CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
4 IRVING PLACE
NEW YORK, NY 10003

DISTRIBUTION ENGINEERING
SYSTEM DESIGN

SPECIFICATION EO-2032
REVISION 14

DESIGN CRITERIA FOR VENTILATION OF TRANSFORMER VAULTS AND NETWORK PROTECTOR COMPARTMENTS

PREPARED BY	**RESK E. UOSEF, Ph.D., P.E.**
TARGET AUDIENCE	**All Regions**
NESC REFERENCE 2017	**NESC SECTIONS 11 and 14**
REVIEWED BY	**Deepak Khubani**
FILING	**APPLICATION AND DESIGN MANUAL NO. 4**
APPROVER	**Stephen Pupek (Signature on File)**
EFFECTIVE DATE	**11-December-24**

TABLE OF CONTENTS

1.0 SCOPE

This specification defines the ventilation requirements for 208V and 460V network distribution installations.

2.0 REGIONS APPLICABLE

All Regions

3.0 DEFINITIONS

For the purpose of this specification the following terms are defined:

3.1 Company - Consolidated Edison Company of New York

3.2 Customer - The concern requesting service.

3.3 Natural Ventilation - Normal convective ventilation using louvers/ Gratings (3 square inches net free area per kVA).

3.4 Mechanical Ventilation - Forced air ventilation systems as described herein.

3.5 Normal Operation - All transformers in operation.

3.6 1st Contingency Operation - One transformer out of service.

3.7 2nd Contingency Operation - Two transformers out of service.

3.8 **Climate Change Planning and Design Guideline:** The procedure developed by the Company and referenced in CI-610-4 to provide standardized climate change projections to guide Company organizations in design, construction, operation, and maintenance of company assets and planning and coordination for emergency response.

4.0 DIVISION OF RESPONSIBILITY

The following is an outline of the division of responsibility regarding the design, equipment purchases and installation of the required ventilation systems for network protectors and/ or transformers.

4.1 Installation by the Company

The Company shall furnish and install all equipment and material in each network protector compartment and leads through the compartment wall or floor for connection, by the Customer, to the ventilation control and alarm systems.

4.2 Installation by the Customer

4.2.1 All required equipment and material (including thermostats and fire dampers, etc.) shall be furnished, installed and connected by the customer in accordance with this specification and all prevailing local codes and/or standards.

4.2.2 The customer, at their cost, shall furnish, install, operate and maintain the mechanical ventilation system. Semi-annual maintenance reports showing air flow in cubic feet per minute (CFM) under normal, first and second contingency operation, shall be available on Company's request.

4.2.3 The customer shall submit an air flow diagram (see Fig.1as an example), a physical layout, mechanical and electrical drawings with a system operating description for review and approval by the Company prior to finalizing the design.

4.2.4 The professional engineer’s stamp is a formal declaration that the design documents conform to all requirements of the applicable standards and codes. It is a statement that the design complies with the laws and regulations governing the practice of engineering. By applying her seal to a design, the professional engineer is stating that her/his work satisfies the professional standards necessary to protect the public’s safety, health and welfare, therefore all customer physical layouts, mechanical and electrical drawings should be provided with professional engineer’s stamp.

5.0 NATURAL VENTILATION

5.1 Natural ventilation to outdoor air is the approved method of ventilation. Gratings and/or louvers shall provide a minimum free opening area for ventilation of three-square inches per kVA. Vaults containing dry type

transformers shall have louvers designed so that the net free louver opening does not exceed 40% of gross louver area. Louvers for vaults in buildings containing liquid filled transformers may be designed to exceed the 40% net free louver opening area if inlet air velocity does not exceed 450 feet per minute (FPM) across the face area. Minimum net free area requirements for liquid filled transformers (based on its highest rating) and dry type transformers are listed below.

