapter 5 for a checklist of various functions of the ESP unit. Observe whether the corresponding indicator reacts normally while running each function. Refer to Chapter 7 for trouble shooting measures when something wrong happens.



- ✓ When the operation fails, do refer to Article 7 for trouble shooting measures.

5 Operation

5.1 Control Panel Introduction

- Do refer to the Cadexair Control Panel line (CC-200 or CC-35)
- Digital display of electric Box
 - Power indicator light: lights up when the power supply connection is OK.
 - The ESP unit running indicator light: lights up when the filter cells are working.



- Fault indicator: lights up when malfunction happens



- Digital Display screen: show working current or fault code. Different code represents different fault cause. Please refer to the table in 7.2

5.2 Operation Guidelines

- A. Start ESP unit: Power up, switch "ROTARY ISOLATOR" on the electrical box to "ON".
- B. Normal Running Status: "POWER ON" and "WORKING" indicator lights on LED panel of electric box would stay lit constantly, while "FAULT" indicator light would be unlit.
- C. Stop ESP unit: switch "ROTARY ISOLATOR" on the electrical box to "OFF". The "WORKING" indicator light is unlight.



- D. If electric discharge twice in 5 seconds, the electric current will be reduced by a level automatically (the lowest current is down to 10MA). And if there is no electric discharge in 5 minutes, the electric current will be increased by a level automatically (the highest current value is according to factory defaults).

5.3 Operation of Power on Start-up and Fan Linkage Start-up

Do refer to the Cadexair Control Panel line (CC-200 or CC-35)

5.4 Notes



Danger

- ✓ There is very high voltage generated inside the ESP unit when the electrostatic precipitation function is running. Do not open the filter cell access door or unload any other parts of the ESP unit before cutting off the main power supply.

6 Maintenance

Users should keep regular and effective maintenance and inspection on the ESP unit so as to ensure its long-term stable performance and high purification efficiency.

6.1 Maintenance Checklist

Frequency	Items for Maintenance
Daily	<ol style="list-style-type: none"> 1. Keep the ESP unit surface clean. 2. Check if the drainage outlet can work normally.
Monthly	<ol style="list-style-type: none"> 1. Inspect the perforated pre-filter and electric filter cells. 2. Depending on the cooking activity, if necessary clean the perforated pre-filter and electric filter cells inside the ESP unit.
Every six month	<ol style="list-style-type: none"> 1. Depending on the cooking activity, if necessary clean the grease deposits inside the ESP unit. 2. Check if the fire damper can work normally or not.

6.2 Maintenance Guidelines



Requirement

- ✓ Operators should wear goggles, gloves, helmet and protective clothing to protect the skin against the harm of alkalinity detergent.

6.2.1 Clean Perforated Pre-filter and Electric Filter Cells

Draw out the perforated pre-filter and electric filter cells, as shown in Figure A, jet clean them with high pressure water gun and home detergents solution, as shown in Figure B, if they are not very dirty.

Or soak the perforated pre-filter and electric filter cells in a water tank filled with hot home detergent solution, as shown in Figure C, if they get very dirty.

Or soak the perforated pre-filter and electric filter cells in hot CADEXPRO solution (CADEXPRO: water =1 :25 in weight), if the residual grease deposits cannot be completely removed.

Use brush to brush each tube as shown in Figure D.

