

# Substation transformers-unit and open types



## General

Eaton designs its Cooper Power™ series substation transformers to meet a wide variety of customer specifications.

Flexibility in design, combined with the highest quality manufacturing processes, equipment, and testing procedures, enable Eaton to provide a product optimized to the customer's requirements. All units meet applicable American National Standards Institute (ANSI®), Institute of Electrical and Electronics Engineers, Inc. (IEEE®) and National Electrical Manufacturers Association (NEMA®) standards, as well as National Electric Code® (NEC®), Department of Energy (DOE) and Canadian Standards Association (CSA®) specifications.

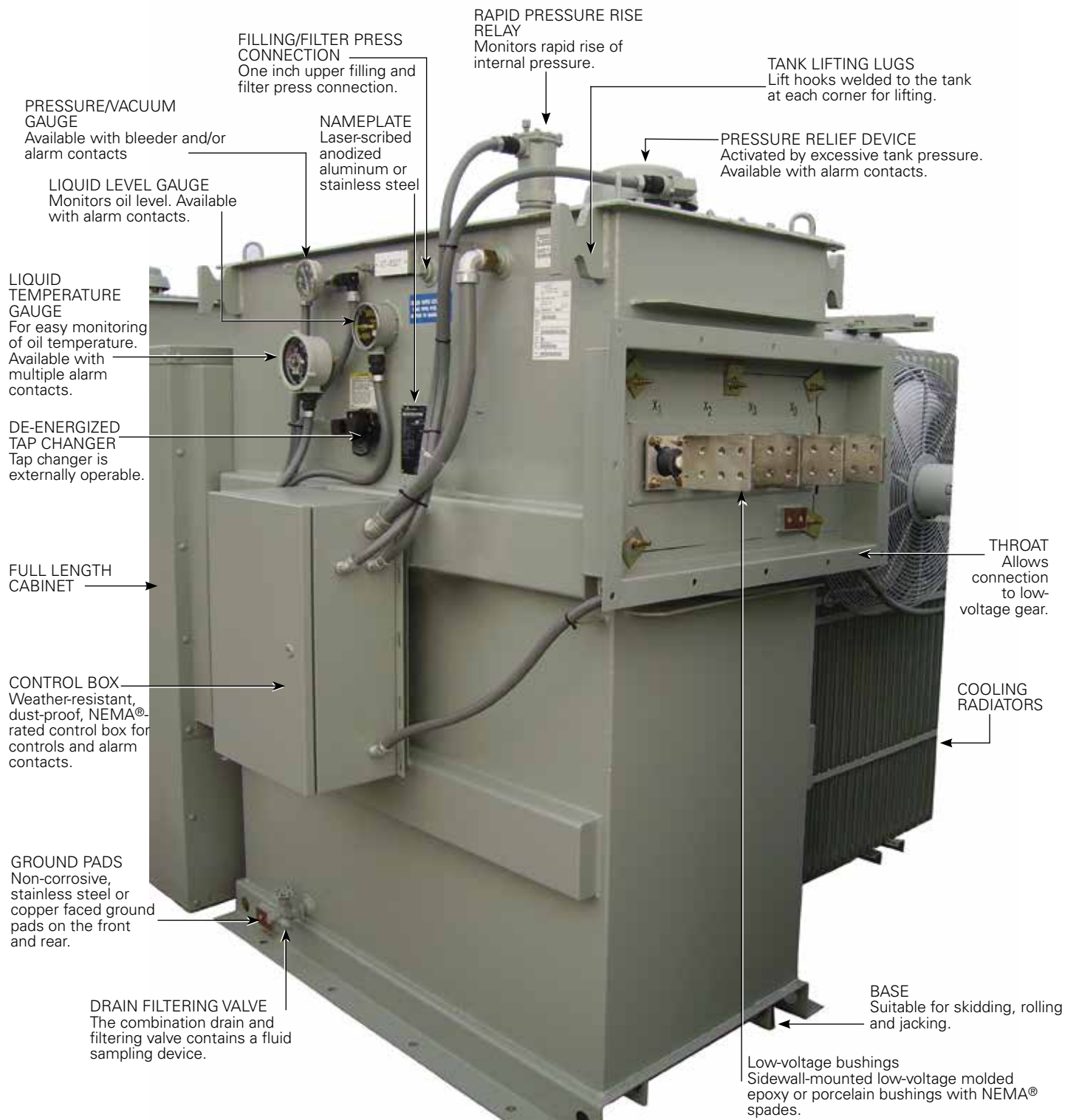
Substation transformers are available with cover-mounted bushings or sidewall-mounted bushings for connections to primary and/or secondary switchgear.

Substation transformers are made with a wide range of core steels and winding conductors to optimize efficiency versus cost. Flexible core/coil and tank construction enable your dimensional requirements to be met.

