



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

**DISTRIBUTION ENGINEERING DEPARTMENT  
SYSTEM DESIGN SECTION**

**SPECIFICATION EO - 2080  
REVISION 7  
DECEMBER 2017**

**EFFECTIVE DATE  
DECEMBER 31, 2017**

**DESIGN OF 120/208 VOLT NETWORK INSTALLATIONS**

**FILE: APPLICATION AND DESIGN MANUAL No.4**

<b>TARGET AUDIENCE</b>	<b>DISTRIBUTION ENGINEERING ELECTRIC OPERATIONS – ALL REGIONS ENERGY SERVICES DISTRIBUTED RESOURCE INTEGRATION</b>
<b>NESC REFERENCE</b>	<b>SECTIONS 9, 12-125</b>

## **TABLE OF CONTENTS**

1.0	SCOPE .....	3
2.0	REGIONS APPLICABLE .....	3
3.0	DEFINITIONS .....	3
4.0	ELECTRICAL CHARACTERISTICS OF 120/208 VOLT INSTALLATIONS .....	5
5.0	ELECTRICAL EQUIPMENT .....	5
6.0	STRUCTURAL EQUIPMENT HOUSINGS .....	9
7.0	DESIGN CONSIDERATIONS .....	9
8.0	GROUNDING .....	12
9.0	EXCEPTIONS .....	13
10.0	REFERENCE SPECIFICATIONS .....	13

Specification	Revision	Rev Date	Effective Date	Copyright Information	Page
EO – 2080	7	11/01/2017	12/31/2017	1971-2017 Consolidated Edison Co. of New York, Inc.	2/14
<b>Filing Information</b>		Application and Design		Manual No. 4	

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult Distribution Engineering Intranet Site [Distribution Engineering](#) or <http://distribution>, for the current version prior to use.

## 1.0 **SCOPE**

- 1.1 This specification gives the general requirements for all 120/208 volt network installations supplying:
- 1.2 Secondary network grids
- 1.3 Isolated networks
- 1.4 Spot networks
- 1.5 Modified secondary grids.

## 2.0 **REGIONS APPLICABLE**

- 2.1 All Regions.

## 3.0 **DEFINITIONS**

- 3.1 The following technical terms are defined:
  - 3.1.1 Transformer Vault - Structure to house a transformer with or without network protector (Installed under sidewalks or within buildings).
  - 3.1.2 Bus Vault - Structure housing a paralleling bus and its associated cable connections (Installed under sidewalks).
  - 3.1.3 Network Protector/Bus Compartment - Structure housing a network protector or a network protector supporting the paralleling bus assembly, as well as any associated cable connections (Installed under sidewalks or within buildings).
  - 3.1.4 Diving Bell Bus Vault - Vault intended for submersible operation (Installed under sidewalks or in building basements). The diving bell vault is a monolithically poured concrete structure having a closed top and sides and with the bottom open. Its purpose is to effectively act as a water tight chamber in which the bus is mounted.

- 3.1.5 Transformer Manhole - Structure housing a transformer with an attached submersible network protector, generally located on the roadway. Exception: the TM-11 manhole was adapted for sidewalk installation and is used for 500 kVA suspension type transformer installation.
- 3.1.6 Crab Joint - A multiple cable connector.
- 3.1.7 Crab Vault - Structure to house crab joints for the interconnection of transformers
- 3.1.8 Set of Cables - One cable of each phase and the neutral. (All cables are of the same size).
- 3.1.9 Phase Grouping - Cables of all three phases installed in the same duct with or without neutral cable. (All cables are of the same size).
- 3.1.10 Phase Isolated - Cables of the same phase only are installed in the same duct. (All cables are of the same size).
- 3.1.11 Inter-vault Tie - Cables connecting a network protector and a paralleling bus or crab vault.
- 3.1.12 Street Ties - Cables between a network installation and the secondary network grid.
- 3.1.13 Bus to Bus Tie - Cables connecting the paralleling bus of two 120/208 volt installations.
- 3.1.14 Transformer Secondary Tie - Cables between transformer and a separately mounted network protector.
- 3.1.15 Service Take-Off - Bus or cable extension to Company's point of service termination.
- 3.1.16 Point-of-Service Termination - Point where the customer's cables or bus are connected to the Company's cables or bus.
- 3.1.17 Vault Type Transformer - A transformer which rests on the floor of a vault and is designed to be used with a separately mounted network protector.
- 3.1.18 Vault Type Transformer With Throat - Same as 3.1.17 except that the network protector is attached to its side.