Figure A, draw out pre-filter and filter cell

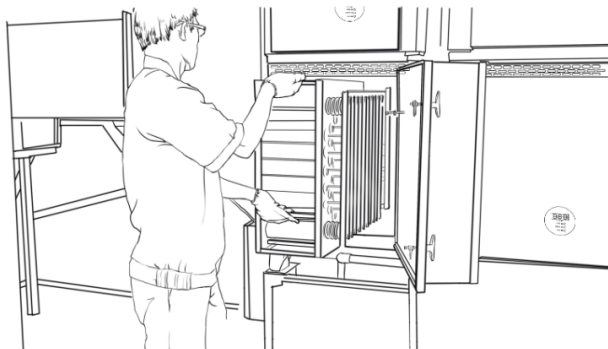


Figure B, jet cleaning of filter cell

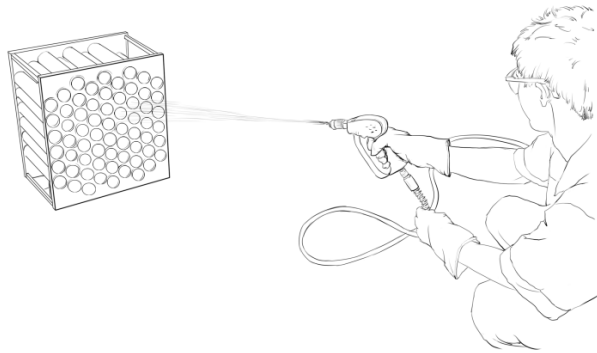


Figure C, soak cleaning of pre-filter and electric filter cells

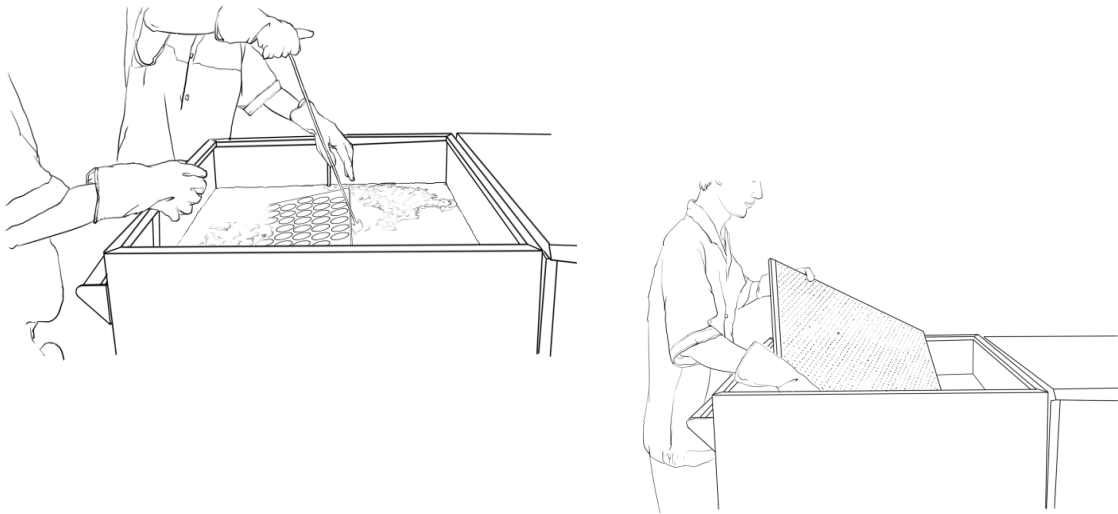
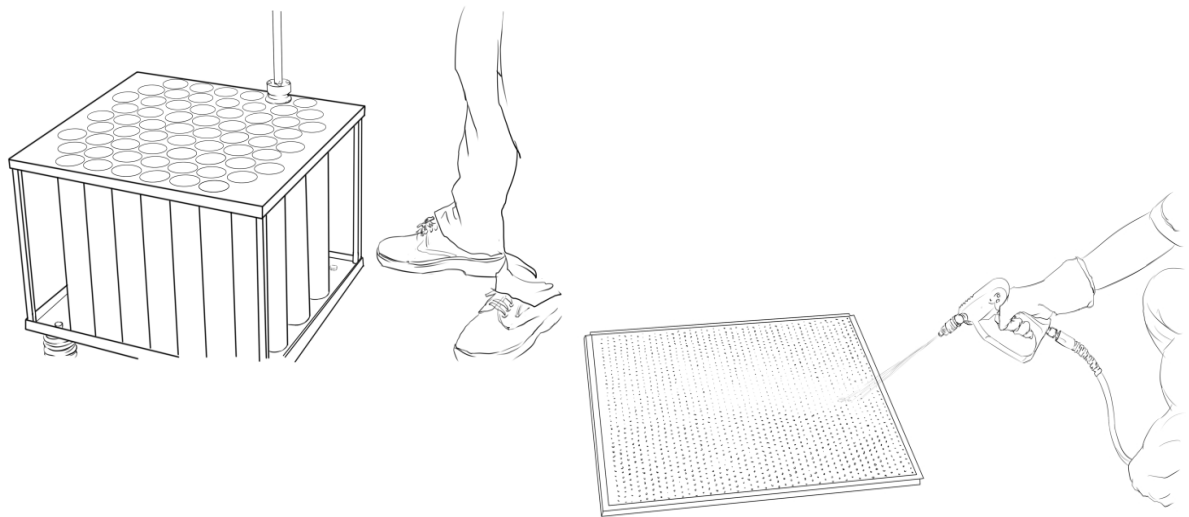