Liquid Filled		**Dry Type**	
Transformer (kVA)	Minimum Net Free Area	Transformer (kVA)	Minimum Net Free Area
500	12 SQ. FT.	500	10 SQ. FT.
750	17 SQ. FT	1,000	20 SQ. FT
1,000	23 SQ. FT.	2,500	50 SQ. FT.
2,500	56 SQ. FT		

5.2. Vault ventilation design shall be based on a 100^0 F ($38\ ^0$C) outdoor ambient Temperature based on the Climate Change Planning and Design Guideline (CI-610-4), the more stringent requirement shall prevail. The louver should be adequately size for allowing a natural air flow to maintain the targeted ambient temperature. The maximum allowable ambient temperature rise of 50^0 F ($10\ ^0$C), based on stratification of air within the vault resulting in a maximum temperature of 145^0F (63^0C). The average ambient temperature in the vault shall not exceed 113^0 F (45^0C).

5.3 All liquid filled transformers will be natural ventilation NEC (2017)-450-45.

5.4 Depending on the contingency criterion for each region; the minimum air requirements for liquid filled transformer and Dry type transformer vaults are listed below

Liquid Filled Type			
Transformer (kVA)	CFM Normal	CFM-1ST Contingency	CFM-2ND Contingency
500	900	1,300	1,900
750	1,300	1,900	2,700
1,000	1,700	2,400	3,200
2,500	3,200	4,600	6,700

Dry Type			
Transformer (kVA)	CFM Normal	CFM-1ST Contingency	CFM-2ND Contingency
500	1,300	1,700	2,400
1,000	1,900	2,600	3,700
2,500	3,800	5,000	7,400

Air requirements shall be increased by 10% when the transformer vault contains a network protector.

5.5 Minimum air requirements and opening sizing for network protector compartments are as follows:

120/208 V Installation			
Transformer (kVA)	Network Protector (AMPS)	Minimum Flow (CFM) PER COMP	Minimum Sleeve/Opening
500	2250	500	12"x12"
750	3400	700	18"x18"
1000	4500	1900	20"x20"

265/460 V Installation			
Transformer (kVA)	Network Protector (AMPS)	Minimum Flow (CFM) PER COMP	Minimum Sleeve/Opening
1000	2250	1900	20"x20"
2500	5100	1900	20"x20"

6.0 MECHANICAL VENTILATION

6.1 Except as specifically noted, each paragraph relates to both transformer vault and network protector compartment installations.

6.2 A Mechanical ventilation system for transformer vaults shall be provided where:

6.2.1 Natural ventilation cannot meet the required ventilation as Noted.

6.2.2 When Dry type transformers are installed, either natural or mechanical ventilations are acceptable.

6.3 Mechanical ventilation system shall be provided for all 265/460 V network protector compartments except when protectors are installed in separate structures away from the building (see 7.20.3).

6.4 Exhaust type ventilation:

The only approved method for mechanically ventilating transformer vaults or network compartments is forced exhaust. No mechanical means are acceptable (Air blown into a compartment or vault, or recirculation of air (either total or partial)) and will not be approved for service. Air flow measurements shall be taken either inside the exhaust duct, or at the exhaust register.

6.5 In multibank indoor transformer vault installations where mechanical ventilation is used, each transformer vault shall be individually ventilated (IEEE C57.12.00-1993) for Liquid filled type transformers and (IEEE C57.12.01-1989) for Dry type transformers direct drive fans are preferred

6.5.1 One exhaust fan is required for network protector mechanical ventilation systems. The minimum design air quantity shall equal the normal air requirement for the entire multibank installation.

6.5.2 Two exhaust fans are required for transformer mechanical ventilation system. The minimum design air quantity for each fan shall equal the normal air requirement for the entire multibank installation. Each exhaust fan controller shall be interlocked to automatically alternate as the “Normal” or “Standby “fan.

6.6 The fans shall derive their power from a customer's distribution panel which is served directly from a Company service take-off. All fans shall have an alternate source of power supply in buildings served by two or more company service takeoffs. The transfer may be accomplished by the use of a manual transfer switch. The transfer switch must be labeled as follows: Con Edison transformer vault/network protector ventilation system to be operated only by building Engineer or authorized personnel.

