

Eaton's Cooper Power Systems catalog  
Pad-mount & substation transformers

# Pad-mount & substation transformers

Catalog information

**Cooper  
Power Systems**  
by **EAT•N**

# Pad-mount & substation transformers catalog contents

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# Single-phase pad-mounted distribution transformers



## General

Eaton's Cooper Power Systems manufactures a complete line of single-phase pad-mounted distribution transformers. They are available in standard ratings and configurations or can be customized to meet specific needs.

Single-phase transformers are available as Shrubline™, MaxiShrub™, and Ranch Runner™ transformers (shown above in order). All of these distribution transformers are oil-insulated, self-cooled, available in loop or radial feed, and are dead-front.

Both the Shrubline and MaxiShrub transformer versions are manufactured with ratings from 10-167 kVA. All of these transformers meet or exceed ANSI®, IEEE® and NEMA® standards.

The Shrubline transformer from Eaton's Cooper Power Systems is a Type-2 single-phase dead-front pad-mounted transformer. The low profile design blends visually with surroundings—shrubs, low hedges, and home air conditioners—making it ideal for residential applications.

The MaxiShrub transformer from Eaton's Cooper Power Systems is an ANSI® and IEEE® Type-1

single-phase dead-front pad-mounted transformer. The ANSI® and IEEE® Type-1 frontplate arrangement allows vertical feed to the primary and secondary bushings. It is ideal for single-phase industrial and residential applications where a wide range of kVAs or heavy cabling is required.

The Ranch Runner transformer is manufactured with ratings from 10-50 kVA. It is Rural Utilities Services (RUS) approved, and meets all ANSI® and IEEE® requirements except frontplate arrangements. The Ranch Runner transformer is a very compact pad-mounted transformer. Its compact design makes it ideal for irrigation, oil field and residential applications. It offers an economical design which provides standard transformer capabilities in a very compact space. This unit is shipped complete with its own poly-pad suitable for shipping and installation.

Eaton's Cooper Power Systems offers poly-pads that are usable with most transformers conforming to ANSI® C57.12.25-1990 standard (Type-1 or Type-2). This polymer pad serves as a shipping pallet as well as an installation pad.

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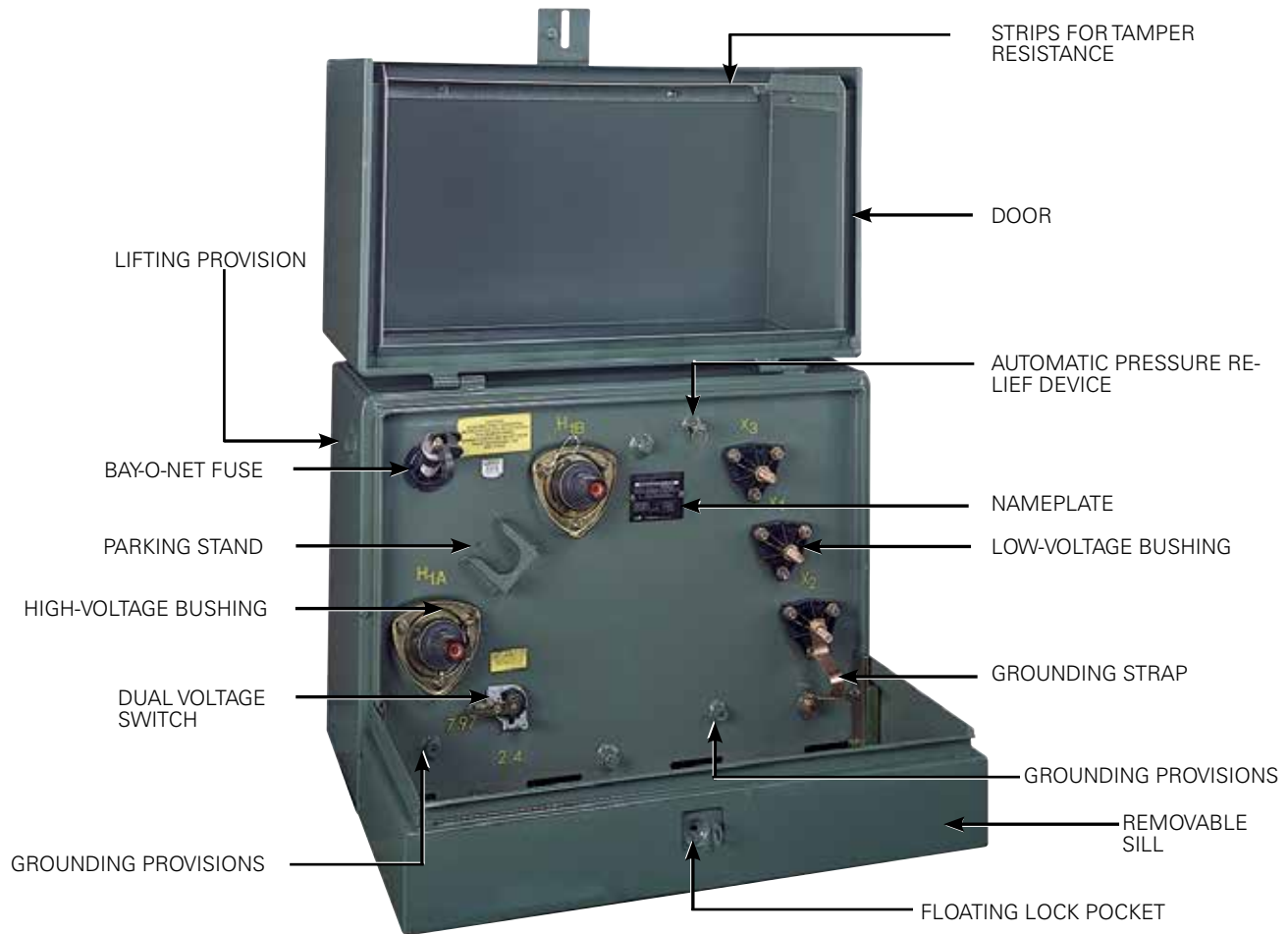


Figure 1. Shrubline single-phase pad-mounted transformer.

### Standard features

- Meet or exceeds ANSI®, IEEE® and NEMA® standards
- Meets DOE Energy Efficiency Standard 10 CFR Part 431 for distribution transformers
- Tank coating exceeds IEEE Std C57.12.28™-2005 and IEEE Std C57.12.29™-2005 standards (stainless steel units only)
- Full compliance with IEEE Std C57.12.28™-2005 standard enclosure integrity requirements
- Laser engraved nameplate
- Recessed stainless steel lifting provisions
- Tank grounding provisions
- Automatic pressure relief device
- Electrical grade mineral oil
- Hinged door with stainless steel hinge pins and barrels
- Floating lock pocket for easy alignment
- Captive stainless steel pentahead door locking bolt
- Oil fill and drain provisions
- Removable sill
- Welded domed tank cover
- High-voltage bushing wells - 200 A

- Ground strap from X2 to tank ground
- Tamper strips of noncorrosive material
- Decal bushing designations
- Quality System ISO 9001 certified

### Optional features

- Various multiple voltages or taps
- Externally-operable multiple voltage or tap changer switches for safe operation
- Stainless steel tank, tank bottom, sill, door, and/or hardware
- Service entrance in sill
- Various spades and terminals available for secondary bushings
- High efficiency transformers at 0.05% above DOE efficiency or higher
- Stencilled bushing designations
- Various other designations available, e.g., kVA, voltages, fuse number
- High-voltage bushing inserts
- Ground connectors
- Captive stainless steel hexhead door locking bolt
- RUS design

- One piece high-voltage bushings
- High-voltage bushing wells with removable studs
- Envirotemp™ FR3™ fluid where less-flammable fluid is required and where superior environmental characteristics are desired
- Canadian Standards Association (CSA) and Consumer Electronics Association (CEA) designs
- Special designs to meet international specifications are also available
- Loadbreak switches<sup>1</sup>
- Drain/sampling valve<sup>1</sup>
- Pressure vacuum gauge<sup>1</sup>

- Liquid level gauge<sup>1</sup>
- Temperature gauge<sup>1</sup>
- Combination shipping and installation poly-pad<sup>3</sup>

<sup>1</sup> Not available with the Ranch Runner.

<sup>2</sup> Only available with ANSI®and/or IEEE® Type -2 front plate configurations.

<sup>3</sup> Standard with the Ranch Runner transformer.

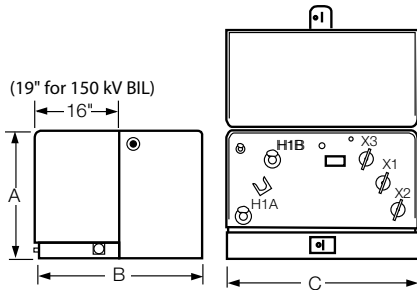
### Single-phase pad-mounted shrubline transformer

**Product Scope:**

kVA: 10-167

Primary Voltage: 2400-19,920 V

Secondary Voltage: 120-600 V



**Figure 2. Single-phase pad-mounted Shrubline.**

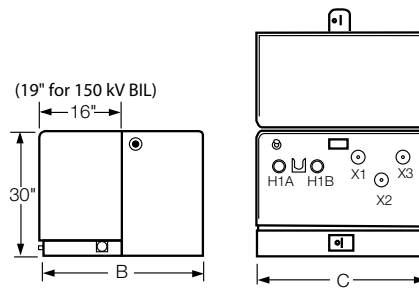
### Single-phase pad-mounted maxishrub transformer

**Product Scope:**

kVA: 10-167

Primary Voltage: 2400-19,920 V

Secondary Voltage: 120-600 V



**Figure 3. Single-phase pad-mounted MaxiShrub.**

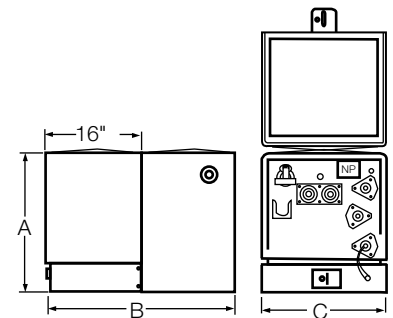
### Single-phase pad-mounted ranch runner transformer

**Product Scope:**

kVA: 10-50

Primary Voltage: 2400-14,400 V

Secondary Voltage: 120-600 V



**Figure 4. Single-phase pad-mounted Ranch Runner.**

**Table 1. Typical Dimensions and Weights<sup>3</sup>**

kVA	Dimensions (in.)			Approx. Weight (lbs.)
	"A"	"B"	"C"	
10	24	29 <sup>1</sup>	33	600
15	24	29 <sup>1</sup>	33	625
25	24	29 <sup>1</sup>	33	650
37.5	24	30 <sup>1</sup>	33	700
50	24	32 <sup>1</sup>	33	750
75	24	34 <sup>1</sup>	33	1000
100	30	37 <sup>1</sup>	36	1150
167	30	47 <sup>1,2</sup>	36	1650

<sup>1</sup> Add 3" for 150 kV BIL

<sup>2</sup> Includes corrugate

<sup>3</sup> Weights, gallons of fluid and dimensions are for reference only, and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.