Specification	Revision	Rev Date	Effective Date	Copyright Information	Page
EO – 2080	7	11/01/2017	12/31/2017	1971-2017 Consolidated Edison Co. of New York, Inc.	4/14
<b>Filing Information</b>		Application and Design		Manual No. 4	
Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult Distribution Engineering Intranet Site <a href="#">Distribution Engineering</a> or <a href="http://distribution">http://distribution</a> , for the current version prior to use.					

- 3.1.19 Subway Suspension Type Transformer - A transformer which is suspended within a vault and has a network protector mounted on its end.
- 3.1.20 Interior Distribution System - An installation within the customer's premises that is not adjacent to the property line.

#### **4.0 ELECTRICAL CHARACTERISTICS OF 120/208 VOLT INSTALLATIONS**

- 4.1 The following electrical characteristics apply to 120/208 volt network installations:
  - 4.1.1 Single transformer installations are paralleled to the network grid by means of secondary street ties.
  - 4.1.2 A group of network distribution transformers installed in the field, or in isolated and spot networks within buildings, is called a "multibank installation" and has the low voltage windings paralleled by means of the paralleling bus, crab joints or secondary street mains. For definitions of isolated and spot networks refer to Specification EO-4007 contained in System Operation Manual # 5.
  - 4.1.3 Network transformer winding connections for single and multibank installations are delta-wye when supplied by 13, 27 or 33 kV feeders and wye-wye when fed by 4 kV feeders. They all step down the voltage to 125/216 volts.
  - 4.1.4 The service voltage for all network installations is referred to as "120/208 volts nominal" and the design operating limits are stipulated in Specification EO-2065. Company policy for A.C. Services is detailed in EO-2065 and motor inrush current limitations are given in EO-2008.
  - 4.1.5 Each multibank installation is limited to a maximum of six transformers so that a possible solid 3-phase fault at the 120/208 volt paralleling bus would not exceed 200,000 Amperes RMS Symmetrical.

#### **5.0 ELECTRICAL EQUIPMENT**

##### **5.1 Transformers**

- 5.1.1 The following transformers are used in 120/208 volt new installations:

Specification	Revision	Rev Date	Effective Date	Copyright Information	Page
EO – 2080	7	11/01/2017	12/31/2017	1971-2017 Consolidated Edison Co. of New York, Inc.	5/14
<b>Filing Information</b>		Application and Design		Manual No. 4	
Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult Distribution Engineering Intranet Site <a href="#">Distribution Engineering</a> or <a href="http://distribution">http://distribution</a> , for the current version prior to use.					

<b>Nominal Voltage(KV)</b>	<b>Size(*) (KVA)</b>	<b>Phase</b>	<b>Type</b>	<b>Application</b>
4	500	3	Liquid(**)	Subway/suspension
13,27,33	500	3	Liquid(**)	Subway/suspension
13,27,33	500	3	Liquid(**)	Vault/vault with throat
13	500	3	Dry(***)	Vault
13,27,33	1000	3	Liquid(**)	Subway/Suspension
13,27,33	1000	3	Liquid(**)	Vault/vault with throat
13	1000	3	Dry(***)	Vault

(\*) Post 1991 vintage transformers.

(\*\*) Customer property, sidewalk vaults and street vaults transformers shall use Mineral Oil or Natural Ester. In buildings Natural Ester (Preferred) or Silicone filled transformers shall be used.

(\*\*\*) Natural Ester is preferred in buildings however. Dry type can be used where it exist in building and structural load is a concern.

5.1.2 The above transformers are self-cooled and available as dry or liquid filled units. Detailed description of network transformers is given in purchase and Test Specification EO-5025 and EO-5031 for dry type and liquid filled respectively.