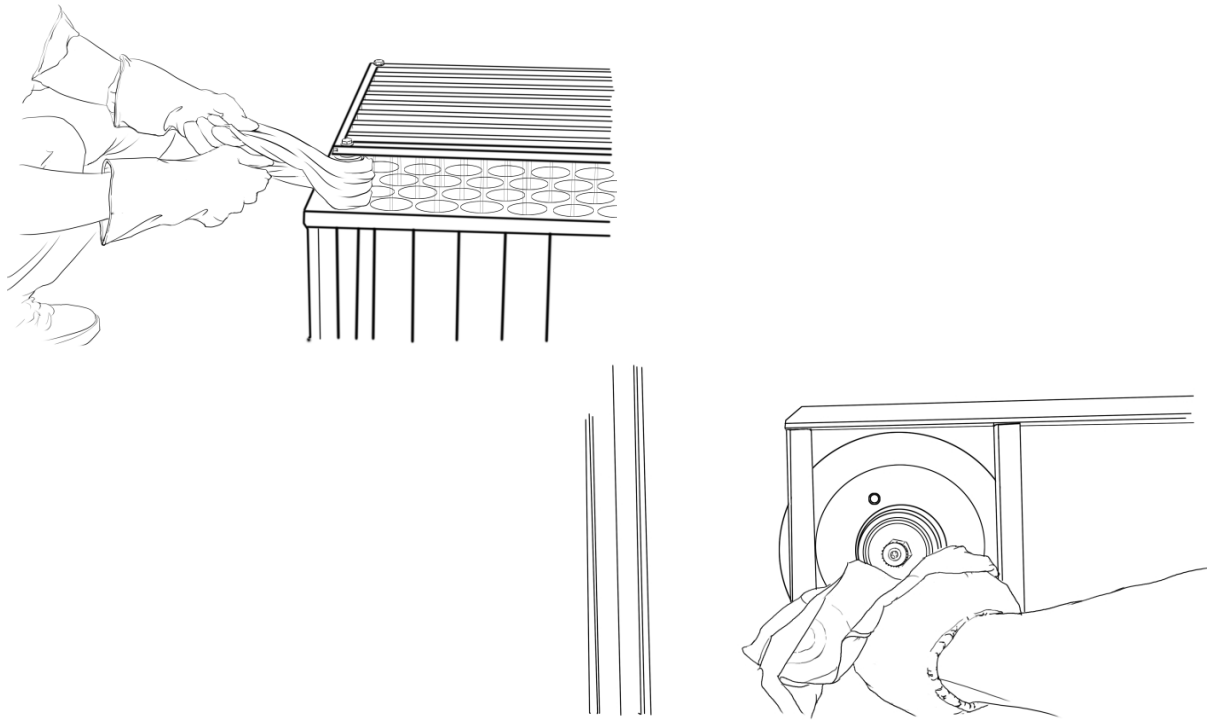
Figure D, use brush to brush each tube of filter cell



6.2.2 Clean insulators

Use home detergent solution, or CADEXPRO solution, to clean the high voltage output ceramic insulators and the 4 ceramic post insulators supporting the cathode needle frame of each filter cell. Then use clean water to rinse out residue solution and detergents on the surface of insulators, and wipe them dry, as shown as Figure E.

Figure E, clean Insulator



Requirement

- ✓ Insulators must be rinsed with clean water and wiped dry, as residual electrolyte of a strong alkaline solution on the surface of the insulators would cause surface flashover, which would influence the proper function of the ESP unit and posing safety challenges to the system.
- ✓ Insulators with cracks should be replaced immediately.

6.2.3 Overhaul the Filter Cells

6.2.3.1 Inspection: Check if there is any cylindrical anode tube has been dented or damaged, as shown in Figure F. If so, carefully restore the initial shape with a round stick, as shown in Figure G.

Figure F

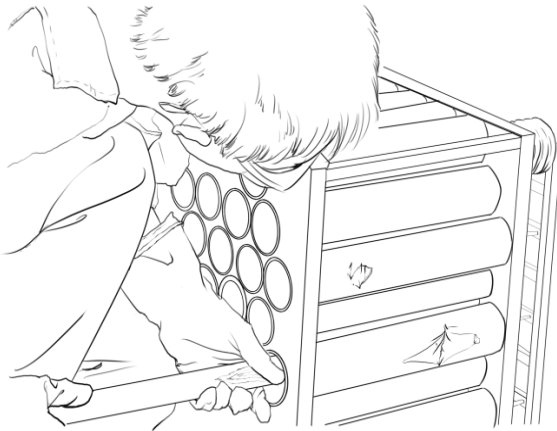
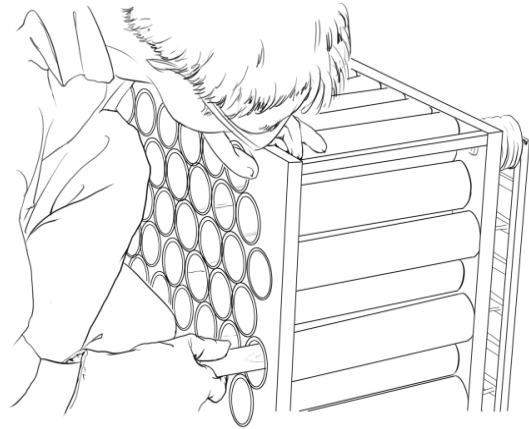