**Table 2. Typical Dimensions and Weights<sup>3</sup>**

kVA	Dimensions (in.)		Approx. Weight (lbs.)
	"B"	"C"	
10	28 <sup>1</sup>	33-36	700
15	38 <sup>1</sup>	33-36	700
25	28 <sup>1</sup>	33-36	700
37.5	28 <sup>1</sup>	33-36	750
50	30 <sup>1</sup>	33-36	800
75	32 <sup>1</sup>	33-36	1000
100	34 <sup>1</sup>	36	1150
167	46 <sup>1,2</sup>	36	1650

<sup>1</sup> Add 3" for 150 kV BIL

<sup>2</sup> Includes corrugate

<sup>3</sup> Weights, gallons of fluid and dimensions are for reference only, and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.

**Typical Dimensions and Weights<sup>1</sup>**

kVA	Dimensions (in.)			Approx. Weight (lbs.)
	"A"	"B"	"C"	
10	24	28.5	21	400
15	24	28.5	21	500
25	24	32.5	21	600
37.5	24	35.5	21	650
50	24	35.5	21	720

<sup>1</sup> Weights, gallons of fluid and dimensions are for reference only, and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.

## Protection options

- Bay-O-Net expulsion fuse with Flapper™ valve
- Bay-O-Net and partial range current-limiting fuses
- Weak link fuse
- Weak link and partial range current-limiting fuses
- Secondary breaker with weak link1
- MagneX™ interrupter with isolation link1
- MagneX interrupter with partial range current-limiting fuse1
- Under-oil high-voltage MOV arrester1
- Low-voltage distribution-class MOV arrester, internally or externally mounted
- Vacuum Fault Interrupter (VFI) for electronic breaker trip control2

1 Not available with the Ranch Runner.

2 Only available with ANSI® and/or IEEE® Type -2 front plate configurations.

## Single-phase VFI transformer

The VFI transformer combines a conventional Eaton's Cooper Power Systems distribution transformer with the proven Vacuum Fault Interrupter (VFI). This combination provides both voltage transformation and overcurrent protection in one space-saving, money-saving package.

The single-phase pad-mounted VFI transformer with loop protection is designed to protect the loop or downstream section of a feeder, and provide proper coordination with upstream and downstream protective devices. In this configuration, when a fault occurs downstream, the VFI trips and isolates the fault, leaving the transformer load uninterrupted.

The VFI breaker has an interrupting rating that far exceeds standard riser pole fuses, enabling better fault clearing coordination and thereby minimizing outage area. Because it is resettable, fault locating is simplified and outage time is reduced.

## Poly-pad

Eaton's Cooper Power Systems offers a poly-pad that is usable with most transformers conforming to ANSI® C57.12.25-1990 standard (Type-1 or Type-2). This polymer pad enables transformers to be shipped and installed on the same pad. Use of the poly-pad can eliminate the purchasing, inventory, and administrative costs associated with conventional concrete, polymer or fiberglass pads. Installation costs can also be significantly reduced since the transformer is pre-mounted to its pad. These forkliftable units can be transported damage free during shipping and handling.

## Quality control

Single-phase pad-mounted distribution transformers manufactured by Eaton's Cooper Power Systems provide outstanding performance.

All transformers from Eaton's Cooper Power Systems pass routine tests as prescribed per ANSI® and IEEE® prior to shipment.

MaxiShrub ANSI® and IEEE® Type-1, Shrubline ANSI® and IEEE® Type-2 and Ranch Runner designs are in full compliance with IEEE Std C57.12.28™-2005 standard security requirements.

Corrosion resistance is optimized with the utilization of a superior coating system, combined with the strategic use of stainless steel material, and a tank designed to reduce the retention of water. Our coating systems exceed IEEE Std C57.12.28™-2005 and IEEE Std C57.12.29™-2005 standards. Stainless steel components include door hinge pins and barrels, parking stands, mounting studs, and recessed lifting provisions.

Door and tank covers are permanently domed to eliminate retention of water. All external parts are full-welded to eliminate corrosion caused by moisture entrapment. Bumper pads on doors reduce shipping damage. Lifting provisions are recessed to reduce damage during handling.

The Quality System at Eaton's Cooper Power Systems Transformer Products is ISO 9001 certified.

## Fluid options

Transformers can be filled with standard electrical grade mineral insulating oil, Envirotemp™ FR3™ fluid, or other dielectric coolants.

For fire-sensitive locations, Envirotemp™ FR3™ fluid, a fire resistant natural ester-based fluid is recommended. Envirotemp™ FR3™ fluid also offers the benefits of a soy oil-based dielectric coolant that is sustainable and has unique environmental and material properties in addition to increased fire safety over conventional mineral oil.

Check with Eaton's Cooper Power Systems for the availability of other dielectric coolants in single-phase, pad-mounted transformers.

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For Eaton's Cooper Power Systems single-phase pad-mounted transformer product information call 1-877-277-4636 or visit: [www.cooperpower.com](http://www.cooperpower.com).

# PEAK™ single-phase pad-mounted distribution transformers



## General

PEAK™ transformers from Eaton's Cooper Power Systems are a class of transformer technologies that are designed to improve performance in terms of kVA rating, compact dimensions, lighter weight, safety, and sustainability. Conventional transformers operate at 65 °C for the Average Winding Rise (AWR) at full load. PEAK transformers are currently available with ratings up to 75 °C AWR.

PEAK transformers are ANSI® compliant, available with all current conventional transformer options and are backed by Eaton's Cooper Power Systems quality control assurances. They are offered in either 65/75 °C slash rated or 75 °C rise rated configurations. A 65/75 °C rated PEAK transformer is comparable in size to a conventional transformer but has nameplated overload capability. A 75 °C rise rated PEAK transformer is smaller in size but delivers the same kVA as its conventional counterpart.

All PEAK transformers use Envirotemp™ FR3™ dielectric fluid as their cooling fluid. Envirotemp™ FR3™ has a higher flash point than conventional transformer fluids which increases PEAK transformer's fire protection. Envirotemp™ FR3™ fluid increases the life span of the core and fluid insulation to a point where the overall life expectancy of PEAK transformers is significantly increased. Envirotemp™ FR3™ fluid is also a green product that has nearly neutral carbon footprint.

PEAK transformers are available in Shrubline™, MaxiShrub™, and Ranch Runner™ styles. All of these distribution transformers are filled with Envirotemp™ FR3™ fluid, self-cooled, available in loop or radial feed, and are dead-front. They are available in standard ratings and configurations or can be customized to meet specific needs.

Transformers shown above (left to right) include the PEAK shrubline, PEAK MaxiShrub and PEAK Ranch Runner style transformers.

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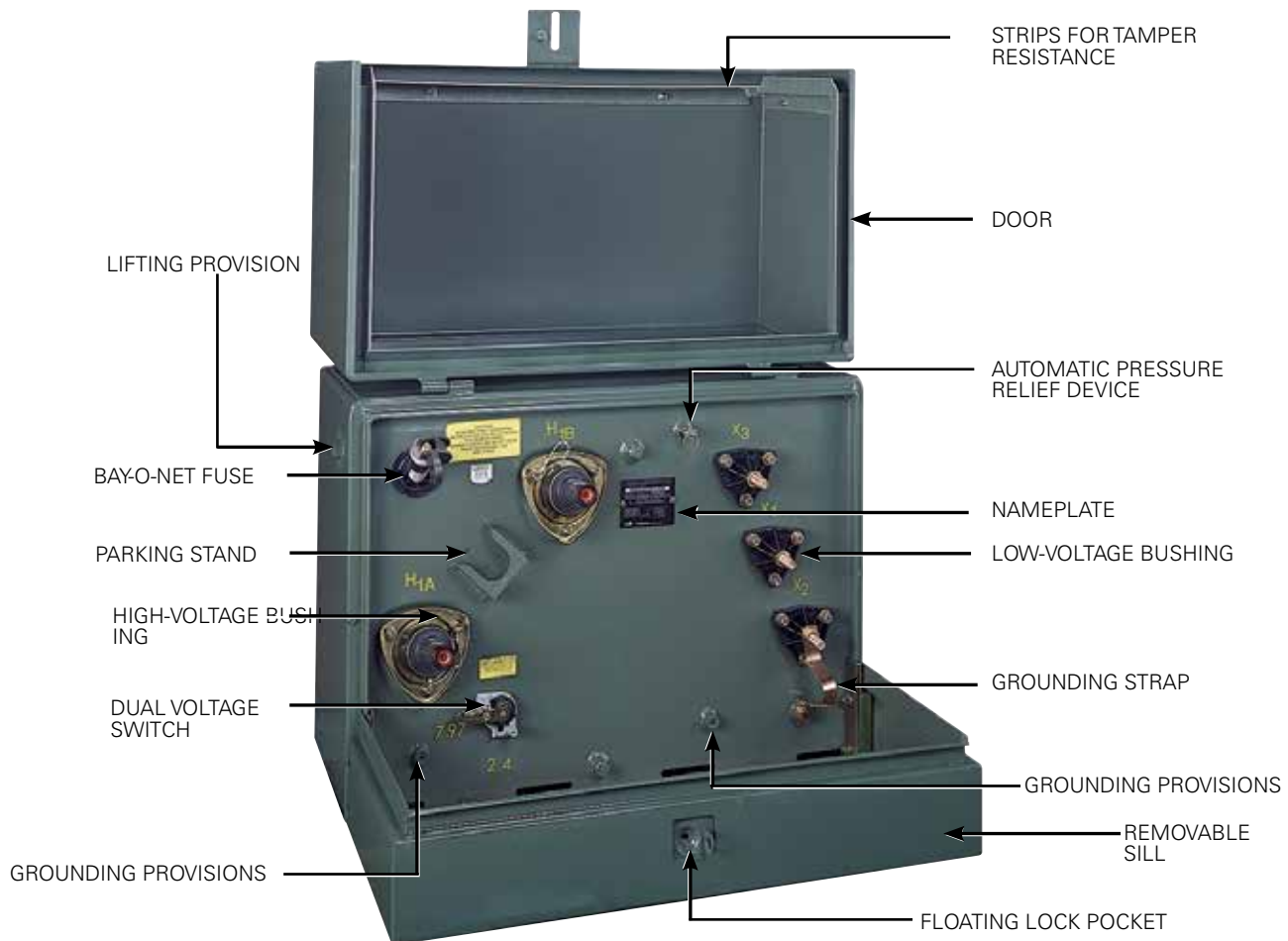


Figure 1. PEAK single-phase pad-mounted transformer, Shrubline style.

Both the PEAK transformer, Shrubline and MaxiShrub styles are manufactured with ratings from 10-167 kVA. All of these transformers meet or exceed ANSI®, IEEE® and NEMA® standards.

The PEAK transformer in the Shrubline style is a Type-2 single-phase dead-front pad-mounted transformer. The low profile design blends visually with surroundings-shrubs, low hedges, and home air conditioners-making it ideal for residential applications.