Eaton's Cooper Power series transformers are available with Envirotemp™ FR3™ fluid, a less-flammable and bio-degradable fluid, or electrical grade mineral insulating oil. Substation transformers intended for indoor use are solely filled with Envirotemp™ FR3™ fluid, which meets Occupational Safety and Health Administration (OSHA) and Section 450.23, 2014 NEC® requirements. Electrical codes recognize the advantages of using Envirotemp™ FR3™ fluid both indoors and outdoors for fire-sensitive applications.

**EATON**

*Powering Business Worldwide*



**Figure 1. Unit type substation transformer with standard features and optional accessories.**

**Product Scope**

<b>Type</b>	Three-Phase or Single-Phase, 50 or 60 Hz, 65 °C. 55 °C and 55/65 °C available. See CA202004EN for 75 °C options.
<b>Fluid Type</b>	Envirotemp™ FR3™ fluid or Mineral Oil
<b>Size</b>	Three-Phase: 300 – 12,000 kVA Single-Phase: 250-5000 kVA
<b>Primary Voltage</b>	2400 – 46,000 V
<b>Secondary Voltage</b>	208-15,000 V (25 kV available upon special request)
<b>Specialty Designs</b>	Hardened Data Centers Grounding Transformers K-factor ( up to K-20) Hazardous Location (Class I, Division 2, Groups B, C, and/or D) Internal Vacuum Fault Interrupter (VFI) UL® Listed & Labeled/ Classified Factory Mutual (FM) Approved Solar/Wind Designs Variable Speed Drives or Rectifier Duty Mining/Skid-Mounted Applications Multi-tap designs for electric submersible pump (ESP) applications

**Table 1. Three-Phase, Single Temperature kVA Ratings**

**Three-Phase kVA Self-Cooled and Forced-Air Cooled with 65 °C Temperature Rise**

65 °C Rise KNAN		65 °C Rise KNAN/KNAF
500		N/A
750		863
1000	+15%	1150
1500		1725
2000		2300
2500		3125
3750		4688
5000	+25%	6250
7500		9375
10000		12500
12000	+33%	16000

**Table 3. Three-Phase, Dual Temperature kVA Ratings**

**Three-Phase kVA Self-Cooled and Forced-Air Cooled with Dual Rated 55 °C/65 °C Temperature Rise**

55 °C Rise KNAN	65 °C Rise KNAN	55°C Rise KNAN/KNAF	65 °C Rise KNAN/KNAF
500	560	N/A	N/A
750	840	863	966
1000	1120	1150	1288
1500	1680	1725	1932
2000	2240	2300	2576
2500	+12%	2800	3125
3750		4200	4688
5000		5600	6250
7500		8400	9375
10000		11200	12500
12000		13440	16000
			17920

**Note:** For transformers with a 75 degree C rating, please refer to *Catalog CA202004EN, PEAK™ Substation Transformers.*

**Table 2. Impedance Voltage**

kVA Rating (1PH and 3PH)	HV BIL (kV)	Impedance Voltage <sup>1</sup>	
		LV 600 V and below	LV above 600 V
112.5-749	≤200	1.70-5.75	1.70-5.75
750-4999	≤110	5.75	5.75
750-4999	150	6.75	6.5
750-4999	200	7.25	7
750-4999	250	7.75	7.5
5000-10000	150	-	6.5
5000-10000	200	-	7
5000-10000	250	-	7.5

<sup>1</sup> The standard tolerance is ±7.5%.

**Note:** Impedances listed above are per IEEE Std C57.12.36™-2007 standard. Impedances per IEEE Std C57.12.10™-2010 standard are also available.

**Table 4. Audible Sound Levels**

Self-Cooled, Two Winding kVA Rating	NEMA® Average	
	dB, KNAN	dB, KNAF
500	56	N/A
501-700	57	67
701-1000	58	67
1001-1500	60	67
1501-2000	61	67
2001-2500	62	67
2501-3000	63	67
3001-4000	64	67
4001-5000	65	67
5001-6000	66	68
6001-7500	67	69
7501-10000	68	70
10001-12500	69	71

**Table 5. Insulation Test Levels**

kV Class	Induced Test 180 or 400 Hz 7200 Cycle	kV BIL		Applied Test 60 Hz (kV)
		Distribution	Power	
1.2		30	45	10
2.5		45	60	15
5		60	75	19
8.7		75	95	26
15	TWICE RATED VOLTAGE	95	110	34
25 (Grd Y Only)		125	150	40
25		150	150	50
34.5 (Grd Y Only)		150	200	50
34.5		200	200	70
46		250	250	95

**Table 6. Temperature Rise Ratings 0-3300 feet (0-1000 meters)**

	Standard	Optional
Unit Rating	65 °C	55 °C, 55/65 °C
Maximum Ambient Temperature Rise	40 °C	50 °C
Ambient Temperature 24 Hour Av.	30 °C	40 °C
Temperature Rise Winding <sup>1</sup>	65 °C	55 °C
Temperature Rise Hotspot	80 °C	65 °C

<sup>1</sup> Average Rise by resistance. Refer to IEEE Std C57.12.00™-2010 standard.