Figure G

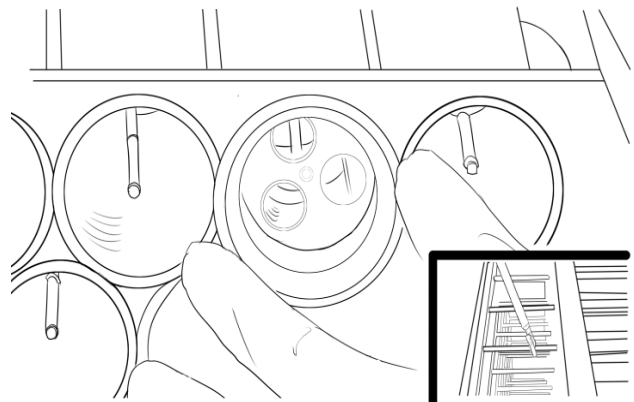


6.2.3.2 Calibration: The cathode ionizing needle of the filter cell is supposed to be right in the center of the anode collecting tube, so check whether there is any location deviation of the cathode needles from the center of the anode tubes before installing the electric filter cell back into the ESP unit. Place the electric filter cell on a horizontal surface, and use the deviation test tool kit offered by the manufacturer to confirm the position of each cathode needle, as shown in Figure H. If the cathode needle can be partially seen through the smaller hole in the middle, it indicates that the deviation of the cathode needle is within allowable range. Otherwise, calibrate the position of the cathode needle with the calibration pole, as shown in Figure I, to the extent that the deviation is within the allowable range. Make sure that each cathode needle's position has been checked and all excessive deviation has been calibrated before installing the electric filter cell back into the ESP unit.

Figure H



Figure I



6.2.3.3 Installation of the filter cells: there are 2 kinds of filter cells, one is without the ejector pin, as shown in Figure J, the other one is with the ejector pin, as shown in Figure K. The filter cells without an ejector pin should be placed into the ESP unit first, then the ones with the ejector pins, the ejector pin should point inward.