The PEAK transformer in the MaxiShrub style is an ANSI® and IEEE® Type-1 single-phase dead-front pad-mounted transformer. The ANSI® and IEEE® Type-1 frontplate arrangement allows vertical feed to the primary and secondary bushings. It is ideal for single-phase industrial and residential applications where a wide range of kVAs or heavy cabling is required.

The PEAK transformer in the Ranch Runner style is manufactured with ratings from 10-50 kVA. It is Rural Utilities Services (RUS) approved, and meets all ANSI® and IEEE® requirements except frontplate arrangements. The PEAK transformer, Ranch Runner style, is a very compact pad-mounted transformer. Its compact design makes it ideal for irrigation, oil field and residential applications. It offers an economical design which provides standard transformer capabilities in a very compact space. This unit is shipped complete with its own poly-pad suitable for shipping and installation.

Cooper Power Systems offers poly-pads that are usable with most transformers conforming to ANSI C57.12.25™ -1990 standard (Type-1 or Type-2). This polymer pad serves as a shipping pallet as well as an installation pad.

### Standard features

- Meet or exceeds ANSI/IEEE and NEMA standards
- Meets DOE Energy Efficiency Standard 10 CFR Part 431 for distribution transformers
- Envirotemp™ FR3™ fluid
- Tank coating exceeds IEEE Std C57.12.28™-2005 and IEEE Std C57.12.29™-2005 standards (stainless steel units only)
- Full compliance with IEEE Std C57.12.28™-2005 standard enclosure integrity requirements
- Laser engraved nameplate
- Recessed stainless steel lifting provisions
- Tank grounding provisions
- Automatic pressure relief device
- Hinged door with stainless steel hinge pins and barrels
- Floating lock pocket for easy alignment
- Captive stainless steel pentahead door locking bolt
- Fluid fill and drain provisions
- Removable sill
- Welded domed tank cover
- High-voltage bushing wells - 200 A
- Ground strap from X2 to tank ground
- Tamper strips of noncorrosive material
- Decal bushing designations
- Quality System ISO 9001 certified



**Optional features**

- Various multiple voltages or taps
- Externally-operable multiple voltage or tap-changer switches for safe operation
- Stainless steel tank, tank bottom, sill, door, and/or hardware
- Service entrance in sill
- Various spades and terminals available for secondary bushings
- High efficiency transformers at 0.05% above U.S. Department of Energy (DOE) efficiency or higher
- Stencilled bushing designations
- Various other designations available, e.g., kVA, voltages, fuse number
- High-voltage bushing inserts
- Ground connectors
- Captive stainless steel hexhead door locking bolt
- Rural Utilities Service (RUS) design

- One piece high-voltage bushings
- High-voltage bushing wells with removable studs
- Canadian Standards Association (CSA) and Consumer Electronics Association (CEA) designs
- Special designs to meet international specifications are also available
- Loadbreak switches<sup>1</sup>
- Drain/sampling valve<sup>1</sup>
- Pressure vacuum gauge<sup>1</sup>
- Liquid level gauge<sup>1</sup>
- Temperature gauge<sup>1</sup>
- Combination shipping and installation poly-pad<sup>3</sup>

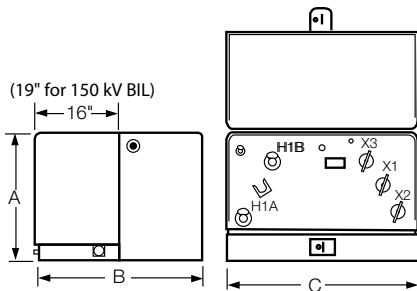
<sup>1</sup> Not available with the PEAK transformer, Ranch Runner style .  
<sup>2</sup> Only available with ANSI® and IEEE® Type -2 front plate configurations.  
<sup>3</sup> Standard with the PEAK transformer, Ranch Runner style.

**PEAK transformer dimensions and weights**

**Shrubline-style**

**Product Scope:**

kVA: 10-167  
 Primary Voltage: 2400-19,920 V  
 Secondary Voltage: 120-600 V

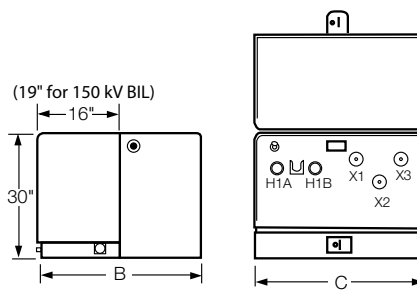


**Figure 2. PEAK single-phase pad-mounted transformer, Shrubline style.**

**MaxiShrub-style**

**Product Scope:**

kVA: 10-167  
 Primary Voltage: 2400-19,920 V  
 Secondary Voltage: 120-600 V

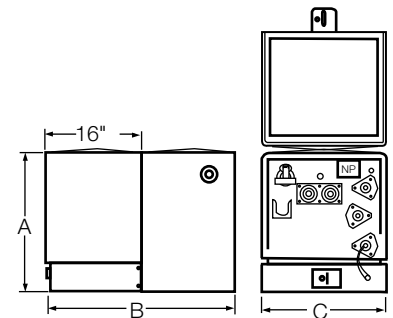


**Figure 3. PEAK single-phase pad-mounted transformer, MaxiShrub style.**

**Ranch Runner-style**

**Product Scope:**

kVA: 10-50  
 Primary Voltage: 2400-14,400 V  
 Secondary Voltage: 120-600 V



**Figure 4. PEAK single-phase pad-mounted transformer, Ranch Runner style.**

**Table 1. Typical Dimensions and Weights<sup>3</sup>**

kVA	Dimensions (in.)			Approx. Weight (lbs.)
	"A"	"B"	"C"	
10	24	28 <sup>1</sup>	33	580
15	24	28 <sup>1</sup>	33	610
25	24	28 <sup>1</sup>	33	630
37.5	24	29 <sup>1</sup>	33	680
50	24	31 <sup>1</sup>	33	730
75	24	33 <sup>1</sup>	33	970
100	30	36 <sup>1</sup>	36	1120
167	30	46 <sup>1,2</sup>	36	1600

<sup>1</sup> Add 3" for 150 kV BiL  
<sup>2</sup> Includes corrugate  
<sup>3</sup> Weights, gallons of fluid and dimensions are for reference only, and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.

**Table 2. Typical Dimensions and Weights<sup>3</sup>**

kVA	Dimensions (in.)		Approx. Weight (lbs.)
	"B"	"C"	
10	27 <sup>1</sup>	33-36	680
15	27 <sup>1</sup>	33-36	680
25	27 <sup>1</sup>	33-36	680
37.5	27 <sup>1</sup>	33-36	730
50	29 <sup>1</sup>	33-36	780
75	31 <sup>1</sup>	33-36	970
100	33 <sup>1</sup>	36	1120
167	45 <sup>1,2</sup>	36	1600

<sup>1</sup> Add 3" for 150 kV BiL  
<sup>2</sup> Includes corrugate  
<sup>3</sup> Weights, gallons of fluid and dimensions are for reference only, and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.

**Table 3. Typical Dimensions and Weights<sup>1</sup>**

kVA	Dimensions (in.)			Approx. Weight (lbs.)
	"A"	"B"	"C"	
10	24	27.5	21	390
15	24	27.5	21	485
25	24	31.5	21	580
37.5	24	34.5	21	630
50	24	34.5	21	700

<sup>1</sup> Weights, gallons of fluid and dimensions are for reference only, and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.

## Protection options

- Bay-O-Net expulsion fuse with Flapper™ valve
- Bay-O-Net and partial range current-limiting fuses
- Weak link fuse
- Weak link and partial range current-limiting fuses
- Secondary breaker with weak link<sup>1</sup>
- MagneX™ interrupter with isolation link<sup>1</sup>
- MagneX interrupter with partial range current-limiting fuse<sup>1</sup>
- Internal, under-oil VariSTAR™ surge arrester
- Storm Trapper™ H.E. (High Energy), low-voltage distribution-class surge arrester, internally or externally mounted<sup>1</sup>

<sup>1</sup> Not available with the PEAK transformer, Ranch Runner-style.

## Poly-pad

Eaton's Cooper Power Systems offers a poly-pad that is usable with most transformers conforming to ANSI C57.12.25™-1990 standard (Type-1 or Type-2). This polymer pad enables transformers to be shipped and installed on the same pad. Use of the poly-pad can eliminate the purchasing, inventory, and administrative costs associated with conventional concrete, polymer or fiberglass pads. Installation costs can also be significantly reduced since the transformer is pre-mounted to its pad. These forkliftable units can be transported damage free during shipping and handling.

## Quality control

PEAK single-phase pad-mounted distribution transformers manufactured by Eaton's Cooper Power Systems provide outstanding performance.

PEAK transformers from Eaton's Cooper Power Systems pass routine tests as prescribed per ANSI® and IEEE® prior to shipment.

PEAK transformers offered in the MaxiShrub style ANSI® and IEEE® Type-1, Shrubline style ANSI® and IEEE® Type-2 and Ranch Runner style designs are in full compliance with IEEE Std C57.12.28™-2005 standard security requirements.

Corrosion resistance is optimized with the utilization of a superior coating system, combined with the strategic use of stainless steel material, and a tank designed to reduce the retention of water. Our coating systems exceed IEEE Std C57.12.28™-2005 and IEEE Std C57.12.29™-2005 standards stainless steel components include door hinge pins and barrels, parking stands, mounting studs, and recessed lifting provisions.

Door and tank covers are permanently domed to eliminate retention of water. All external parts are full-welded to eliminate corrosion caused by moisture entrapment. Bumper pads on doors reduce shipping damage. Lifting provisions are recessed to reduce damage during handling.

The Quality System at Eaton's Cooper Power Systems Transformer Products is ISO 9001 certified.

## Additional information

B201-12076, A New Era in Transformer Design Standards

B240-11013, Optimal Overcurrent Transformer Protection

S201-20-1, Instructions for Mineral Oil-Filled, single-Phase Pad-mounted Distribution Transformers

201-50, PEAK Single-Phase Overhead Distribution Transformers

240-34, MagneX Single-Phase Interrupter

235-64, VariSTAR Type AZU Heavy Duty Distribution-Class Under-Oil MOV Arrester

235-16, Storm Trapper H.E. (High Energy) Low-Voltage Distribution-Class MOV Surge Arrester

240-34, Sidewall-Mounted and Cover-Mounted Bay-O-Net Fuse Assembly

240-40, Sidewall-Mounted and Cover-Mounted Bay-O-Net Fuse Assembly

240-45, Current Sensing Bay-O-Net Fuse Link

240-46, Dual Sensing Bay-O-Net Fuse Link

240-48, Dual Element Bay-O-Net Fuse Link

240-31, Oil Immersed Current Sensing Weak Link Cartridge

240-32, Oil Immersed Dual Sensing Weak Link Cartridge

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For Eaton's Cooper Power Systems PEAK transformer product information call 1-877-277-4636 or visit: [www.cooperpower.com](http://www.cooperpower.com).