**Note:** Derate kVA by 0.4% for each 100 M (330 ft.) that the altitude is above 1000 M (3300 ft.).

**Table 7. Fluid-Filled—Aluminum Windings 55/65 °C Rise<sup>1</sup>**

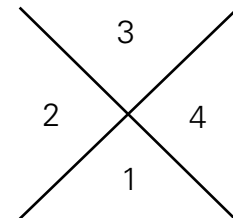
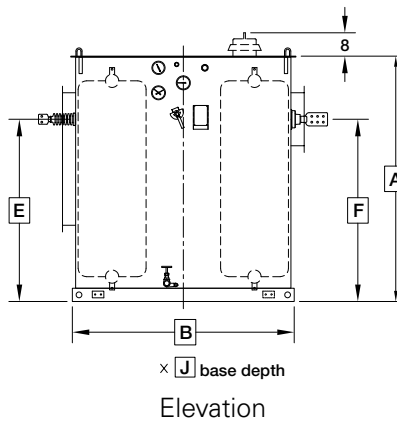
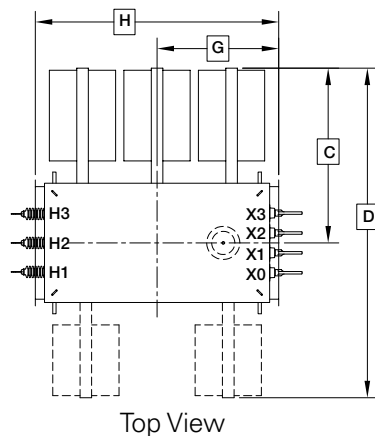
kVA	Drawing Dimensions (in.)									Gallons Of Fluid	Approx. Total Weight (lbs.) (With Fluid)
	A	B	C	D	E	F	G	H	J		
500	66	55	26	52	45	45	32	64	35	320	5800
750	75	59	30	60	55	55	34	68	35	370	7200
1000	75	67	30	60	55	55	38	76	35	440	8700
1500	75	67	59	80	55	55	38	76	35	480	10100
2000	85	71	67	90	55	55	40	80	39	550	12600
2500	85	75	68	92	55	55	42	84	41	570	15300
3750	85	75	70	120	65	65	42	84	45	790	20500
5000	99	87	72	144	65	65	48	96	49	1050	26000
7500	99	95	74	148	75	75	52	104	53	1320	35000
10,000	99	103	76	152	75	75	56	112	57	1740	43000
12,000	99	103	82	164	75	75	56	112	61	1850	49000

<sup>1</sup> Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact your Eaton representative for exact dimensions. Dimensions for 2500 kVA and below are based on DOE 2016 efficiency requirements

**Table 8. Fluid-Filled—Copper Windings 55/65 °C Rise<sup>1</sup>**

kVA	Drawing Dimensions (in.)									Gallons Of Fluid	Approx. Total Weight (lbs.) (With Fluid)
	A	B	C	D	E	F	G	H	J		
500	66	51	26	52	45	45	30	60	35	310	6100
750	75	59	26	52	55	55	34	68	35	370	7700
1000	75	67	26	52	55	55	38	76	35	430	9200
1500	75	61	59	80	55	55	36	72	35	470	10700
2000	85	67	67	90	55	55	38	76	39	540	13600
2500	85	73	68	92	55	55	40	80	41	630	15700
3750	85	75	70	120	65	65	42	84	45	830	21500
5000	99	87	72	144	65	65	48	96	49	1090	28000
7500	99	95	74	148	75	75	52	104	53	1360	37000
10,000	99	103	76	152	75	75	56	112	57	1780	45000
12,000	99	103	82	164	75	75	56	112	61	1880	50000

<sup>1</sup> Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact your Eaton representative for exact dimensions. Dimensions for 2500 kVA and below are based on DOE 2016 efficiency requirements



**Figure 2. High-Voltage left (Segment 2) shown. High-Voltage right (Segment 4) also available.**

**Figure 3. ANSI® segment designation.**

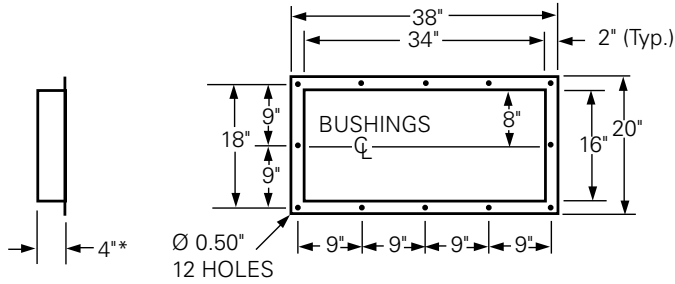


Figure 4. Throat.