## 5.2 Autotransformers

5.2.1 An autotransformer may be used to connect a 265/460 volt spot network to the 120/208 volt network grid.

5.2.2 Autotransformers are self-cooled, oil-filled, vault type units purchased on the following standard sizes

500 kVA, 3-phase 480/277 to 216/125 volts

1000 kVA, 3-phase 480/277 to 216/125 volts

5.2.3 Detailed description of autotransformers is given in Purchase and Test Specification EO-5011. For instructions on their use, see Operation and Maintenance of Equipment Specification EO-11,206 of Manual No. 1.

## 5.3 Network Protectors

5.3.1 The following network protectors are used on the 120/208 volt installations:

<b>Specification</b>	<b>Revision</b>	<b>Rev Date</b>	<b>Effective Date</b>	<b>Copyright Information</b>	<b>Page</b>
EO – 2080	7	11/01/2017	12/31/2017	1971-2017 Consolidated Edison Co. of New York, Inc.	6/14
<b>Filing Information</b>		Application and Design		Manual No. 4	

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult Distribution Engineering Intranet Site [Distribution Engineering](#) or <http://distribution>, for the current version prior to use.

<b>NWP Maximum Rating</b> (Amperes)	<b>Associated Transformer</b> (KVA) (*)	<b>Type</b>
2250	500	Transformer-mounted, submersible
	500	Separately-mounted, submersible
	500	Separately-mounted, ventilated
4500	1000	Transformer-mounted, submersible
	1000	Transformer-mounted, ventilated
	1000	Separately-mounted, submersible
	1000	Separately-mounted, ventilated

(\*) Post 1991 vintage transformers

5.3.2 These units are available with dust proof or submersible housings. However, submersible type housings shall be used for all new 120/208V secondary network equipment installations. In addition, submersible type housings shall be used for all targeted storm hardening installations or replacements of ventilated 120/208V cabinets, where space permits. Refer to EO-5103 for detailed description for network protectors and to EO-117000 for specific roll-out and enclosure information.

#### 5.4 Fuses

5.4.1 The fuses used on 120/208 volt installations shall be those listed in the various Specifications contained in Section 11 of the Purchase and Test Standards Manual No. 6. Network protector fuses and bus stab service take-off fuses are applied on the system according to Specification EO-5400 and EO-5402 respectively, which are part of Application and Design Manual # 4.

#### 5.5 Limiters

5.5.1 Limiters employed on 120/208 volt installations are listed in the various Specifications contained in Section 14 of the Purchase and Test Standards Manual No. 6 and applied on the system according to EO-5400.

#### 5.6 Bus Bars

5.6.1 Rectangular ventilated copper tube is used as the standard for

paralleling bus bar of phase conductors and service take-offs, with dimensions of 6" x 5" x 1/4". Copper tubes are purchased according to Specification EO-100049 of Manual No. 6 and their standard ratings are given in Specification EO-5415 of Manual No. 4.

5.6.2 Rubber-insulated rectangular copper bus bar to be used in Flood Zone locations. For paralleling bus bar of phase conductors, use dimension 8" x 3/4".

## 5.7 Cables

5.7.1 The following Ethylene Propylene Rubber (EPR) 600 volt rated cables are used on 120/208 volt installations.

- A. 500 kcmil, EPR, Copper, Cable EO-609E
- B. 750 kcmil, EPR, Copper, Cable EO-610E
- C. Both above cables are listed in Specification [EO-18](#) on Section 3 of Manual No. 6.

5.7.2 No aluminum cables shall be used on such installations.

## 5.8 Crab Joints

5.8.1 Crab joints used on 120/208 volt installations are listed in the various EO-Specifications on Section 9 of Purchase and Test Manual No. 6.

## 5.9 Low-Voltage Switch

5.9.1 The Low-Voltage Switch is a 125V single-phase underground switch. The main purpose of the switch is to provide for a less intrusive means of isolation and ease of restoration of the low voltage distribution grid.

5.9.2 The switch is installed in conjunction with 500 kcmil cable limiters in accordance with Drawing No: 506487, on either side of the switch. Cable limiter installation is not necessary if secondary crabs are located in the next closest structure, and are in series with the switch.