# Three-phase pad-mounted compartmental type transformer



## General

At Eaton's Cooper Power Systems, we are constantly striving to introduce new innovations to the transformer industry, bringing you the highest quality, most reliable transformers. Eaton's Cooper Power Systems Transformer Products are ISO 9001 compliant, emphasizing process improvement in all phases of design, manufacture, and testing. In order to drive this innovation, we have invested both time and money in the Thomas A. Edison Technical Center, our premier research facility in Franksville, Wisconsin. Headquarters for the Systems Engineering Group of Eaton's Cooper Power Systems, such revolutionary products as distribution-class UltraSIL™ Polymer-Housed Evolution™ surge arresters and Envirotemp™ FR3™ fluid have been developed at our Franksville lab.

With transformer sizes ranging from 45 kVA to 12 MVA and high voltages ranging from 2400 V to 46 kV, Eaton's Cooper Power Systems has you covered. From fabrication of the tanks and cabinets to winding of the cores and coils, to production of arresters, switches, tap changers, expulsion fuses, current limit fuses, bushings (live and dead) and molded rubber goods, Eaton's Cooper Power Systems does it all. Eaton's Cooper Power Systems transformers are available with electrical grade mineral oil or Envirotemp™ FR3™ fluid, a less-flammable and bio-degradable fluid. Electrical codes recognize the advantages of using Envirotemp™ FR3™ fluid both indoors and outdoors for fire sensitive applications. The bio-based fluid meets Occupational Safety and Health Administration (OSHA) and Section 450.23 NEC Requirements.

**Cooper  
Power Systems**  
by **E•T•N**

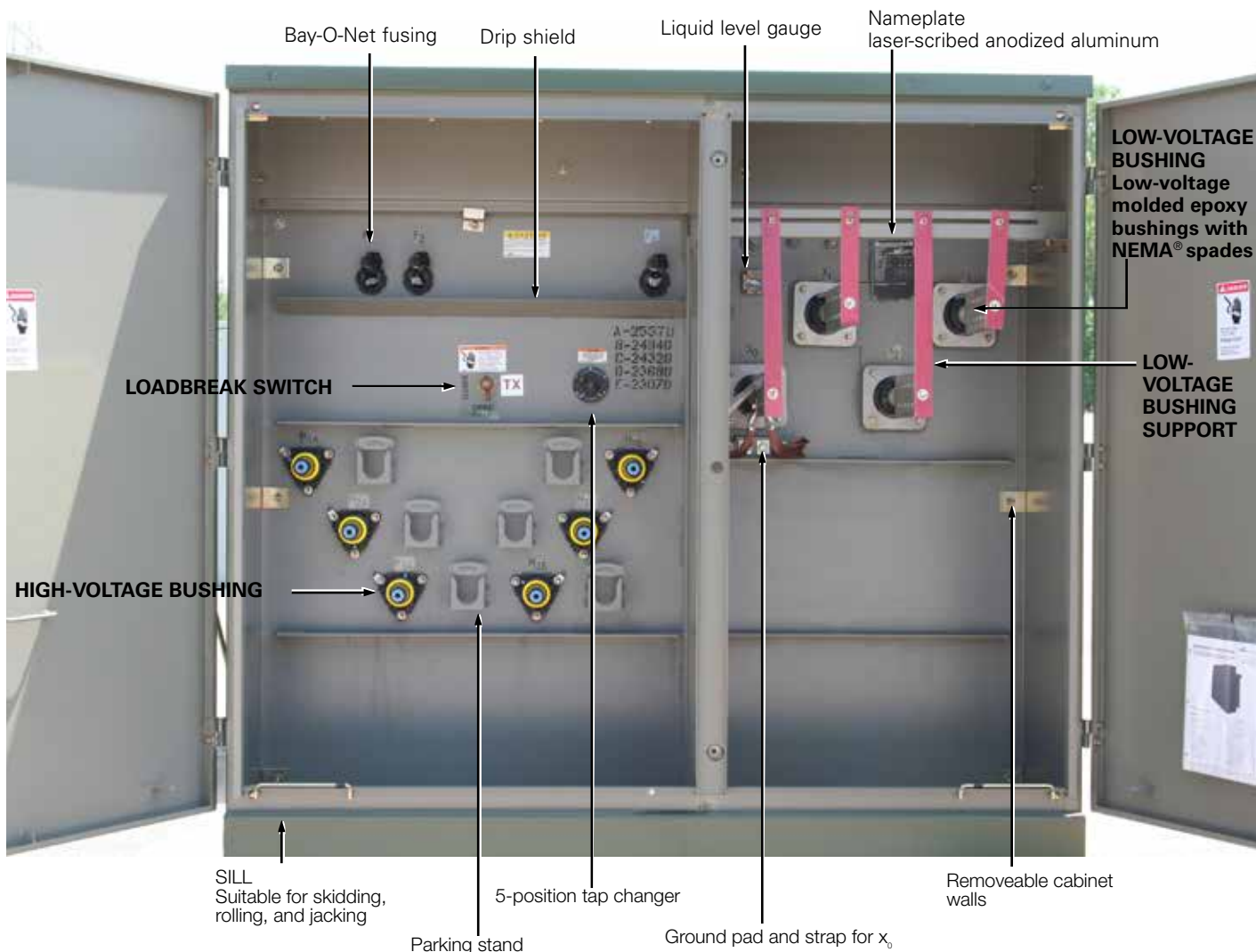


Figure 1. Three-phase pad-mounted compartmental type transformer.

Table 1. Product Scope

<b>Type</b>	Three Phase, 50 or 60 Hz, 65 °C Rise (55 °C, 55/65 °C), 65/75 °C, 75 °C
<b>Fluid Type</b>	Mineral oil or Envirotemp™ FR3™ fluid
<b>Coil Configuration</b>	2-winding or 4-winding or 3-winding (Low-High-Low), 3-winding (Low-Low-High)
<b>Size</b>	45 – 12,000 kVA
<b>Primary Voltage</b>	2,400 – 46,000 V
<b>Secondary Voltage</b>	208Y/120 V to 14,400 V
	Inverter/Rectifier Bridge
	K-Factor (up to K-19)
	Vacuum Fault Interrupter (VFI)
	UL® Listed & Labeled and Classified
<b>Specialty Designs</b>	Factory Mutual (FM) Approved®
	Solar/Wind Designs
	Differential Protection
	Seismic Applications (including OSHPD)
	Hardened Data Center

**Table 2. Three-Phase Ratings**

<b>Three-Phase 50 or 60 Hz</b>
kVA Available: 45, 75, 112.5, 150, 225, 300, 500, 750, 1000, 1500, 2000, 2500, 3000, 3750, 5000, 7500, 10000, 12000
Transformers are available in the standard ratings and configurations shown or can be customized to meet specific needs.

**Table 3. Audible Sound Levels**

<b>Self-Cooled, Two Winding kVA Rating</b>	<b>NEMA® TR-1 Average</b>
	<b>Decibels (dB)</b>
45-500	56
501-700	57
701-1000	58
1001-1500	60
1501-2000	61
2001-2500	62
2501-3000	63
3001-4000	64
4001-5000	65
5001-6000	66
6001-7500	67
7501-12000	68

**Table 4. Insulation Test Levels**

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

**Table 5. Temperature Rise Ratings 0-3300 Feet (0-1000 meters)**

	<b>Standard</b>	<b>Optional</b>
<b>Unit Rating (Temperature Rise Winding)</b>	65 °C	55 °C, 55/65 °C, 75 °C
<b>Ambient Temperature Max</b>	40 °C	50 °C
<b>Ambient Temperature 24 Hour Average</b>	30 °C	40 °C
<b>Temperature Rise Hotspot</b>	80 °C	65 °C

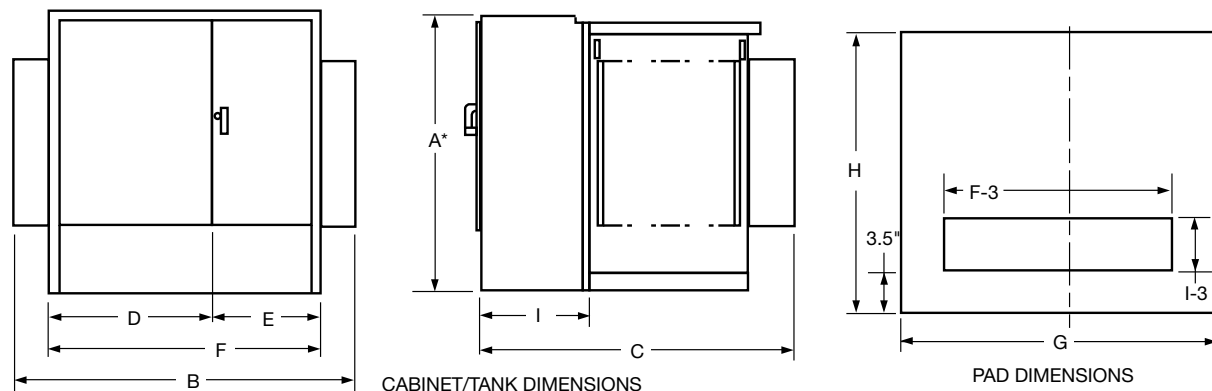


Figure 2. Transformer and pad dimensions.

\* Add 9" for Bay-O-Net fusing.

Table 6. Fluid-filled—aluminum windings 55/65 °C Rise<sup>1</sup>

65° Rise DEAD-FRONT—LOOP OR RADIAL FEED—BAY-O-NET FUSING OIL FILLED—ALUMINUM WINDINGS												
OUTLINE DIMENSIONS (in.)											Gallons of Fluid	Approx. Total Weight (lbs.)
kVA Rating	A*	B	C	D	E	F	G	H	I			
45	50	68	39	42	26	68	72	43	20	110	2,100	
75	50	68	39	42	26	68	72	43	20	115	2,250	
112.5	50	68	49	42	26	68	72	53	20	120	2,350	
150	50	68	49	42	26	68	72	53	20	125	2,700	
225	50	72	51	42	30	72	76	55	20	140	3,150	
300	50	72	51	42	30	72	76	55	20	160	3,650	
500	50	89	53	42	30	72	93	57	20	190	4,650	
750	64	89	57	42	30	72	93	61	20	270	6,500	
1000	64	89	59	42	30	72	93	63	20	350	8,200	
1500	73	89	86	42	30	72	93	90	24	410	10,300	
2000	73	72	87	42	30	72	76	91	24	490	12,500	
2500	73	72	99	42	30	72	76	103	24	530	14,500	
3000	73	84	99	46	37	84	88	103	24	620	16,700	
3750	84	85	108	47	38	85	88	112	24	660	19,300	
5000	84	96	108	48	48	96	100	112	24	930	25,000	
7500	94	102	122	54	48	102	100	126	24	1,580	41,900	

<sup>1</sup> Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.

\* Add 9" for Bay-O-Net fusing.