\* Increase to 5" for containment pans.

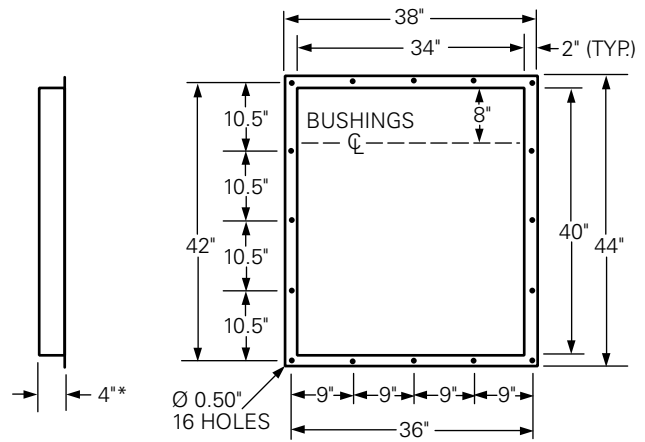


Figure 7. Flange.

\*Increase to 5" for containment pans.

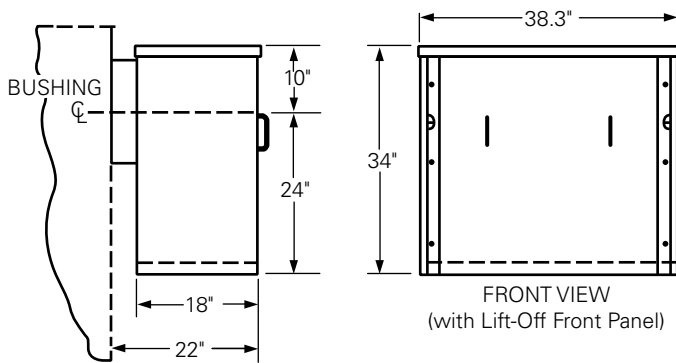


Figure 5. Air terminal chamber-bottom entry.

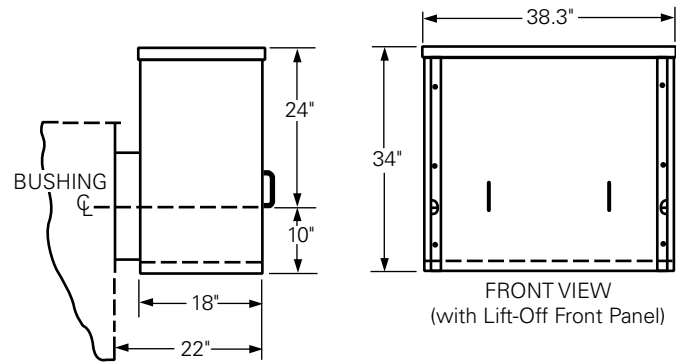


Figure 8. Air terminal chamber-top entry.

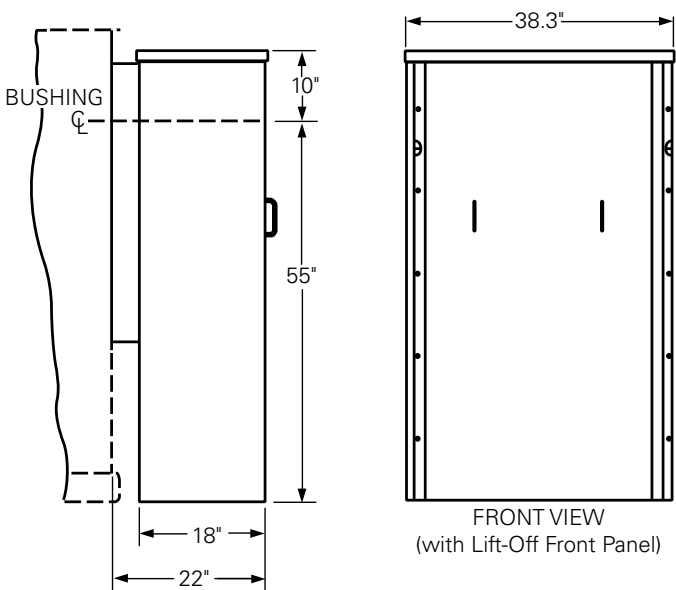


Figure 6. Full length cabinet-bottom entry.