Figure J



Figure K

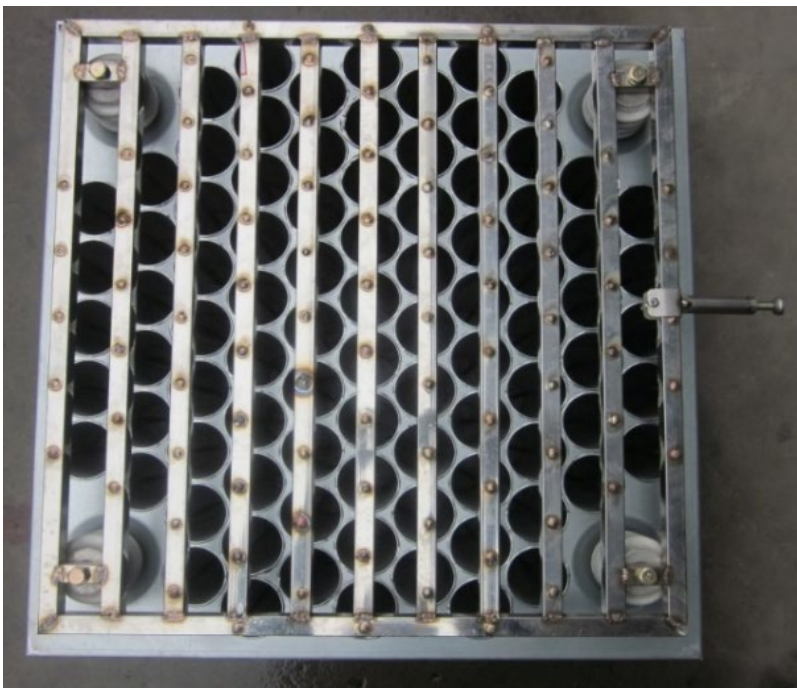
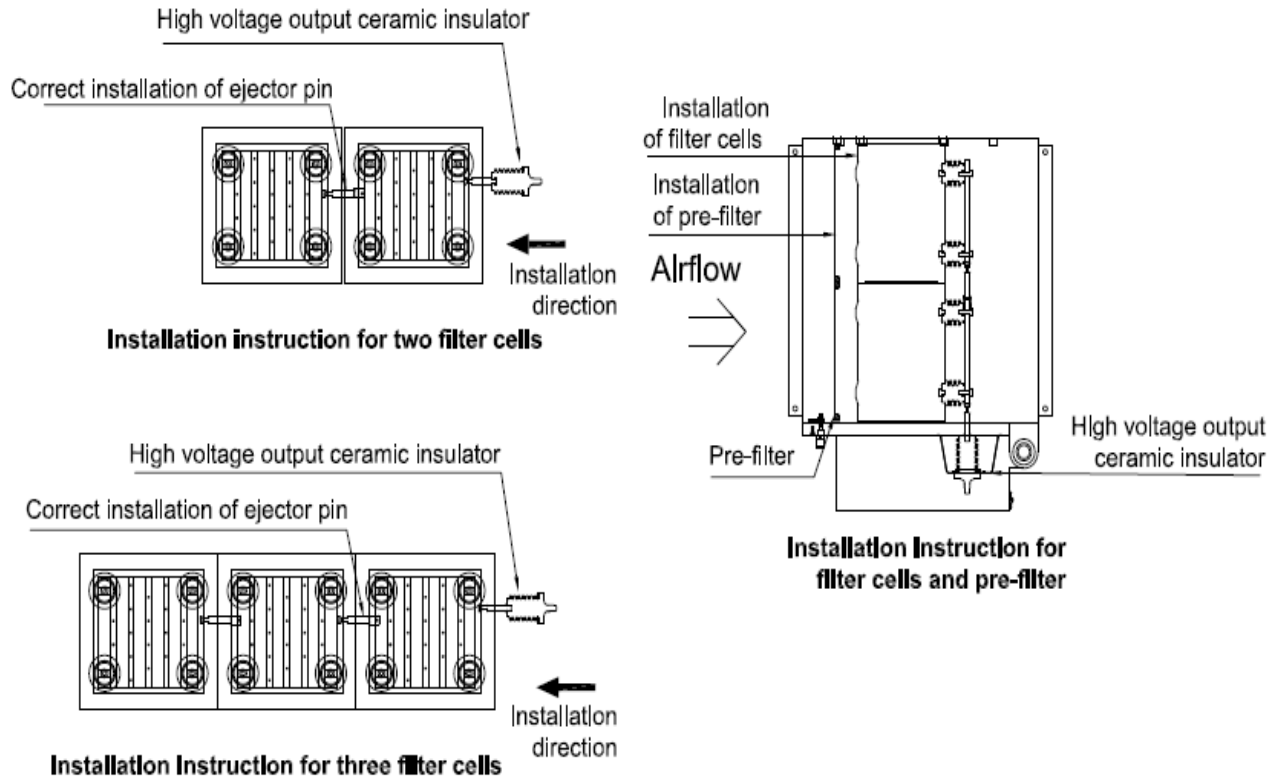


Figure L



Requirement

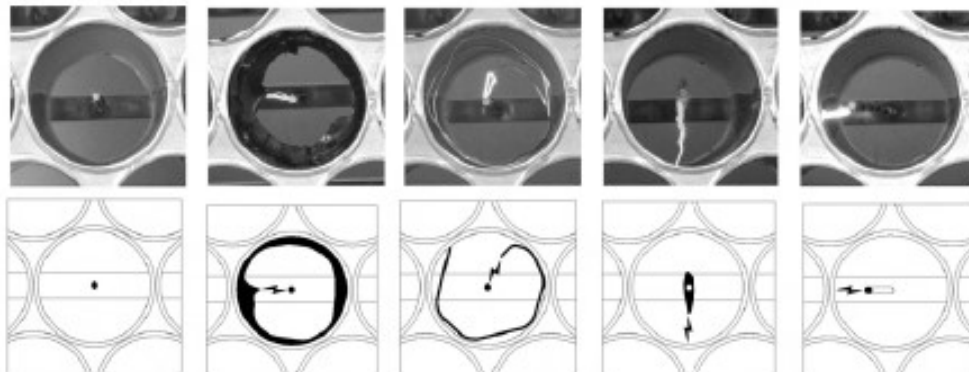
- ✓ The disassembled filter cells and other parts should be put away in a safe location to avoid possible damages caused by trampling and impact.

6.2.4 Usage of Cleaning Device

If there is too much grease deposits inside some of the cylinders, users can clean the deposits with Cadexair specially designed brush to avoid possible distortion/ damages on the cathode needles caused by other cleaning devices. Just put the brush into each cylinder to remove the deposited grease.