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

65° Rise DEAD-FRONT—LOOP OR RADIAL FEED—BAY-O-NET FUSING OIL FILLED—COPPER WINDINGS												
OUTLINE DIMENSIONS (in.)											Gallons of Fluid	Approx. Total Weight (lbs.)
kVA Rating	A*	B	C	D	E	F	G	H	I			
45	50	64	39	34	30	64	69	43	20	110	2,100	
75	50	64	39	34	30	64	69	43	20	115	2,350	
112.5	50	64	49	34	30	64	69	53	20	115	2,500	
150	50	64	49	34	30	64	69	53	20	120	2,700	
225	50	64	51	34	30	64	73	55	20	140	3,250	
300	50	64	51	34	30	64	75	55	20	160	3,800	
500	50	81	53	34	30	64	85	57	20	200	4,800	
750	64	89	57	42	30	72	93	61	20	255	6,500	
1000	64	89	59	42	30	72	93	63	20	300	7,800	
1500	73	89	86	42	30	72	93	90	24	410	10,300	
2000	73	72	87	42	30	72	76	91	24	420	11,600	
2500	73	72	99	42	30	72	76	103	24	500	14,000	
3000	73	84	99	46	37	84	88	103	24	720	18,700	
3750	84	85	108	47	38	85	88	112	24	800	20,500	
5000	84	96	108	48	48	96	100	112	24	850	25,000	
7500	94	102	122	54	48	102	100	126	24	1,620	46,900	

<sup>1</sup> Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.

\* Add 9" for Bay-O-Net fusing.

**Standard features**

**Connections and neutral configurations**

- Delta - Wye: Low voltage neutral shall be a fully insulated X0 bushing with removable ground strap.
- Grounded Wye-Wye: High voltage neutral shall be internally tied to the low voltage neutral and brought out as the H0X0 bushing in the secondary compartment with a removable ground strap.
- Delta-Delta: Transformer shall be provided without a neutral bushing.
- Wye-Wye: High voltage neutral shall be brought out as the H0 bushing in the primary compartment and the low voltage neutral shall be brought as the X0- bushing in the secondary compartment.
- Wye-Delta: High voltage neutral shall be brought out as the H0 bushing in the primary compartment. No ground strap shall be provided (line to line rated fusing is required).

**High and low voltage bushings**

- 200 A bushing wells (15, 25, and 35 kV)
- 200 A, 35 kV Large Interface
- 600 A (15, 25, and 35 kV) Integral bushings (dead-front)
- Electrical-grade wet-process porcelain bushings (live-front)

**Tank/cabinet features**

- Bolted cover for tank access (45-1750 kVA)
- Welded cover with hand hole (2000-12,000 kVA)
- Three-point latching door for security
- Removable sill for easy installation
- Lifting lugs (4)
- Stainless steel cabinet hinges and mounting studs
- Steel divider between HV and LV compartment
- 20" Deep cabinet (45-1000 kVA)
- 24" Deep cabinet (1500-7500 kVA)
- 30" Deep cabinet (34.5/19.92 kV)
- Pentahead captive bolt
- Stainless steel 1-hole ground pads (45-500 kVA)
- Stainless steel 2-hole ground pads (750-10,000 kVA)
- Parking Stands

**Valves/plugs**

- One-inch upper filling plug
- One-inch drain plug (45-500 kVA)
- One-inch combination drain valve with sampling device in low voltage compartment (750-12,000 kVA)
- Automatic pressure relief valve

**Nameplate**

- Laser-scribed anodized aluminum nameplate



Figure 3. Drain valve with sampler.



Figure 4. Automatic Pressure relief valve.



Figure 5. Liquid level gauge.



Figure 6. External Gauges.



Figure 7. External visible break with gauges.

## Optional features

### High and low voltage bushings

- 200 A (15, 25 kV) bushing inserts
- 200 A (15, 25 kV) feed thru inserts
- 200 A (15, 25 kV) (HTN) bushing wells with removable studs
- High-voltage 600 A (15, 25, 35 kV) deadbreak one-piece bushings
- Low voltage 6-, 8-holes spade
- Low voltage 12-, 16-, 20-holes spade (750-2500 kVA)
- Low voltage bushing supports

### Tank/cabinet features

- Stainless steel tank base and cabinet
- Stainless steel tank base, cabinet sides and sill
- 100% stainless steel unit
- Service entrance (2 inch) in sill or cabinet side
- Touch-up paint (domestic)
- Copper ground bus bar
- Kirk-Key provisions
- Nitrogen blanket
- Bus duct cutout

### Special designs

- Factory Mutual (FM)
- UL® Classified
- Triplex
- High altitude
- K-Factors
- Step-up
- Critical application
- Modulation transformers
- Seismic applications (including OSHPD)

### Switches

- One, two, or three On/Off loadbreak switches
- 4-position loadbreak V-blade switch or T-blade switch
- Delta-wye switch
- 3-position V-Blade selector switch
- 100 A, 150 A, 300 A tap changers
- Dual voltage switch
- Visible break with VFI interrupter interlock
- External visible break (15, 25, and 35 kV, up to 3 MVA)
- External visible break with gauges (15, 25, and 35 kV, up to 3 MVA)

### Gauges and devices

- Liquid level gauge (optional contacts)
- Pressure vacuum gauge (optional contacts and bleeder)
- Dial-type thermometer (optional alarm contacts)
- Cover mounted pressure relief device
- Ground connectors
- Hexhead captive bolt
- Breaker mounting provisions
- External gauges in padlockable box

### Overcurrent protection

- Bay-O-Net fusing (Current sensing, dual sensing, dual element, high amperage overload)
- Bay-O-Net expulsion fuse in series with a partial range under-oil ELSP current limiting fuse (below 23 kV)
- Cartridge fusing in series with a partial range under-oil ELSP current limiting fuse (above 23 kV)
- MagneX™ interrupter with ELSP current-limiting fuse
- Vacuum Fault Interrupter (VFI)
- Visible break window
- Fuse/switch interlock

### Valves/plugs

- Drain/sampling valve in high-voltage compartment
- Globe type upper fill valve

### Overvoltage protection

- Distribution-, intermediate-, or station-class surge arresters
- Elbow arresters (for dead-front connections)

### Metering/fan/control

- Full metering package
- Current Transformers (CTs)
- Metering Socket
- NEMA® 4 control box (optional stainless steel)
- NEMA® 7 control box (explosion proof)
- Fan Packages

### Testing

- Customer test witness
- Customer final inspection
- Zero Sequence Impedance Test
- Heat Run Test
- ANSI® Impulse Test
- Audible Sound Level Test
- RIV (Corona) Test
- Dissolved Gas Analysis (DGA) Test
- 8- or 24-Hour Leak Test

### Coatings (paint)

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

### Nameplate

- Stainless steel nameplate

### Decals and labels

- High voltage warning signs
- Mr. Ouch
- Bi-lingual warning
- DOE compliant
- Customer stock code
- Customer stenciling
- Shock and arc flash warning decal
- Non-PCB decal



## 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

Pad-mounted 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

Pad-mounted transformer core and coil assemblies are braced with heavy steel ends to prevent the rectangular coil from distorting under short-circuit 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 pressure-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™-2005 standards. 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 two 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.

### Insulating fluid

Transformers from Eaton's Cooper Power Systems are available with electrical-grade mineral insulating oil or Envirotemp™ FR3™ fluid. 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.

Eaton's Cooper Power Systems 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 (UL®) Classified "Less-Flammable" per NEC® Article 450-23, fitting the definition of a Listed Product per NEC®.



Figure 8. VFI transformer with visible break.

### Pad-mounted VFI transformer

The VFI transformer combines a conventional distribution transformer from Eaton's Cooper Power Systems with the proven Vacuum Fault Interrupter (VFI). This combination provides both voltage transformation and transformer over current protection in one space saving and money saving package. The pad-mounted 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.

Due to the resettable characteristics of the VFI breaker, restoring three-phase service is faster and easier.

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 loadbreak switch contacts are in an open or closed position before performing maintenance.

**Envirotran™ FM Approved special protection transformer**

The Envirotran™ transformer from Eaton's Cooper Power Systems is FM Approved and suitable for indoor locations. Factory Mutual Research Corporation's (FMRC) approval of the Envirotran transformer line makes it easy to comply with and verify compliance with Section 450.23, 2008 NEC, Less-Flammable Liquid-Filled Transformer Requirements for both indoor and outdoor locations.

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

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

Envirotran FM Approved transformers are manufactured under strict compliance with FMRC Standard 3990 and are filled with FM Approved Envirotemp™ FR3™ fluid, a fire-resistant dielectric coolant.



**Special application transformers**

**Data Center transformer**

With focus rapidly shifting from simply maximizing uptime and supporting demand to improving energy utilization, the data center industry is continually looking for methods to increase its energy efficiency and reliability. Utilizing cutting edge technology, Eaton's Cooper Power Systems Hardened Data Center (HDC) transformers are the solution. Designed with special attention given to surge protection, HDC liquid-filled transformers provide superior performance under the harshest electrical environments. Contrary to traditional dry-type units, HDC transformers provide unsurpassed reliability, overloadability, operational life, efficiency, thermal loading and installed footprint. These Eaton's Cooper Power Systems units have reliably served more than 100 MW of critical data center capacity for a total of more than 6,000,000 hours without any reported downtime caused by a thermal or short-circuit coil failure.

The top priority in data center operations is uninterrupted service. Envirotran HDC transformers from Eaton's Cooper Power Systems, having substantially higher levels of insulation, are less susceptible to voltage surges. Eaton's Cooper Power Systems has experienced zero failures due to switching transients. The ANSI® and IEEE® standard impulse withstand ratings are higher for liquid-filled transformers, making them less susceptible to insulation failure. The Envirotran HDC transformer provides ultimate protection by increasing the BIL rating one level higher than standard liquid-filled transformer ratings. The cooling system of liquid-filled transformers provides better protection from severe overloads—overloads that can lead to significant loss of life or failure.

Data center design typically includes multiple layers of redundancy, ensuring maximum uptime for the critical IT load. When best in class transformer manufacturing lead times are typically weeks, not days, an unexpected transformer failure will adversely affect the facility's reliability and profitability. Therefore, the ability to determine the electrical and mechanical health of a transformer can reduce the probability of costly, unplanned downtime. Routine diagnostic tests, including key fluid properties and dissolved gas analysis (DGA), can help determine the health of a liquid-filled transformer. Although sampling is not required for safe operation, it will provide the user with valuable information, leading to scheduled repair or replacement, and minimizing the duration and expense of an outage. With a dry-type transformer, there is no reliable way to measure the

health or likelihood of an impending failure.

**Solar transformer**

As a result of the increasing number of states that are adopting aggressive Renewable & Alternative Energy Portfolio Standards, the solar energy market is growing—nearly doubling year over year. Eaton's Cooper Power Systems, a key innovator and supplier in this expanding market, is proud to offer Envirotran transformers specifically designed for Solar Photovoltaic medium-voltage applications. Eaton's Cooper Power Systems is working with top solar photovoltaic developers, integrators and inverter manufacturers to evolve the industry and change the way we distribute power.