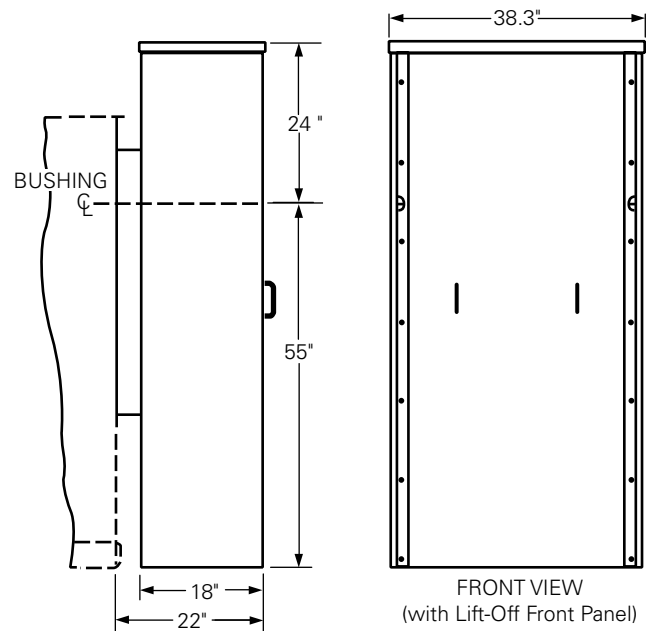


Figure 9. Full length cabinet-top entry.

## Standard features

### Fluid

- Envirotemp™ FR3™ fluid
- Electrical grade mineral insulating oil

### Mechanical features

- De-energized tap changer, externally operable

### High- and low-voltage bushings

- Cover or sidewall-mounted high-voltage porcelain bushings
  - Deadfront bushings also available
- Cover or sidewall-mounted low-voltage molded epoxy or porcelain bushings with NEMA® spades

### Tank

- Tank bases designed for skidding or rolling in any direction
- Extra-heavy, welded-in-place lifting lugs (4) and jacking provisions
- Stainless steel grounding pads (4)
- Cooling radiators or corrugate welded directly to the tank

### Gauges and devices

- Dial-type thermometer
- Dial-type liquid level gauge
- Pressure vacuum gauge
- Cover-mounted automatic pressure relief device
- Pressure test connection

### Valves/plugs

- 1" upper fill plug with filter press connection
- 1" upper filter valve (over 2500 kVA)
- 1" drain valve with sampler combination (2500 kVA and below)
- 2" drain valve with sampler (over 2500 kVA)

### Coatings (Paint)

- ANSI® #61 Light Gray
- ANSI® #70 Sky Gray
- Special paint available per request

### Nameplate

- Laser-scribed anodized aluminum nameplate

## Optional features

### Bushing enclosure options

- Throat
- Flange
- Top- or bottom-entry air terminal chamber
- Top- or bottom-entry full length cabinet

### Gauges and devices

- With Alarm Contacts
  - Dial-type thermometer (Standard with Fan Package)
  - Liquid level gauge
  - Pressure/vacuum gauge
  - Cover-mounted pressure relief device
  - Winding temperature indicator
- Rapid pressure rise relay with optional seal-in panel
- Nitrogen gas preservation system
- Infrared (IR) Windows



Figure 10. Automation solutions for remote monitoring.



Figure 11. 12-pulse application with bushing supports.

### Valves/plugs

- Pressure vacuum bleeder valve
- Detachable, bolt-on radiators with valves

### Control boxes

- Control box (NEMA® 4, NEMA® 4X, NEMA® 7)

### Forced-air fan control package

- Forced-air fan control package includes fans, NEMA® control box, fan controls, dial-type thermometer with alarm contacts

### Overcurrent protection

- Vacuum Fault Interrupter (VFI)
  - Visible Break Switch
  - Tri-phase with Ground Trip technology (TPG)
  - SCADA
  - Relays
  - Feeder Protection Relay (iDP-210)
  - Transformer Protection Relay (iXP-420)
  - Motor Operator

- Bay-O-Net Fuse with Isolation Link
- Bay-O-Net Fuse with Partial Range Current Limiting Fuse
- Primary air disconnect switch with fuses

### Overvoltage protection

- Distribution-, Intermediate-, or Station-class surge arresters
- Elbow arresters (for dead-front connections)

### Tank

- 304L stainless steel

## Overcurrent protection features

### Vacuum fault interrupter (VFI) and load interrupter switch (LIS)



Figure 12. VFI—inside transformer tank.

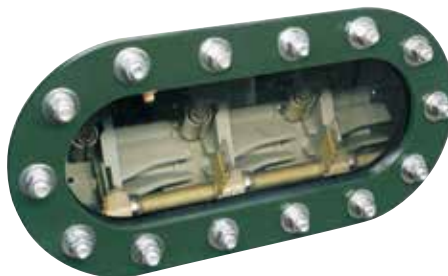


Figure 15. Visible break switch moveable blades shown in the "Open" position.



Figure 18. LIS—switch position viewing window.



Figure 13. VFI—operating handle.



Figure 16. TPG control with SCADA shown.



Figure 19. LIS—interior view showing power fuses.



Figure 14. Motor-operator for open/close of vacuum fault interrupter (VFI).