7. ESP Installation & Operation Manual

"ESP" indicator light is lit, "Fault" indicator light flashes after starting up ESP, then ESP stops run finally	Some filter cells inside the ESP has stopped running due to the changes of smoke concentration	Press the start ESP button again
	Residual water drops on the inner wall of the cabinet and inside the filter cell after cleaning	Run the fan without running the ESP for a while to blow the water drop off entirely, then start ESP.
	Foreign matters or too much residual grease deposit inside the cylindrical tubes (Figure 7-1~3)	Refer to article 6
	Residual detergent or alkaline solution on the insulators	Rinse off the residual agents with clean water and wipe the insulators dry
	Cathode needle deviates from the centre of anode tubes (Figure 7-4)	Refer to article 6
	Cracks on insulators	Replace the cracked ones with new ones
	Temperature of cooking fume is too high	Cool the cooking fume temperature down
	Electric discharge due to the breakage of high voltage line	Check high voltage line after power off
Exhaust air can not be emitted or can not be emitted smoothly	Too much grease deposited on the perforated pre-filter	Refer to article 6



Clean, workable filter cell

Figure7-1

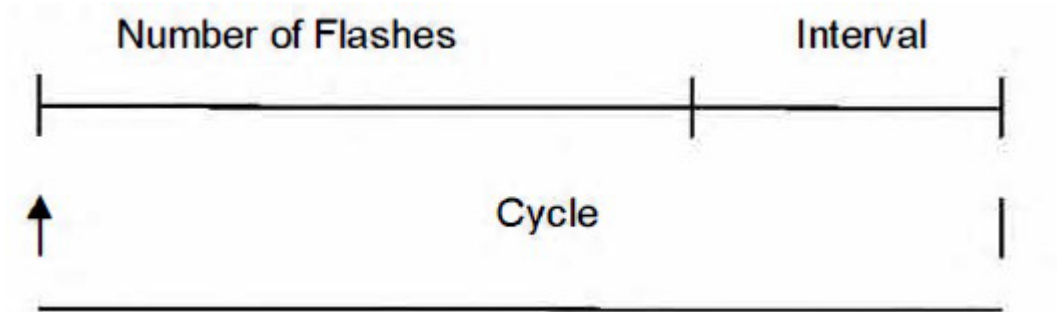
Figure 7-2

Figure 7-3

Figure 7-4

7.1 Troubleshooting diagnostic code table of digital power supply

Note the flashing frequency of the yellow "FAULT" indicator on the panel of individual electrical enclosure every time the power pack goes off line, and look into the following table for possible causes and solutions.



Troubleshooting of ESP Power Pack in the next page

7.2 Notes



Danger

- ✓ There will still be residual current running inside power box even if the equipment is power off. Users should switch off the general power supply before carrying out any maintenance or repair work on the ESP unit.
- ✓ Users should switch "ROTARY ISOLATOR" to "OFF" before opening the equipment access door.
- ✓ Use screwdriver to release residual current inside the electric field as shown on the right, after opening the overhaul door of ESP. To do that user should hold the insulation section of the screwdriver, then use the metallic section of screwdriver to connect the anode with cathode.



Requirement

- ✓ Users should keep record of the maintenance work carried out on the ESP system.

8. Miscellaneous

8.1 Unpacking

The unpacking should be done carefully. Users are also advised to check whether there is paint peeled off or there is any damage done to the equipment, whether the accessories are complete according to the packing list, and whether the certificate of approval and the user's manual is provided or not.

8.2 Delivery and Storage

For more details, please refer to relevant international rules on packing, delivery, storage. Please note that the equipment should be absolutely handled with care. Users should try their best to avoid any collision or damage that could be done to it. The equipment should be stored in dry and ventilative environment, and kept away from hostile conditions, such as high temperature, high dampness, or corrosive gas.

9. Option

9.1 Activated Carbon Device

9.1.1 Application

Activated carbon device is widely applied to remove smell & odor in many industries such as medicine, chemical, textile, food processing and catering business.

9.1.2 Working Principle

Activated carbon is made up of much small carbon granular with large superficial area and lots of micro holes with strong absorption capacity. Therefore, it can touch smoke completely. When smoke with smell pass through the activated carbon, organic molecule and odor molecule contained in smoke can be absorbed and smell can be removed finally.