5.9.3 For details on the operation and installation of the Low-Voltage Switch (LVS) refer to specification EO-4380.

## 6.0 **STRUCTURAL EQUIPMENT HOUSINGS**

- 6.1 Construction requirements for transformer vaults, bus vaults and network protector or paralleling bus compartments, on 120/208 volt installations, are described in Specification EO-5024 of Construction Standards Manual # 3.
- 6.2 Specification EO-2107 of Application and Design Manual # 4 lists all types of manholes and vaults and describes their application in forming various arrangements of single or multibank installations on the 120/208 vault System.

## 7.0 **DESIGN CONSIDERATIONS**

### 7.1 Transformers and Autotransformers

- 7.1.1 Application and Design Specification EO-2120 gives the criteria and guidelines for selecting the type of network transformer (dry, oil, natural ester or silicone filled) for use on new or existing installations.
- 7.1.2 In general, oil filled transformers are used on all outdoor installations (sidewalk vaults, street vaults, outdoor customer vaults, vaults located adjacent to grade and touching the building line).
- 7.1.3 Autotransformers that may be used to connect 265/460 volt spot networks to 120/208 volt network grids are oil filled units.

7.1.4 Only one network transformer shall be installed in each vault.

### 7.2 Network Protectors

- 7.2.1 Network protectors shall be installed in vaults or network protector/bus compartments. Submersible type housings shall be used for all new 120/208V below-grade secondary network equipment installations. In addition, submersible type housings shall be used for all targeted storm hardening installations or replacements of ventilated 120/208V cabinets, where space permits.

Specification	Revision	Rev Date	Effective Date	Copyright Information	Page
EO – 2080	7	11/01/2017	12/31/2017	1971-2017 Consolidated Edison Co. of New York, Inc.	9/14
Filing Information		Application and Design		Manual No. 4	
Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult Distribution Engineering Intranet Site <a href="#">Distribution Engineering</a> or <a href="http://distribution">http://distribution</a> , for the current version prior to use.					

- 7.2.2 Only one protector shall be installed in a vault or network protector/bus compartment.
- 7.2.3 Network protector relaying is described in Application and Design Specification EO-5411.

### 7.3 Fuses

- 7.3.1 Fuses shall be used on every network protector and on every bus stab service take-off.
- 7.3.2 Network protectors shall be fused according to Application and Design Specification EO-5400 by using the low loss fuses listed in Purchase and Test Specification EO-12696-B.
- 7.3.3 Service take-off bus stabs shall be fused according to Application and Design Specification EO-5402 by using the low loss fuses listed in Purchase and Test Specification EO-9689-D
- 7.3.4 Service take-offs consisting of cables need not be fused but should be limited.

### 7.4 Limiters

- 7.4.1 Limiters should be provided at both ends of every phase cable on street ties connecting a single or multibank 120/208 volt installation to the network grid.
- 7.4.2 Service take-offs at multibank installations consisting of cables should have cable limiters at both the company and the customer end of the cable.
- 7.4.3 A service supplied from the network grid should have cable limiters if it consists of 3 or more sets of cables.

### 7.5 Bus Bars

- 7.5.1 The rectangular ventilated copper tube that is used for paralleling bus phase conductors on 120/208 volt installations, shall be placed at 10" center-to-center horizontal spacing among the phases. Rubber-insulated rectangular copper bus bar is to be used in Flood Zone location. The rectangular insulated copper bus for paralleling bus phase shall be placed 13" center-to-center horizontal spacing among phases. Exception is V15-6 Dwg. # 510634 which shows 11½" center-to-center spacing.

Specification	Revision	Rev Date	Effective Date	Copyright Information	Page
EO – 2080	7	11/01/2017	12/31/2017	1971-2017 Consolidated Edison Co. of New York, Inc.	10/14
<b>Filing Information</b>		Application and Design		Manual No. 4	

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult Distribution Engineering Intranet Site [Distribution Engineering](#) or <http://distribution>, for the current version prior to use.