Figure 17. iDP/iXP relays—without and with trip/close pushbuttons.



## Construction

### Core

The three-legged, step-lap mitered core construction is manufactured using a high-quality cutting machine. For maximum efficiency, cores are precisely stacked, virtually eliminating gaps in the corner joints.

Five-legged wound core or shell-type triplex designs are used for wye-wye connected transformers, and other special transformer designs.

Cores are manufactured with precision cut, burr-free, grain-oriented silicon steel. Many grades of core steel are available for optimizing core loss efficiency.

### Coils

Substation transformers feature a rectangular coil configuration with wire-wound, high-voltage primaries and sheet-wound secondaries. The design minimizes axial stress developed by short circuits and provides for magnetic balancing of tap connections.

Coils are wound using the highest quality winding machines providing exacting tension control and conductor placement for superior short-circuit strength and maximum efficiency.

Extra mechanical strength is provided by diamond pattern, epoxy coated paper insulation, used throughout the coil, with additional epoxy at heavy stress points. The diamond pattern distribution of the epoxy and carefully arranged ducts, provide a network of passages through which cooling fluid can freely circulate.

Coil assemblies are heat-cured under calculated hydraulic pressure to ensure performance against short-circuit forces.

### Core and coil assemblies

Substation transformer core and coil assemblies are braced with heavy steel ends to prevent the rectangular coil from distorting under fault conditions. Plates are clamped in place using presses, and welded or bolted to form a solid core and coil assembly. Core and coil assemblies exceed ANSI® and IEEE® requirements for short-circuit performance. Due to the rigidity of the design, impedance shift after short-circuit is comparable to that of circular wound assemblies.

### Tanks

Transformer tanks are designed for high strength and ease of handling, installation, and maintenance. Tanks are welded using precision-cut, hot rolled, pickled and oiled steel. They are sealed to protect the insulating fluid and other internal components.

Transformer tanks are design tested to withstand 7 psig without permanent distortion and 15 psig without rupture.

### Tank finish

An advanced multi-stage finishing process exceeds IEEE Std C57.12.28™-2014 standard. The eight-stage pre-treatment process assures coating adhesion and retards corrosion. It converts tank surfaces to a nonmetallic, water insoluble iron phosphate coating.

The paint method consists of three distinct layers of paint. The first is an epoxy primer (E-coat) layer which provides a barrier against moisture, salt and corrosives. The two-component urethane final coat seals and adds ultraviolet protection.

### Vacuum processing

Transformers are dried and filled with filtered insulating fluid under vacuum, while secondary windings are energized. Coils are heated to drive out moisture, ensuring maximum penetration of fluid into the coil insulation system.

### Cooling system

Less flammable fluid filled-Air cooling (KNAN) is provided with transformers rated 500 kVA. A choice of KNAN/ Future KNAF (Future Forced-Air) or KNAN/KNAF (Forced-Air) cooling is provided with units rated 750 kVA and above.

### Insulating fluid

Eaton offers Envirotemp™ FR3™ fluid or electrical grade mineral insulating oil in its Cooper Power series transformers. The highly refined fluids are tested and degassed to assure a chemically inert product with minimal acid ions. Special additives minimize oxygen absorption and inhibit oxidation. To ensure high dielectric strength, the fluid is re-tested for dryness and dielectric strength, refiltered, heated, dried, and stored under vacuum before being added to the completed transformer.

Transformers filled with Envirotemp™ FR3™ fluid enjoy unique fire safety, environmental, electrical, and chemical advantages, including insulation life extending properties.

A bio-based, sustainable, natural ester dielectric coolant, Envirotemp™ FR3™ fluid quickly and thoroughly biodegrades in the environment and is non-toxic per acute aquatic and oral toxicity tests.

Building for Environmental and Economic Sustainability (BEES) total life cycle assessment software, utilized by the US Dept. of Commerce, reports its overall environmental performance impact score at 1/4th that reported for mineral oil. Envirotemp™ FR3™ fluid has also earned the EPA Environmental Technology Verification of transformer materials.

With a fire point of 360 °C, Envirotemp™ FR3™ fluid is FM Approved® and Underwriters Laboratories® Classified "Less-Flammable" per NEC® Article 450-23, fitting the definition of a Listed Product per NEC®.

## Substation VFI transformer

Eaton combines a conventional distribution transformer from its Cooper Power series transformers with the proven vacuum fault interrupter (VFI) to offer the VFI transformer. This combination provides both voltage transformation and transformer over current protection in one space saving and money saving package. The substation VFI transformer protects the transformer and provides proper coordination with upstream protective devices. When a transformer fault or overload condition occurs, the VFI breaker trips and isolates the transformer.

The three-phase VFI breaker has independent single-phase initiation, but is three-phase mechanically gang-tripped. A trip signal on any phase will open all three phases. This feature eliminates single-phasing of three-phase loads. It also enables the VFI breaker to be used as a three-phase load break switch.