6.7 Damper Requirements:

Each ventilation intake opening in vaults and compartments and the exhaust opening in compartments shall be provided with a locally approved 135^0 F fusible link fire damper, similar to model #119 as manufactured by Air Balance Inc. If 135^0 F ($57\ ^0$C) fusible link fire damper is not available, a 165^0 F($74\ ^0$C) fusible link shall be considered but with prior company's approval. The transformer vault exhaust air opening shall be provided with a fusible link, normally closed, spring loaded motorized damper, similar to model #AC-115 as manufactured by Complete Spiral Manufacturing. Power connections for motorized damper shall be as shown on drawing EO-14294-C(attached). the physical installation shall be in accordance with the manufacturer's recommendations.

7.0 GENERAL VENTILATION REQUIREMENTS

7.1 Ventilation system shall meet local noise requirements, also network compartment negative pressure must not exceed 0.28" w. g. (0.28 inch of water gage). NYC building code section 1008.1.2.3

7.2 Ventilation systems, equipment and/or ductwork associated with transformer vaults shall not be common with network protector compartments. Each type of equipment (transformers or protectors) shall be serviced by a separate and complete ventilation system as described herein.

7.3 No more than six (6) transformer vaults or six (6) network protector compartments shall be served by one ventilation system.

7.4 Supply air provided from the building air conditioning system cannot be used for ventilation requirements.

7.5 The intake air shall be taken directly from an outdoor location or from the building's designated outdoor air intake system (common plenum). The intake air temperatures shall not exceed normal local summer design temperature. Recirculated or unidentified sources of air supplied to vaults or compartments are not permitted.

7.6 Exhaust systems shall be independent of any building air systems and shall be exhausted directly outdoors, at least 25 feet from intake to prevent exhaust air intake to preclude recirculation of hot air.

7.7 All ductwork associated with the mechanical ventilation system shall be designed in accordance with SMACNA* standards and local codes, unless otherwise indicated in this specification or shown on drawing.

* Sheet Metal and Air Conditioning Contractor's National Association

7.8 Sheet metal ductwork is not permitted to extend inside vaults or compartments unless approved by the Company.

7.9 All duct sections shall be of the permanent type. Removable duct sections are not acceptable.

7.10 The size and location of ductwork and required supports shall not require removal for maintenance of any electrical equipment and/or ductwork within the vault or compartment.

7.11 The bottom of supply air openings shall be located two feet two inches (2'-2") above the unfinished floor. The top of exhaust air openings shall be located twelve inches maximum below the ceiling. For transformer vaults the intake and exhaust openings shall be located diagonally on opposite walls. The network protector compartment exhaust and intake openings can be located on the same wall only if opposite wall installation is not feasible.

7.12 Each room should have a logbook to specify the date of cleaning

7.13 Inlet louver shall be storm proof, and shall be sized in a way to prevent water from entering the vault.

7.14 Control/Alarm and Status Monitoring (Refer to EO-7557-C, Attached); fire alarm must be installed online side of the main switch and load side of meter.

7.14.1 Where systems are protected by a firestat, the setting of the firestat shall be 10^{O}F (-12 ^{0}C) higher than the melting of the fire damper fusible link.

7.14.2 All ventilation systems greater than 2000 CFM, shall be provided with a smoke detector that would shut down the system in case of a fire. Heat detectors may be used where smoke detectors are not suitable for out-door applications. A signal shall be sent to

the building alarm system indicating “Fire/Smoke condition”.

7.14.3 A differential pressure switch, similar to the series 3000MRS as manufactured by DWYER instruments Inc.; shall be installed in each vault or compartment exhaust duct to provide status monitoring. Individual indication shall be transmitted to the building's continuously manned alarm panel.

7.14.4 Each vault or compartment thermostat shall be Honeywell Type T631B1054 (Range 35^0 F to 100^0 F) (Range 2^0C to 38^0C) with two 16 amp. AC, C form contacts at 120 V and with assigned functions as noted below.

a. Thermostat #l - Transmits a "High Temperature Alarm".
b. Thermostat #2 - Activates primary mechanical ventilation system.
c. Thermostat #3 -Activates transformer vault standby mechanical ventilation system (not required for network protector mechanical ventilation systems).