In accordance with this progressive stance, every Eaton's Cooper Power Systems Envirotran Solar transformer is filled with non-toxic, biodegradable Envirotemp™ FR3™ dielectric fluid, made from renewable seed oils. On top of its biodegradability, Envirotemp™ FR3™ fluid substantially extends the life of the transformer insulation, saving valuable resources. What better way to distribute green power than to use a green transformer. In fact, delaying conversion to Envirotran transformers places the burden of today's environmental issues onto tomorrow's generations. Eaton's Cooper Power Systems can help you create a customized transformer, based on site specific characteristics including: temperature profile, site altitude, solar profile and required system life. Some of the benefits gained from this custom rating include:

- Reduction in core losses
- Improved payback on investment
- Reduction in footprint
- Improved fire safety
- Reduced environmental impact

For the solar photovoltaic industry, Eaton's Cooper Power Systems is offering standard step up transformers and dual secondary designs, including 4-winding, 3-winding (Low-High-Low) and 3-winding (Low-Low-High) designs.

**Wind transformer**

Eaton's Cooper Power Systems is offering custom designs for renewable energy power generation. Eaton's Cooper Power Systems manufactures Generator Step-Up (GSU) transformers for installation at the base of every wind turbine. Additionally, grounding transformers are available for wind power generation.

**DOE efficiency**

The United States Department of Energy (DOE) has mandated efficiency values for most liquid type, medium voltage transformers. As a result, all applicable Eaton's Cooper Power Systems transformers are designed to meet or exceed the standard efficiency values per DOE 2010; Final Ruling, 10 CFR Part 431.

**Underwriters Laboratories® (UL®) Listed and Labeled/Classified**

The Envirotran transformer from Eaton's Cooper Power Systems 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, 2008 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 transformer

With a drastic increase in the use of ferromagnetic devices, arcing devices, and electric power converters, higher frequency loads have increased significantly. This harmonic loading has the potential to generate higher heat levels within a transformer's windings and leads by as much as 300%. Harmonic loading has the potential to induce premature failure in standard-design distribution transformers.

In addition to standard UL® "K-Factor" ratings, transformers can be designed to customer-provided specifications detailing precise loading scenarios. Onsite measurements of magnitude and frequency, alongside harmonic analysis of the connected load can be performed by Eaton's Cooper Power Systems engineers or a third party consultant. These field measurements are used to determine exact customer needs and outline the transformer specifications.

Eaton's Cooper Power Systems will design harmonic-resistant transformers that will be subjected to the unique harmonic loads. These units are designed to maintain normal temperature rise under harmonic, full-load conditions. Standard UL® "K-Factor" designs can result in unnecessary costs when the "next-highest" K-Factor must be selected for a calculated design factor. To save the customer these unnecessary costs, Eaton's Cooper Power Systems can design the transformer to the specific harmonic spectrum used in the application. K-factor transformers from Eaton's Cooper Power Systems are filled with mineral oil or Envirotemp™ FR3™ fluid and enjoy the added benefits of dielectric cooling such as higher efficiencies than dry-type transformers.

### Modulation transformer

Bundled with an Outboard Modulation Unit (OMU) and a Control and Receiving Unit (CRU), a Modulation Transformer Unit (MTU) is designed to remotely achieve two way communication.

The use of an MTU reduces travel time and expense versus traditional meter reading performed by high voltage electricians. Additionally, with MTU it is possible to manage and evaluate energy consumption data, providing reduced metering costs and fewer tenant complaints.

An MTU utilizes existing utility infrastructure, therefore eliminating the need to engineer and construct a dedicated communication network.



Figure 9. Modular transformer.

### Inverter/rectifier bridge

Eaton's Cooper Power Systems complements its range of applications for transformers by offering dual winding designs. These designs are intended for connection to 12-pulse rectifier bridges.

### Product attributes

To set us apart from other transformer manufactures, Eaton's Cooper Power Systems includes the following guarantees with every three-phase pad-mounted transformer.

#### Engineered to order (ETO)

Providing the customer with a well developed, cost-effective solution is the number one priority at Eaton's Cooper Power Systems. Using customer specifications, Eaton's Cooper Power Systems will work with the customer from the beginning to the end to develop a solution to fit their needs. Whether it is application specific, site specific, or a uniquely specified unit, Eaton's Cooper Power Systems will provide transformers with the best in class value and performance, saving the customer time and money.

#### Made in the U.S.A.

Eaton's Cooper Power Systems three-phase pad-mounted transformers are produced right here in the United States of America. Our manufacturing facilities are positioned strategically for rapid shipment of products. Furthermore, should the need arise, Eaton's Cooper Power Systems has a broad network of authorized service repair shops throughout the United States.

#### Superior paint performance

Protecting transformers from nature's elements worldwide, Eaton's Cooper Power Systems E-coat system provides unrivaled transformer paint life, and exceeds IEEE Std C57.12.28™-2005 and IEEE Std C57.12.29™-2005 standards. In addition to the outside of the unit, each transformer receives a gray E-coat covering in the interior of the tank and cabinet, providing superior rust resistance and greater visibility during service.

If the wide range of standard paint selections does not suit the customer's needs, Eaton's Cooper Power Systems will customize the paint color to meet their requirements.

#### Rectangular coil design

Eaton's Cooper Power Systems utilizes a rectangular coil design. This winding technique results in a smaller overall unit footprint as well as reducing the transformer weight. The smaller unit size does not hinder the transformer performance in the least. Units have proven short circuit withstand capabilities up to 12 MVA.

### Testing

Eaton's Cooper Power Systems performs routing testing on each transformer manufactured including the following tests:

- **Insulation Power Factor:** This test verifies that vacuum processing has thoroughly dried the insulation system to required limits.
- **Ratio, Polarity, and Phase Relation:** Assures correct winding ratios and tap voltages; checks insulation of HV and LV circuits. Checks entire insulation system to verify all live-to-ground clearances.
- **Resistance:** This test verifies the integrity of internal high-voltage and low-voltage connections; provides data for loss upgrade calculations.
- **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:** 3.46 times normal plus 1000 volts for reduced neutral designs.
- **Loss Test:** These design verification tests are conducted to assure 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 7 psig assures a complete seal, with no weld or gasket leaks, to eliminate the possibility of moisture infiltration or fluid oxidation.

#### **Design performance tests**

The design performance tests include the following:

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

#### **Thomas A Edison Research and Test Facility**

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 Systems 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. Headquarters for the Systems Engineering group of Eaton's Cooper Power Systems, this research facility is fully available for use by our customers to utilize our advanced electrical and chemical testing labs.



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For Eaton's Cooper Power Systems three-phase pad-mounted transformer product information call 1-877-277-4636 or visit: [www.cooperpower.com](http://www.cooperpower.com).

# Substation transformers-unit and open types



## General

Eaton's Cooper Power Systems substation transformers are designed to meet a wide variety of customer specifications.

Flexibility in design, combined with the highest quality manufacturing processes, equipment, and testing procedures, enable Eaton's Cooper Power Systems 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 Systems 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, 2008 NEC® requirements. Electrical codes recognize the advantages of using Envirotemp™ FR3™ fluid both indoors and outdoors for fire-sensitive applications.

**Cooper  
Power Systems**  
by **EAT•N**

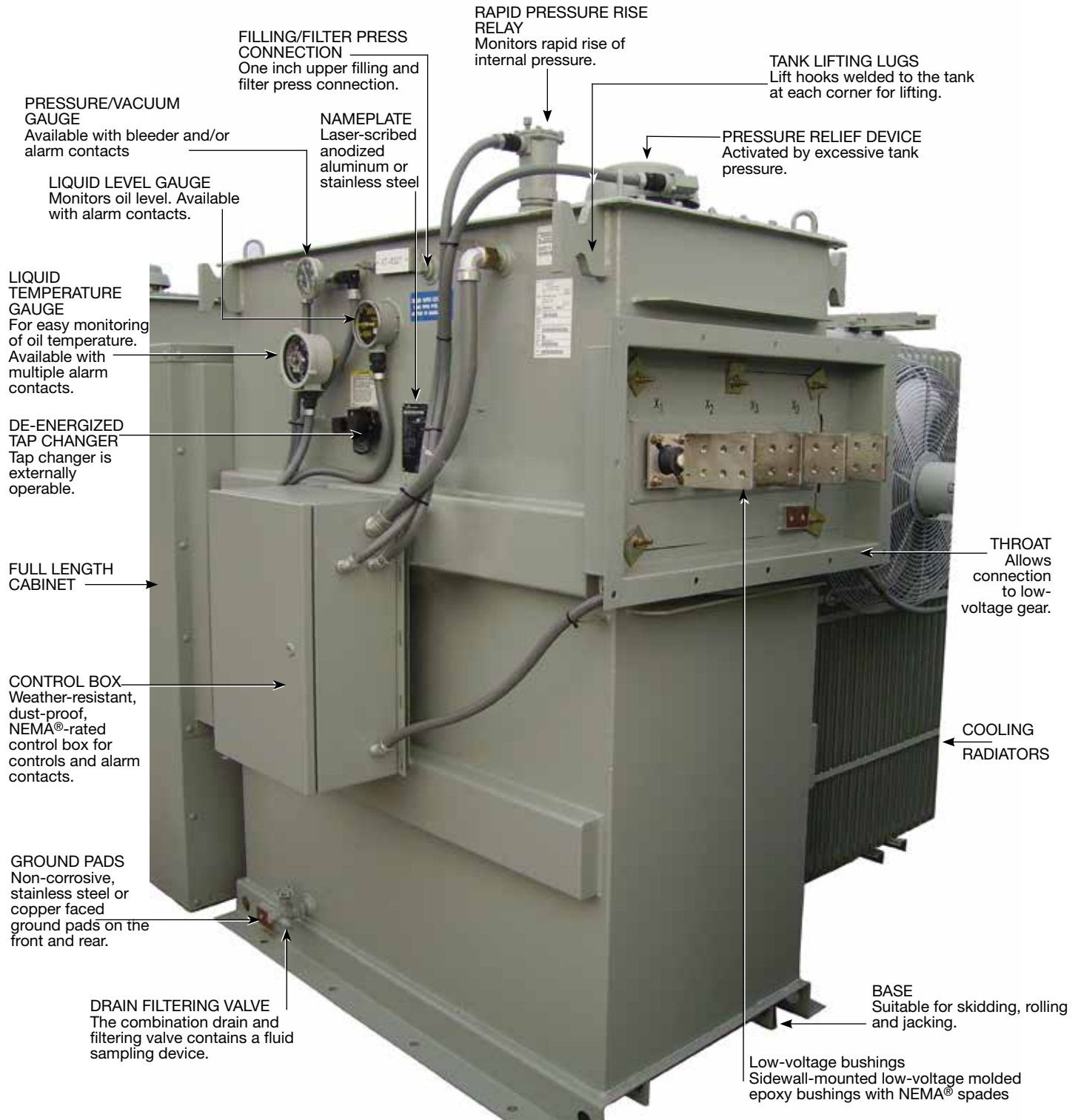


Figure 1. Unit type substation transformer with standard features and optional accessories.