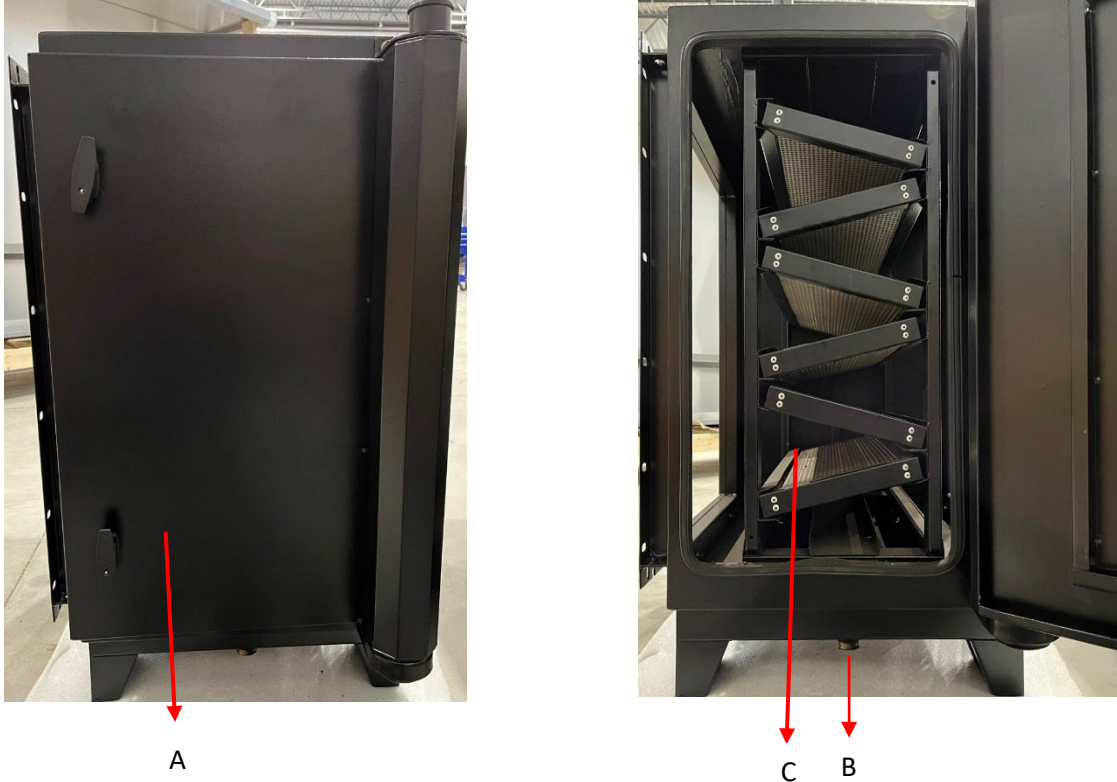
9.1.3 Basic Features

- ★ Make use of the absorption ability of activated carbon to absorb organic matter and odor contained in smoke.
- ★ Apply granular activated carbon with large superficial area and is easy to maintain.
- ★ Unit design make it easy to install and take down.

9.1.4 Requirements on installation site

- A. Temperature: +5—+50t
- B. Humidity: 20-90%
- C. Altitude: <1000M
- D. Nature of smoke: <50°C, non-flammable, non-explosive, non-volatile and non- corrosive.

9.2 Structure chart



No.	Name	Function
A	Access door	Inspect activated carbon box
B	Drain outlet	Discharge grease & dirty water
C	Carbon Box	V-shape type with activated carbon granule inside

9.3 Installation

9.3.1 Installation Drawing

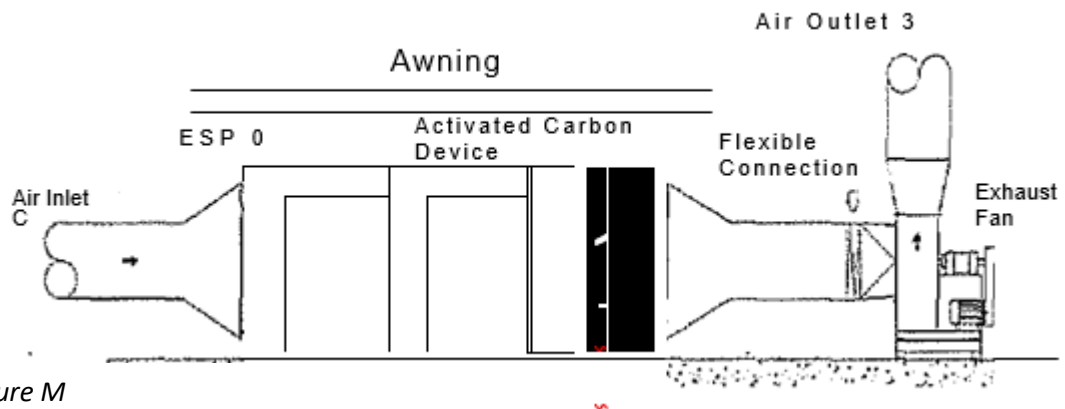


Figure M

9.3.2 Assessment on installation site

- Installation site should meet the following requirements:
- The ground should be flat and smooth
- The ground or installation platform should be strong enough to support the whole unit.
- There should be enough (1meter) maintenance space at the side of access door. Please refer to figure M
- Temperature of smoke going into the device should be lower than 50°C.}
- Temperature of smoke going into the device should be lower than 50°C.}