7.14.5 Thermostats #2 and #3 shall be set at 85^0 F (29^0C) and 95^0F (35^0C) respectively.

7.14.6 If any vault or compartment temperature reaches 85^0 F (29^0C), the associated thermostat #2 activates the mechanical ventilation system. The ventilation system control shall be furnished with a field adjustable time delay relay of 0 to 30 minutes (set at 15 minutes), to allow the system to continue to run after the temperature falls below 85^0 F (29^0C).

7.14.7 Thermostat #3 of any vault activates the transformer standby exhaust fan when vault temperature reaches 95^0 F (35^0C). The standby exhaust fan shutdown shall be interlocked with the operating unit so that both units’ shutdown simultaneously.

7.14.8 Thermostat #1 shall be connected to the Building Engineer's audible and visual alarm panel to activate "High Temperature alarm" when the vault or compartment temperature reaches 100^0 F (38^0C).

7.15 Each vault or compartment (EO-7557-C -19) smoke detector shall be SIEMENS self-contained Photoelectric Air Duct model FDBZ492-PR Duct Housing with OP121 Photoelectric conventional detector and STA sampling tube of proper length, otherwise, selecting different models will

require company approval (Con Edison). The source of power shall be derived from the building alarm system.

7.16 Smoke detectors provided shall automatically stop their respective fan(s) upon detecting the presence of smoke (NYC Fire department Regulations section 902.1).

7.17 The Building Engineer shall notify the Company of the high Temperature / smoke condition. In the event, that during certain times of day or night, Customer personnel are not present to hear the alarm, an additional auxiliary alarm (installed and maintained by the Customer) shall be placed in an area where a responsible party is present at all times, and is able to respond to such alarms. Customer shall train the personnel at these auxiliary alarm locations to report trouble to appropriate parties within the customer organization.

7.18 In the event that there are no Customer personnel on duty to hear the alarm (i.e., at nights, weekends) then an automatic telephone security device (triggered by the high temperature thermostat or smoke detector alarm and installed, operated and maintained by the customer) shall be used to page the appropriate Company Division Emergency Control Room. The telephone message shall indicate:

7.18.1 A high temperature/smoke condition exists
7.18.2 Location of vault

7.19 If the telephone alarm system is utilized, the alarm notification to the Building Engineer, as described in paragraph 7.17 shall not be required. All required equipment and material for connection to the telephone system shall be furnished and installed by customer.

7.20 Exception:

7.20.1 Multibank installations inside a building using a combination of natural and mechanical ventilation require special considerations to determine overall ventilation requirements. In these cases, the customer's proposed ventilation system shall be referred to the Electrical Distribution Engineer as early as possible for evaluation and/or concept approval.

7.20.2 Transformer louver design that require an interior and an exterior louvers should meet the following:

a. The interior louver will be “Chain-link Fence” as described in EO-1124
b. The exterior louver (customer proposed louver) must:
   i. Meet the requirements within this specification
   ii. be removable to allow for both installation and replacement of the transformer.
   iii. Have a minimum of 3 feet of width between the interior and exterior louvers.

7.20.3 Block House Design:

7.20.3.1 For all new installations of the block house, no mechanical means are acceptable:

a. Air blown into a compartment or recirculation of air, either total or partial will not be approved for service.
b. The interior floor to ceiling height shall be 13 feet.
c. The ventilation opening size for the network protector compartment shall be 3 feet by 3 feet.
d. Louver blade design shall be 50 degrees as described in drawing EO-5494-C
e. All new ventilation openings shall have a vent “hood” design as described in drawing 512659
   To achieve cross ventilation, an additional exhaust opening should be on the wall across from the wall of the existing opening. A fusible link fire damper shall be installed on the new ventilation opening, as described in drawing EO-14123-B (see paragraph 6.7).