- 7.5.2 Buses of 120/208 volt multibank installations are designed to withstand a maximum solid 3-phase fault of 200,000 amperes RMS Symmetrical. Standard design of bus bar installations, bus ampere ratings and provision for service take-offs are described in Application and Design Specification EO-5415.
- 7.5.3 All buses shall be constructed to provide spare terminations for future cable connections. Each connection shall be equivalent to the full capacity of one 1000 KVA network transformer.
- 7.5.4 Network bus installations and bus support assemblies are detailed in Section 46 of Construction Standards Manual No. 3.
- 7.6 Secondary Cables
- 7.6.1 Application and Design Specification EO-2035 covers all secondary cable vault installations on the 120/208 volt Network System, such as: secondary cables within or between transformer vaults and bus vaults (bus compartments); and street ties and service cables associated with the vault installation.
- 7.7 Crab Joints
- 7.7.1 Crab joints are used to connect multiple sets of cables together. Typical uses of crab joints are found in Section 29 of Construction Standards Manual # 3.
- 7.8 Vaults and Ventilation
- 7.8.1 Vaults on the 120/208 volt System constructed on the sidewalk or within buildings and containing liquid filled transformers, shall be reinforced concrete structures. Transformer vaults containing dry type transformers may be constructed of 100 percent filled concrete block. Both vault types are described in Specification EO-5024.
- 7.8.2 Transformer vaults, bus vaults and crab vaults are detailed in Specification EO-2107.
- 7.8.3 Transformer vaults shall have the following net clear ventilation area:

Specification	Revision	Rev Date	Effective Date	Copyright Information	Page
EO – 2080	7	11/01/2017	12/31/2017	1971-2017 Consolidated Edison Co. of New York, Inc.	11/14
<b>Filing Information</b>		Application and Design		Manual No. 4	

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult Distribution Engineering Intranet Site [Distribution Engineering](#) or <http://distribution>, for the current version prior to use.

Network Transformer or Autotransformer Size (kVA)	Minimum Net Clear Ventilation Area - Liquid Filled (Square Feet)	Minimum. Net Clear Ventilation Area - Dry Type (Square Feet)
500	12	12
1000	23	23

7.8.4 The following combinations of equipment may be installed within a single vault:

- A. One network transformer with or without its associated network protector.
- B. Same as A, with one autotransformer in the vault.

7.8.5 When a network transformer and an autotransformer are placed in the same vault space, the total of their respective ventilation requirements must be considered.

7.8.6 Transformer vaults and network protector compartments within buildings may be forced exhaust ventilated according to the design criteria of Application and Design Specification EO-2032. (Forced ventilation for new transformer vaults is not permitted but is grandfathered where used in existing installations).

## 8.0 **GROUNDING**

8.1 The neutrals of the sets of cables that connect a network installation to the secondary grid (street ties) provide an adequate ground for such installations.

8.2 Grounding in isolated and spot networks (with no street ties) is achieved by using the concentric neutral/lead sheaths of the primary cables and insulated 4/0 copper cable to connect the neutral bus in the paralleling bus vault to the system ground. For future installations one insulated 4/0 copper cable from the bonding tree to the neutral bus for each network transformer should be installed for safety and reliability reasons. If the above requirement cannot be met a minimum of two insulated 4/0 copper cables in separate ducts are required for each installation with approval from System Design Department Manager or the designee. In addition, one 500 kcmil copper cable shall be used to connect the neutral bus of the installation to the building steel frame.

## 9.0 EXCEPTIONS

- 9.1 Any exceptions to the stipulations of this Specification shall be forwarded to the **System Design Department Manager** of the Distribution Engineering Department.