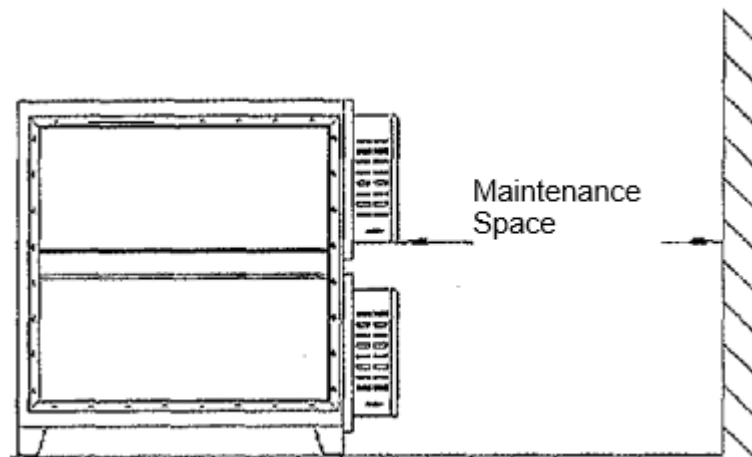


Figure N

Temperature of smoke going into the device should be lower than 50°C.}



Requirement

- ✓ The equipment can not work normally under vibration, so there should be flexible connector between air duct and exhaust fan.
- ✓ Generally, the airflow capacity of exhaust fan will be larger than rated airflow capacity of ESP. We can use transformer to control exhaust fan to assure the ESP is working under rated airflow capacity.
- ✓ There should be 1–2-meter straight duct at the outlet of exhaust fan to reduce the additional pressure drop of exhaust fan.
- ✓ If the equipment is installed outdoor, we should install awning to lengthen service life of the equipment and reduce maintenance cost.

9.3.3 Installation of main device

- Put the device according to the method mentioned above
- The device should be installed horizontally.
- To reduce weight of hoisting, we can take the activated carbon box out

9.3.4 Air Duct Connection

- Heat resisting oil seal rubber pad should be used at the connection between equipment and air duct.
- Air duct should be installed in a certain slope to reduce oil grease staying inside air duct.
- Absorber should be installed at the foot stand of exhaust fan.



Requirement

- ✓ The blow-off line connected with equipment should be as straight as possible and make sure it is not higher than the position of drain outlet to blow off smoothly.
- ✓ Please deal with the drain according to your local environmental policy.

9.3.5 Attention



Requirement

- ✓ The installation design should be done by qualified staff.
- ✓ Do not install the equipment near device producing flammable and explosive gas.
- ✓ The equipment should be grounded reliably, and the grounding resistance should be less than 20.
- ✓ The equipment should be installed horizontally and stably.
- ✓ To ensure safety of maintenance staff, maintenance platform can be set up at suitable height.
- ✓ For regions with low temperature, blow-offline and air duct should be kept warm.

9.4 Maintenance

Only if we maintain the equipment effectively and regularly, can it work stably for a long time and keep high smell removal efficiency.

9.4.1 Maintenance Schedule

Time	Item
Every month	1. check whether it is necessary to replace activated carbon

Figure O

9.4.2 Replace activated carbon

Activated carbon should be replaced regularly to keep good smell removal effect. Normally, it should be replaced when necessary depending on the cooking activities. The replacement cycle should also be decided by concentration of smoke. If activated carbon is not replaced for a long

time, other than the smell removal efficiency will be affected, the pressure drop of equipment will be increased and normal operation of ventilation system will be affected.



Danger

Activated carbon is flammable. Please keep it far away from other flammable and explosive things. It will be dangerous to have activated carbon go into eyes or lung. Goggles and respirator should be worn to protect ourselves from dust while replacing activated carbon. If we have activated carbon in eyes carelessly, please wash eyes with clean water.



Operators should be well safeguarded. The users should keep a record of the maintenance work carried out on the equipment.

9.5 Others

9.5.1 Unpacking

The unpacking should be done carefully. Users are also advised to check whether there is paint peeled off or there is any damage done to the equipment, whether the accessories are complete according to the packing list, and whether the certificate of approval and the user's manual is provided or not.

9.5.2 Delivery and Storage

For more details, please refer to relevant international rules on packing, delivery, storage. Please note that the equipment should be absolutely handled with care. Users should try their best to avoid any collision or damage that could be done to it. The equipment should be stored in dry and ventilative environment, and kept away from hostile conditions, such as high temperature, high dampness, or corrosive gas.