7.20.3.2 If necessary and deemed required by Distribution Engineering System Design Manager, for existing block house Design built at grade in Flood Zone:
- an exhaust power vent with 14 inches by 14 inches opening
- should have both humidity set at 40% and temperature set at 90 degrees settings with 800 CFM
- should be installed in the middle of the wall in each network protector compartment as described in drawing 512880.

7.20.3.3 For existing block house Design built at grade in **Non**-Flood Zone:

- This will be case by case study that is forwarded to Distribution Engineering System Design Manager or his/her designee for consideration.

8.0 COMPANY ACCEPTANCE OF VENTILATION SYSTEM

8.1 The following items are to be provided by the Customer:

8.1.1 Ventilation system construction drawings shall be submitted for approval prior to equipment installation.

8.1.2 Identification log with current names, business and home telephone numbers of the Building Engineer and his designated representative/alternate.

8.1.3 Written system operating description, air flow diagram, control and wiring diagrams for the ventilation system and alarms.

8.2 The complete ventilation system shall be successfully tested before the company's service can be connected. All tests are subject to witnessing by company Field Representatives. Certified test reports shall be submitted to the company upon completion of the final tests. In addition, every two years certified test reports shall be submitted to ensure that the ventilation system has been periodically tested and found to be in proper operating condition. The customer shall notify the company two weeks in advance of all tests to allow the time to schedule a company Field Representative to witness these tests.

8.3 Any exceptions to this specification shall be forwarded to Distribution Engineering System Design Manager or his/her designee for consideration.

9.0 FIELD TEST OF CUSTOMER 265/460 VENTILATION SYSTEM

These tests must be repeated for each Network Compartment, the equipment to be tested are Alarm Panel, Exhaust Fan Indicator Light, High Temperature Indicator Light, Visual & Audible Alarm Indicators, Alarm Silencer, Auxiliary Indicator Reset Button, air flow Indicator Lights, Smoke Detector Indicator Lights, In-Take vents and exhaust vents.

9.1 TEST PROCEDURES

First TEST:

Air flow balance test to ensure that the minimum air flow is 1600 CFM (Cubic Feet per Minute) from each exhaust vents from a 18”x18” opening. See Section 5.5 table for 265/460.

“Utilize a lightweight tissue or paper to test the incoming air flow on the in-take vent and outgoing flow of air on the exhaust vents vent. Bring a two foot stick so you can tape the paper to it to reach the exhaust vents”.

SECOND TEST:

Thermostat #2 drops the test temperature from 85^0F to 45^0F, the room should be warm enough to start the FANS. Re-set to 85^0 F, the fans should remain running for (15 minutes) to stabilize temperature below 85^0 F.
Look at the alarm panel you should see the Exhaust fan and Air Flow Lights on. After a (15 minutes) time delay, the lights go out and the fans stop.

THIRD TEST:

Thermostat #1 drops the test temperature from 100^0F to 45^0F, it should be warm enough for the High Temperature Light to go on with a High Audible Alarm and an optional installation of a visual strobe light. The fans will Keep operating with a high Temperature condition and the fans will not shutdown in15 minutes, See section 7.14.8

“Use the Alarm Silencer and Auxiliary Re-Set Button for Indicators”.

FOURTH TEST:

Test Smoke Detectors reduce temperature setting of thermostat #2 from 85^0F to 45^0F to ensure the fans are running and the fan lights are lit on the panel. The customer will blow Smoke from a container into the Out-Take Vent – the smoke light will be lit on the panel with an audible alarm. The fan must go off and the fan lights on the panel also go off, see section 7.1