Thanks to the resettable characteristics of the VFI breaker, restoring three-phase service is quick and simple.

The sealed visible break window and switch is an option that can be installed to provide visible break contact. This feature provides enhanced safety and allows an operator to see if the contacts are in an open or closed position on the VFI before performing maintenance.

## Envirotran™ FM Approved® transformer

Eaton's Cooper Power series Envirotran™ transformer is FM Approved® and suitable for indoor locations. FM Global® approval of the Envirotran transformer line makes it easy to comply and verify compliance with Section 450.23, 2014 NEC®, Less-Flammable Liquid-Filled Transformer Requirements for both indoor and outdoor locations.

FM Approved® Envirotran transformers offer the user the benefit of a transformer that can be easily specified to comply with NEC® and makes FM Global® Property Loss Prevention Data Sheet compliance simpler, while also providing maximum safety and flexibility for both indoor and outdoor installations.

Since the "FM Approved®" logo is readily visible on the transformer and its nameplate, NEC® compliance is now easily verifiable by the inspector.

Substation Envirotran FM Approved® transformers, part of Eaton's Cooper Power series transformers, are manufactured under strict compliance with FM Standard 3990 and are filled with FM Approved® Envirotemp™ FR3™ fluid, a fire-resistant dielectric coolant.

## ABS® type approved substation transformers

Eaton's Cooper Power series transformers offer liquid-filled substation and padmounted distribution-class transformers from 0.5 to 10 MVA with type-approved certification from the American Bureau of Shipping (ABS®) for marine and off-shore applications.

## Multi-tap transformers

Our multi-tap transformers step-up the low voltage output from a Variable Speed Drive (VSD) to power your electric submersible pumps (ESP). With 25 different voltage settings in both delta and wye connections, our transformers can meet a wide variety of pump applications. Multi-tap transformers are available with both mineral oil and Envirotemp™ FR3™ fluid and can be specified as UL® Listed & Labeled. See *Product Aid PA202001EN, Multi-tap Transformers* for details.

## Specialty designs

### Hardened data center

Envirotran Hardened Data Center (HDC) transformers are designed for critical Data Center power delivery where the absolute highest reliability is required and where mere "Industry Standard" isn't good enough! Envirotran HDC liquid filled transformers are engineered with higher electrical withstand, increased levels of insulation, and greater electrical clearance. All Envirotran HDC transformers are subjected to a more stringent series of factory tests which include a higher BIL withstand than standards dictate for its kV rating and special assurance tests for sealing integrity. Furthermore, Envirotran HDC transformers are provided with biobased Envirotemp™ FR3™ fluid that carries Factory Mutual rated fire resistance, provides extended insulation life, and ultimate biodegradability. All of these characteristics far surpass those of more traditional dry type transformers. Rest assured, Envirotran HDC will deliver the highest standard of reliability, quality, and performance available in the industry today. See *Bulletin B210-10035, Data Center Solutions* for details.

### Grounding transformers

Eaton offers customized grounding transformers for applications where a ground path needs to be introduced to a system.

### Hazardous locations (Class I Division 2)

Hazardous locations can be defined as areas where combustible materials are present. Eaton is offering UL® Listed explosion proof designs that prevent gasses from coming in contact with switching arcs. These explosion proof control boxes are made of cast aluminum and are designed to contain an arc.

### Underwriters Laboratories® (UL®) Listed & Labeled/Classified

Eaton's Cooper Power series Envirotran transformer can be specified as UL® Listed & Labeled and/or UL® Classified.

Underwriters Laboratories (UL®) listing is a verification of the design and construction of the transformer to the ANSI® and IEEE® standards. UL® listing generally is the most efficient, cost-effective solution for complying with relevant state and local electrical codes.

UL® Combination Classification/Listing is another way in which to comply with Section 450.23, 2014 NEC® requirements. This combines the UL® listed transformer with a UL® Classified Less-Flammable Liquid and complies with the use restrictions found within the liquid Classification.

### K-factor

Eaton can design transformers with appropriate K-factor correction to mitigate the effects of non-linear harmonic loading conditions.

### Solar/wind designs

Eaton is offering custom designs for renewable energy power generation. Eaton's manufactures its Cooper Power series Generator Step-Up (GSU) transformers for use at the base of each wind turbine. Additionally, grounding transformers are available for wind power generation. For the solar photovoltaic industry, Eaton is offering inverter step-up transformers, as well as dual secondary designs to isolate a two-inverter input.



## Special protection features

### Vacuum fault interrupter (VFI)

- Provides resettable over current protection using reliable vacuum bottle interrupters
- Utilizes Tri-Phase electronic controller which allows tripping of all three phases upon sensing a fault condition
- Eaton offers intelligent solutions for enhancing the capabilities of the Tri-phase controller
- Tri-Phase with Ground Trip Technology (TPG):

Incorporates separate zero sequence circuit and settings for special applications where increased sensitivity and speed is required in detecting ground fault and phase loading imbalance conditions. Package includes standard Tri-Phase control features with an option for SCADA.