## 10.0 REFERENCE SPECIFICATIONS

- 10.1 The following reference and related specifications are listed below:

EO-Specification	Title	Manual No.
<a href="#">EO-18</a>	Ethylene Propylene Rubber Cables - 600 Volts	6
<a href="#">EO-1100</a>	Sealing Ducts and Bus Openings	3
<a href="#">EO-1101</a>	Conduits for Transformer Manholes and Vaults	4
<a href="#">EO-2002</a>	Loading Limits for Network Transformer Bank Installations	4
<a href="#">EO-2008</a>	Service Voltage Flicker Limits	4
<a href="#">EO-2032</a>	Design Criteria for Ventilation of Transformer Vaults and Network Protector Compartments	4
<a href="#">EO-2035</a>	Secondary Cable Installations for 120/208 Volt Network System Vaults	4
<a href="#">EO-2055</a>	A.C. Services	4
<a href="#">EO-2065</a>	Low Tension A.C. Service Voltage Limits	4
<a href="#">EO-2107</a>	Arrangements of Standard Transformer and Bus Vaults for 208 Volt Network Installations	4
<a href="#">EO-2120</a>	Criteria for Network Transformer Usage	4
<a href="#">EO-4007</a>	Operation of Isolated Networks	5
<a href="#">EO-4380</a>	Operation of 125V Low Voltage Single Phase Underground Switch	1
<a href="#">EO-5011</a>	Detailed Specification for 480/277 to 216/125 Volt Autotransformer	6
<a href="#">EO-5024</a>	Requirements for Construction of 120/208 Volt Network Installations	3
<a href="#">EO-5025</a>	Specification for 13 kV Dry Type Transformers	6
<a href="#">EO-5031</a>	Detailed Specification for Secondary Network Transformers	6
<a href="#">EO-5083</a>	General Specification for Submersible Distribution Transformers	6
<a href="#">EO-5103</a>	Purchase Requirements for Network Protectors and Network Protector Housings/Enclosures	6
<a href="#">EO-5400</a>	Network Protector Fusing and Selectivity with Cable Limiters on 120/208 Volt Networks	4
<a href="#">EO-5402</a>	Fuses for Service Take-offs and Services	4
<a href="#">EO-5411</a>	Network Protector Relaying	4

Specification	Revision	Rev Date	Effective Date	Copyright Information	Page
EO – 2080	7	11/01/2017	12/31/2017	1971-2017 Consolidated Edison Co. of New York, Inc.	13/14
<b>Filing Information</b>		Application and Design	Manual No. 4		

Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult Distribution Engineering Intranet Site [Distribution Engineering](#) or <http://distribution>, for the current version prior to use.

<a href="#">EO-5415</a>	Standard Design and Ratings of Alum/Copper Bus	4
<a href="#">EO-6043</a>	Tagging of Cable	4
<a href="#">EO-9689-D</a>	Type W4 Fuse for 4000 Ampere 120/208 Volt Service Take-Off	6
<a href="#">EO-11206</a>	Instructions for 480/216 Volt Autotransformers	1
<a href="#">EO-12696-B</a>	Low Loss Fuses for Network Protectors	6
<a href="#">EO-100049</a>	Copper Bus (For Electrical Distribution Buses)	6
<a href="#">506487</a>	Installation of Low Voltage Load Break Switch	3
<a href="#">EO-2163</a>	Application of Secondary Low Voltage Switches	4
<a href="#">EO-5155</a>	125V Single Phase Underground Switch	6

Christopher G. Jones (Signature on file)  
Christopher G. Jones  
Department Manager, System Design  
Distribution Engineering Department

Ricardo San Pedro

<p><b><u>REVISION 7</u></b></p> <ol style="list-style-type: none"> <li>1. Added Par. 5.6.2, 7.2.3 and expanded Pars. 7.5.1 and 7.8.6 for implementation of submersible bus on 120/208 Volt Network Installations.</li> <li>2. Added Sub-Section 5.9 on LV Switch.</li> <li>3. Deleted Appendix 1 – NWP Relay Trip &amp; Close Settings moved to an updated spec EO-5411.</li> </ol>	<p><b>FILE:</b></p> <p>Application and Design Manual No.4</p>
---	---

Specification	Revision	Rev Date	Effective Date	Copyright Information	Page
EO – 2080	7	11/01/2017	12/31/2017	1971-2017 Consolidated Edison Co. of New York, Inc.	14/14
Filing Information		Application and Design		Manual No. 4	
Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult Distribution Engineering Intranet Site <a href="#">Distribution Engineering</a> or <a href="http://distribution">http://distribution</a> , for the current version prior to use.					