9.2 CHECK LIST

9.2.1 Test on Original take off

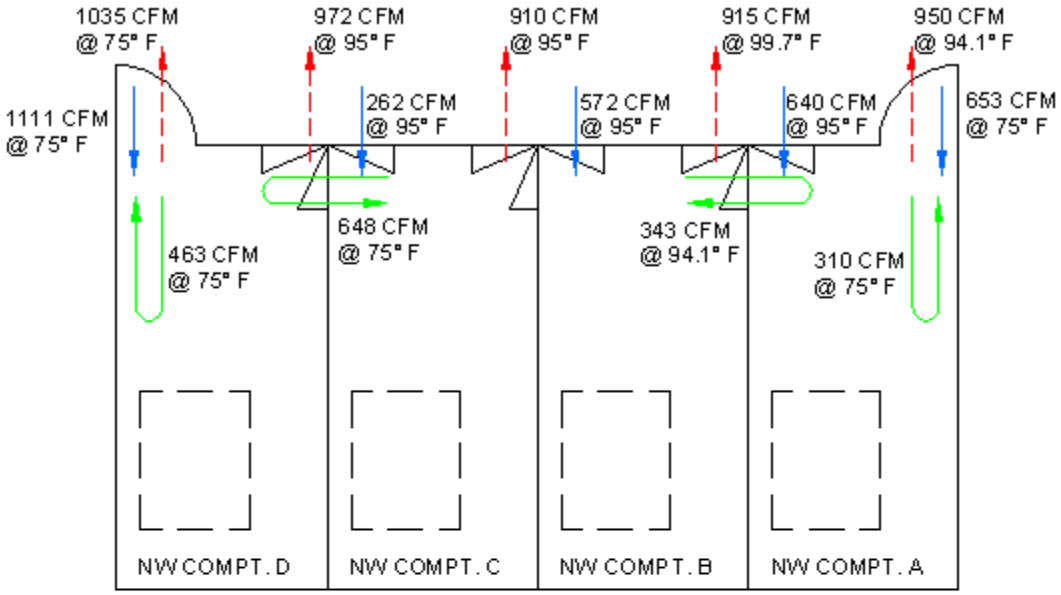
Tested on	*Input date*			
Tested by	*Input CPM name*			
Network Comp	NWC#1 Feeder # Vault #	NWC#2 Feeder # Vault #	NWC#3 Feeder # Vault #	NWC#4 Feeder # Vault #
First Test	------- CFM	------- CFM	------- CFM	------- CFM
Second Test	*Does the Exhaust Fan Indicator Light go on?*			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Does the Air Flow Indicators Light go on?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Is the paper flowing into the NYP from Intake Vent?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Do you see the paper drawn into the exhaust vent?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Does the Fan stay on for 15 minutes?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Does the exhaust Fan & Air Flow Light go out after 15 minutes?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
Third Test	*Does the High Temperature Indicator Light go on?*			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Does the Audible & Visual Alarm go on?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Are the Fans Operating?			

	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Is the Exhaust Fan Indicator Light On?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Is the Air Flow Indicator Light On?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
Fourth Test	*Are the Fans Running?*			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Is the Exhaust Indicator Light On?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Is the Air Flow Indicator Light On?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
Fourth Test	*Did the contractor Blow Smoke in the exhaust vents Vent?*			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Did the Smoke Indicator Light go on?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Did the Audio / Visual Alarm go on?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Did the Fans Shut Off?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Did the Air Flow Indicator Light go off?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Did the Alarm go on in the Manned Station?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----
	Was there an Automated Telephone message sent to Con Edison?			
	YES------ NO----	YES------ NO----	YES------ NO----	YES------ NO----

9.2.2 Test on alternate take off

Perform the above test on alternate Take-off

REVISION 14	FILE
1. Incorporated Corporate Instruction for Climate Change Adaptation & Resiliency; and Strengthened guidance described in **Climate Change Planning and Design Guideline.** 2. Revised paragraphs: 5.2 ,5.3,5.4, 5.5, and 7.15 3. Added paragraph 3.8, and 4.2.4	Application & Design Manual No.4



NETWORK PROTECTOR COMPARTMENTS
AIR FLOW DIAGRAM
FIG. 1

LEGEND

CFM	CUBIC FEET PER MINUTE
	AIR INTO COMPARTMENT
	EXHAUST AIR FROM COMPARTMENT
	AIR INFILTRATION THROUGHT THE DOOR UNDER CUTS, DOOR CRACKS. WALL PENETRATIONS, ETC,
	LOUVERS / GRATINGS