**Product Scope**

<b>Type</b>	Three-Phase or Single-Phase, 50 or 60 Hz, 65 °C. 55 °C and 55/65 °C available. See 210-90 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

**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	1150
1500	1725
2000	2300
2500	3125
3750	4688
5000	6250
7500	9375
10000	12500
12000	16000

+15% (between 1000 and 1500 kVA)  
+25% (between 5000 and 7500 kVA)  
+33% (between 10000 and 12000 kVA)

**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 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	2800	3125	3500
3750	4200	4688	5250
5000	5600	6250	7000
7500	8400	9375	10500
10000	11200	12500	14000
12000	13440	16000	17920

+12% (between 2500 and 3750 kVA)

**Note:** For transformers with a 75 degree C rating, please refer to Catalog 210-90, PEAK™ Substation Transformers.

**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>**

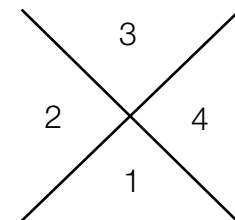
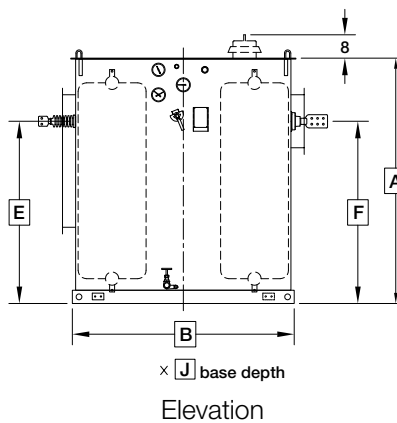
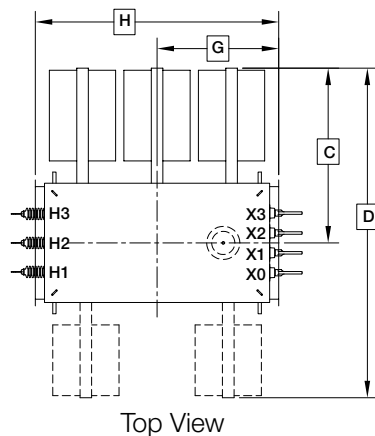
kVA	Drawing Dimensions (in.)									Gallons Of Fluid	Approx. Total Weight (lbs.) (With Fluid)
	A	B	C	D	E	F	G	H	J		
500	66	51	26	52	45	45	30	60	35	300	5600
750	75	59	26	52	55	55	34	68	35	360	7000
1000	75	67	26	52	55	55	38	76	35	420	8400
1500	75	59	59	80	55	55	34	68	35	400	9500
2000	85	67	67	90	55	55	38	76	39	520	12000
2500	85	75	68	92	55	55	42	84	41	570	14600
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 Eaton's Cooper Power Systems for exact dimensions.

**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	5900
750	75	59	26	52	55	55	34	68	35	370	7400
1000	75	67	26	52	55	55	38	76	35	430	8800
1500	75	59	59	80	55	55	34	68	35	420	10000
2000	85	63	67	90	55	55	36	72	39	500	12800
2500	85	67	68	92	55	55	38	76	41	590	14900
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 Eaton's Cooper Power Systems for exact dimensions.



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

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

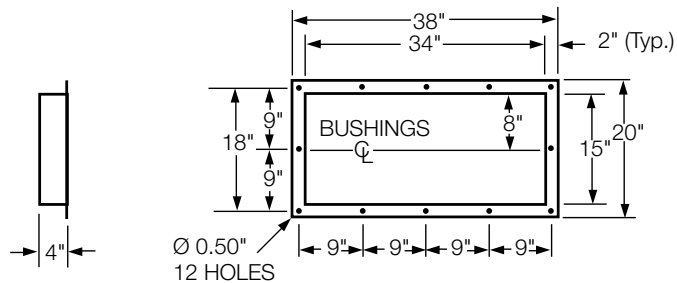


Figure 4. Throat.

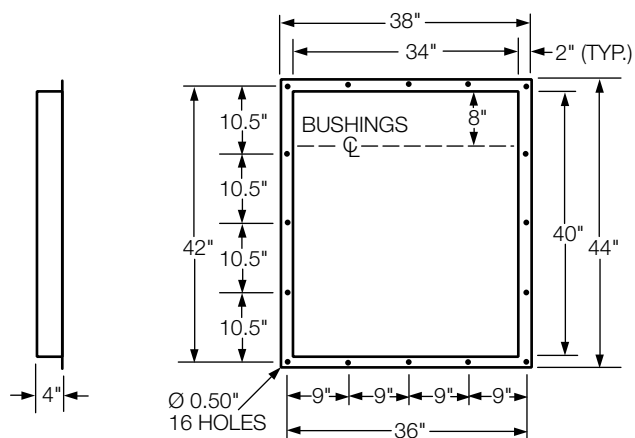


Figure 7. Flange.

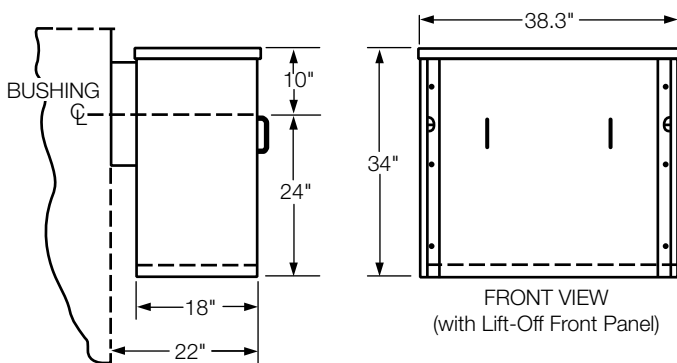


Figure 5. Air terminal chamber-bottom entry.

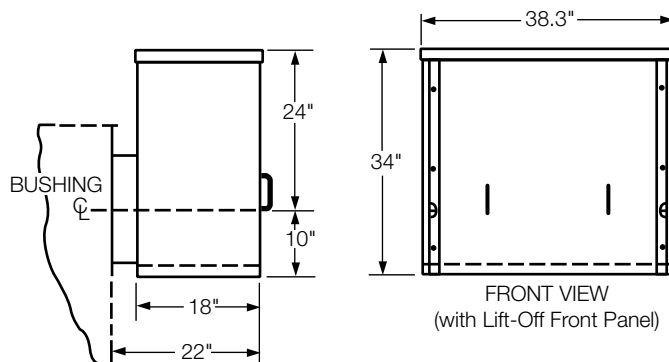


Figure 8. Air terminal chamber-top entry.

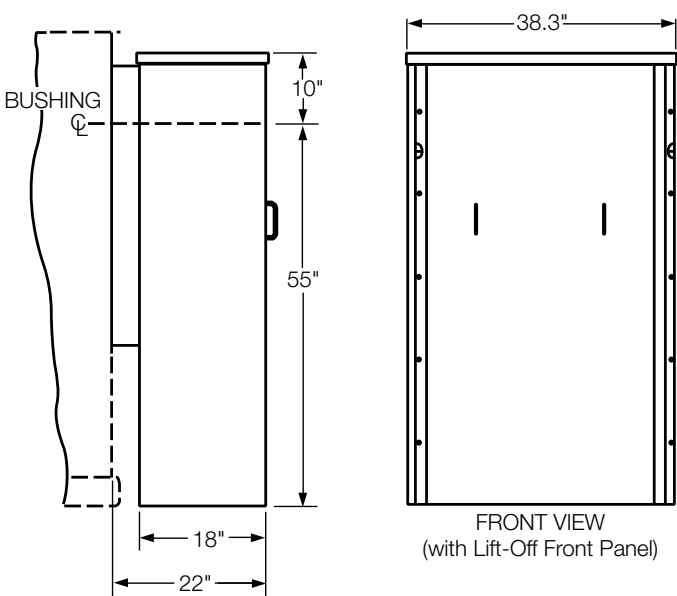


Figure 6. Full length cabinet-bottom entry.

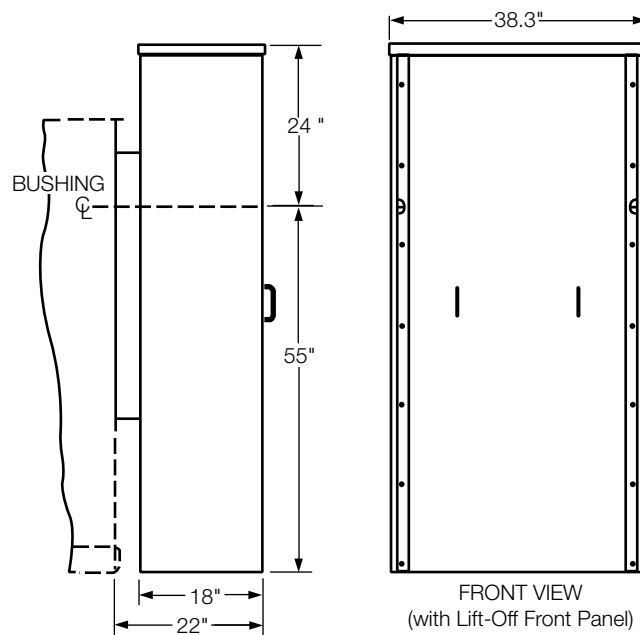


Figure 9. Full length cabinet-top entry.

## 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 and jack pads (4)
- Stainless steel grounding pads (4)
- Cooling radiators 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" drain valve with sampler combination (2500 kVA and below)
- 2" drain valve with sampler (over 2500 kVA)
- 1" upper filter valve (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)

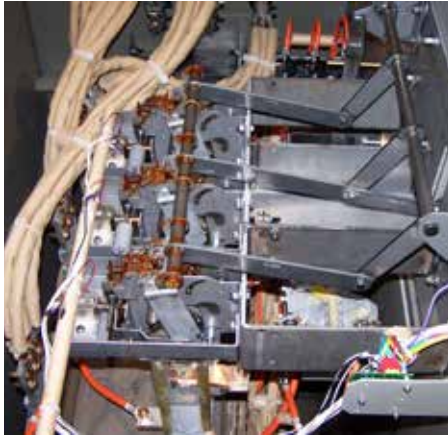


Figure 12. VFI—inside transformer tank.



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™-2005 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

Transformers from Eaton's Cooper Power Systems are available with Envirotemp™ FR3™ fluid or electrical grade mineral insulating oil. 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.

Eaton's Cooper Power Systems 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**

The VFI transformer combines a conventional distribution transformer from Eaton's Cooper Power Systems with the proven Vacuum Fault Interrupter (VFI). 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**

The Envirotran™ Transformer from Eaton's Cooper Power Systems is FM Approved® and suitable for indoor locations. Factory Mutual Research Corporation's (FMRC) approval of the Envirotran transformer line makes it easy to comply and verify compliance with Section 450.23, 2008 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 Safety 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 from Eaton's Cooper Power Systems are manufactured under strict compliance with FMRC 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 Systems offers liquid- filled substation and pad-mounted 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.

**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's Cooper Power Systems 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's Cooper Power Systems 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**

The Envirotran Transformer from Eaton's Cooper Power Systems 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, 2008 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's Cooper Power Systems can design transformers with appropriate K-factor correction to mitigate the effects of non-linear harmonic loading conditions.