- Relays
  - iDP-210 relay: Full featured, multi-function programmable relay includes Phase currents and Event Recorder data and trip signal to LV Circuit breaker (by others)
  - XP-420 relay: Provides all the protection features of iDP-210 relay with the addition of ANSI<sup>®</sup> Device#87

### Primary air disconnect switch

- Provides economical, visible disconnect primary load break switching
- Fully coordinated and packaged with the transformer
- Meets IEEE Std C37.20.3<sup>™</sup>-2013 standard, NEMA<sup>®</sup> SG-5 and related standards
- Standard features
  - Switch
    - Three-pole, two-position, gang-operated air interrupter, unfused
- Standard ratings
  - 600 A continuous and load break; 40 kA fault close and momentary
  - 5 kV (60 kV BIL) or 15 kV (95 kV BIL)
- Enclosure
  - Standardized modular self supporting, bolted design
  - Mechanical safety interlock prevents access when switch is closed or closing of switch when door is open
- Optional Features
  - 1200 A continuous and load break current rating; 61 kA fault close and momentary. Requires 1200 A copper bus option.
  - Key interlocks (single cylinder) for interlocking primary switch with secondary main circuit protective device
  - Auxiliary switch for remote indication of primary switch position
  - Where high interrupting ratings and short-circuit protection are desired: current-limiting non-expulsion power fuses
  - Where lower interrupting ratings are adequate:
    - Non-disconnect power fuses
    - Disconnect power fuses

## Testing

Eaton performs routine testing on each transformer manufactured including the following tests:

- **Ratio, Polarity, and Phase Relation:** Ensures correct winding ratios and tap voltages; checks insulation of HV and LV circuits. Checks entire insulation system to verify all live-to-ground clearances.
- **Winding Resistance:** This test verifies the integrity of internal high-voltage and low-voltage connections; provides data for loss upgrade calculations.
- **Insulation Power Factor:** This test verifies that vacuum processing has thoroughly dried the insulation system to required limits.
- **Routine Impulse Tests:** The most severe test, simulating a lightning surge. Applies one reduced wave and one full wave to verify the BIL rating.
- **Applied Potential:** Applied to both high-voltage and low-voltage windings, this test stresses the entire insulation system to verify all live-to-ground clearances.
- **Induced Potential:** This test verifies the turn-to-turn and layer-to-layer insulation at twice the rated voltage.
- **Loss Test:** These design verification tests are conducted to ensure that guaranteed loss values are met and that test values are within design tolerances. Tests include no-load loss and excitation current along with impedance voltage and load loss.
- **Leak Test:** Pressurizing the tank to 5 psig assures a complete seal, with no weld or gasket leaks, to eliminate the possibility of moisture infiltration or oil oxidation.

### Design performance tests

Design performance tests include the following:

- **Temperature Rise:** Our automated heat run facility ensures that any design changes meet ANSI<sup>®</sup> and IEEE<sup>®</sup> temperature rise criteria.
- **Audible Sound Level:** Ensures compliance with NEMA<sup>®</sup> requirements.
- **Lightning Impulse:** To assure superior dielectric performance, this test consists of one reduced wave, two chopped waves and one full wave in sequence across the medium voltage windings, precisely simulating the harshest conditions.

### Optional tests

The following tests are available for purchase:

- Zero sequence impedance
- RIV (Corona)
- Extended leak test
- Dissolved gas analysis (DGA)
- PCB fluid testing
- Fluid dielectric strength
- Detection of sulfur dioxide

## Thomas A Edison Technical Center

We are constantly striving to introduce new innovations to the transformer industry, bringing you the highest quality transformer for the lowest cost. Eaton's Cooper Power series Transformer Products are ISO 9001 compliant, emphasizing process improvement in all phases of design, manufacture, and testing. We have invested millions of dollars in the Thomas A. Edison Technical Center, our premier research facility in Franksville, Wisconsin affirming our dedication to introducing new innovations and technologies to the transformer industry. This research facility is fully available for use by our customers to utilize our advanced electrical and chemical testing labs.



Figure 20. Substation transformer with visible break technology.



Figure 22. Triplex Indoor Power Center comprised of energy efficient and low noise single-phase substation transformers in a ganged setup.



Figure 21. Substation transformer with customer-specific coordination and accessories.



Figure 23. Class I Div 2 hazardous duty substation transformer.

**Eaton**

1000 Eaton Boulevard  
Cleveland, OH 44122  
United States  
Eaton.com

**Eaton's Power Systems Division**

2300 Badger Drive  
Waukesha, WI 53188  
United States  
Eaton.com/cooperpowerseries

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