**Solar/wind designs**

Eaton's Cooper Power Systems is offering custom designs for renewable energy power generation. Eaton's Cooper Power Systems manufactures 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's Cooper Power Systems 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's Cooper Power Systems 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 Device#87.

### Primary air disconnect switch

- Provides economical, visible disconnect primary load break switching.
- Fully coordinated and packaged with the transformer by Eaton's Cooper Power Systems.
- Meets IEEE Std C37.20.3™-2013 standard, NEMA® 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's Cooper Power Systems performs routine testing on each transformer manufactured including the following tests:

- **Insulation Power Factor:** This test verifies that vacuum processing has thoroughly dried the insulation system to required limits.
- **Ratio, Polarity, and Phase Relation:** Assures correct winding ratios and tap voltages; checks insulation of HV and LV circuits. Checks entire insulation system to verify all live-to-ground clearances.
- **Resistance:** This test verifies the integrity of internal high-voltage and low-voltage connections; provides data for loss upgrade calculations.
- **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:** 3.46 times normal plus 1000 volts for reduced neutral designs.
- **Loss Test:** These design verification tests are conducted to assure 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 7 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® and IEEE® temperature rise criteria.
- **Audible Sound Level:** Ensures compliance with NEMA® 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 Systems Transformer Products is 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. Headquarters for the Systems Engineering Group of Eaton's Cooper Power Systems, 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.

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For Eaton's Cooper Power Systems substation transformer product information call 1-877-277-4636 or visit: [www.cooperpower.com](http://www.cooperpower.com).

# Three-phase pad-mounted PEAK™ transformer



## General

PEAK™ transformers from Eaton's Cooper Power Systems represent the next generation of transformer design, and with two distinct product offerings there is a PEAK transformer to fit your needs. The first PEAK transformer option is a 75 °C average winding rise (AWR) design that offers users a smaller and lighter footprint than today's 65 °C AWR transformers. This design is ideal for applications with size, weight, and dimensional constraints. The second PEAK transformer option is a 65/75 °C AWR design that offers users sustained overload capacity while maintaining IEEE Std C57.91™-2011 standard per unit life requirements. This design offers customers flexibility in transformer sizing by offering the ability to accommodate future load growth without oversizing relative to current load, or the ability to meet periods of peak demand without oversizing based on continuous load.

With both PEAK product offerings being comprised of thermally upgraded kraft paper and Envirotemp™ FR3™ dielectric fluid, all PEAK transformers offer customers a high temperature insulation system that is fully compatible with the new IEEE® standard for transformers using high-temperature insulation systems, IEEE Std C57.154™-2012 standard. In addition, all PEAK transformers provide the high fire point and environmental benefits of Envirotemp™ FR3™ fluid. PEAK transformers are available in various designs and configurations to match almost every application.

**Cooper  
Power Systems**  
by **EAT•N**

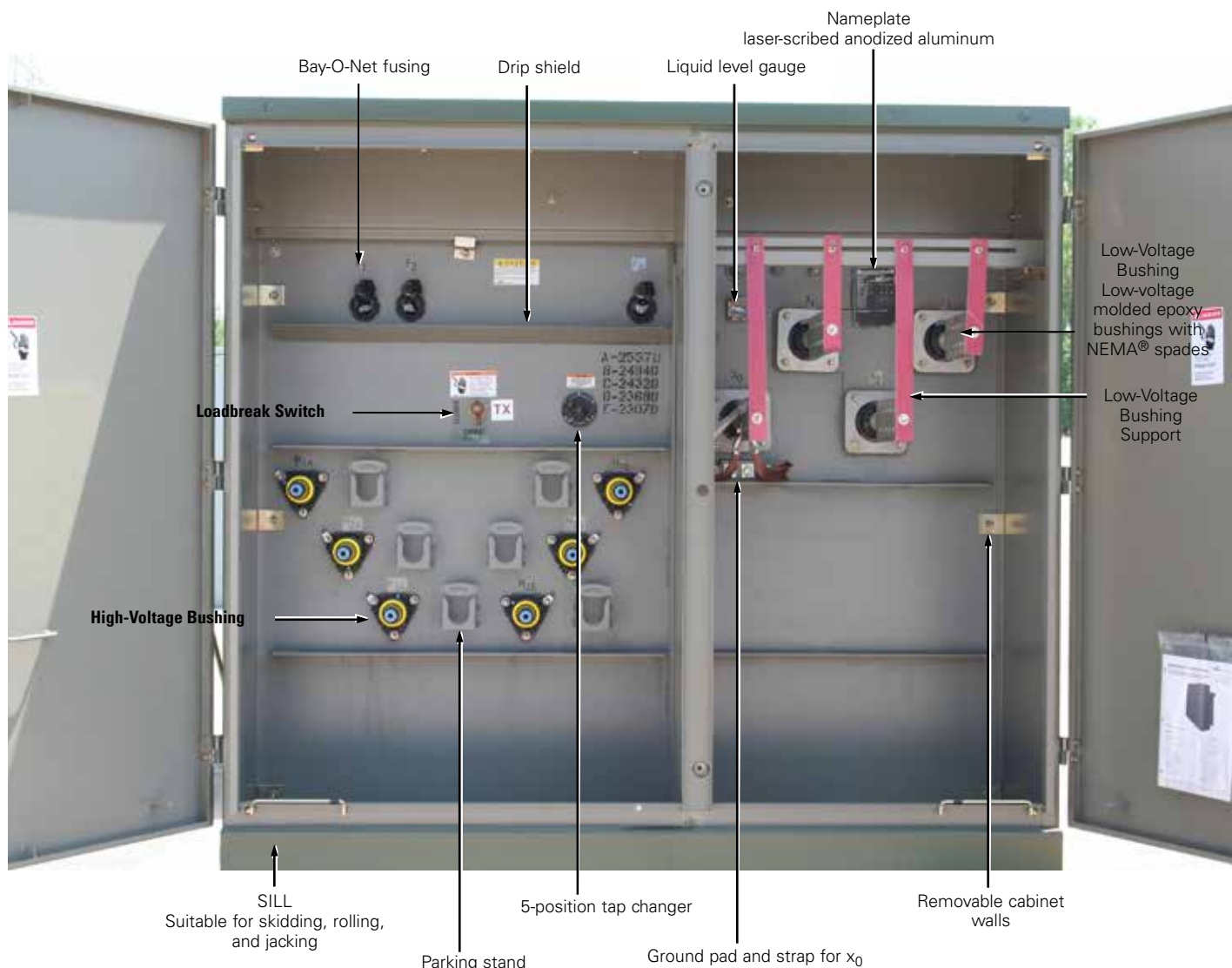


Figure 1. Three-phase pad-mounted PEAK transformer.

Table 1. Product scope

<b>Type</b>	Three-Phase, 50 or 60 Hz, 75 °C Rise and 65 °C/75 °C
<b>Fluid Type</b>	Only Envirotemp™ FR3™ fluid
<b>Coil Configuration</b>	2-winding or 4-winding or 3-winding (Low-High-Low), 3-winding (Low-Low-High)
<b>Size</b>	45 – 12,000 kVA
<b>Primary Voltage</b>	2,400 – 46,000 V
<b>Secondary Voltage</b>	208Y/120 V to 14,400 V
<b>Specialty Designs</b>	Inverter/Rectifier Bridge
	K-Factor (up to K-19)
	Solar/Wind Designs
	Differential Protection
	Seismic Applications (including OSHPD)
	Hardened Data Center
	UL® Listed & Label and Classified
Factory Mutual (FM) Approved®	

**Table 2. Three-Phase Ratings**

**Three-Phase 50 or 60 Hz**

kVA Available<sup>1</sup>:  
45, 75, 112.5, 150, 225, 300, 500, 750, 1000, 1500, 2000, 2500, 3000, 3750, 5000, 7500, 10000, 12000

<sup>1</sup>Transformers are available in the standard ratings and configurations shown or can be customized to meet specific needs.

**Table 3. Audible Sound Levels**

Self-Cooled, Two Winding kVA Rating	NEMA® TR-1 Average
	Decibels (dB)
45-500	56
501-700	57
701-1000	58
1001-1500	60
1501-2000	61
2001-2500	62
2501-3000	63
3001-4000	64
4001-5000	65
5001-6000	66
6001-7500	67
7501-12000	68

**Table 4. Insulation Test Levels**

KV Class	Induced Test 180 or 400 Hz 7200 Cycle	kV BIL Distribution	Applied Test 60 Hz (kV)
1.2	Twice Rated Voltage	30	10
2.5		45	15
5		60	19
8.7		75	26
15		95	34
25 (grd Y Only)		125	40
25		150	50
34.5 (grd Y Only)		125	40
34.5		150	70

**Table 5. Temperature Rise Ratings 0-3300 Feet (0-1000 meters)**

	Unit Rating (Temperature Rise Winding)	
	75 °C	65/75 °C
Ambient Temperature Max.	40 °C	40 °C
Ambient Temperature 24 Hour Average	30 °C	30 °C
Temperature Rise Hotspot	90 °C	90 °C

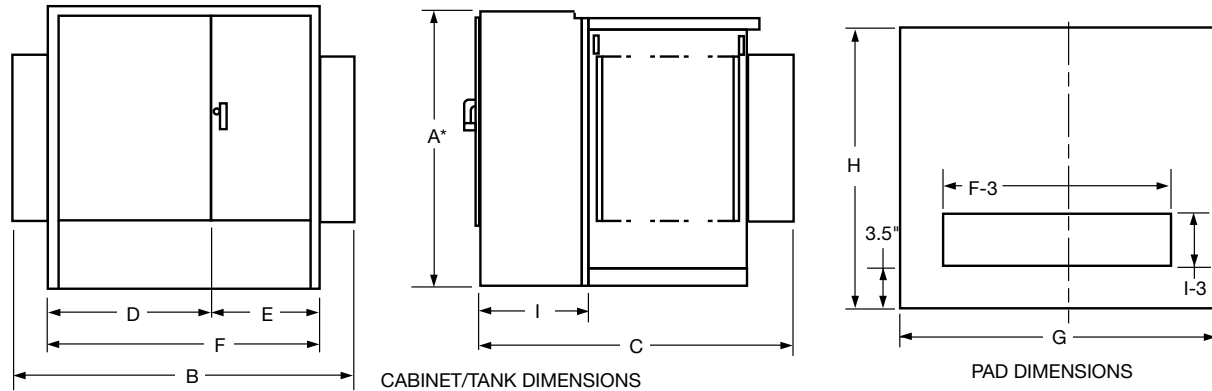


Figure 2. Transformer and pad dimensions.

\* Add 9" for Bay-O-Net fusing.

Table 6. Fluid-Filled—Aluminum Windings 65 °C Rise<sup>1</sup>

kVA	A	B	C	D	E	F	G	H	I	GALLONS	WEIGHT
45	50	66	40	41	25	66	70	44	20	102	1990
75	50	66	40	41	25	66	70	44	20	102	1990
112.5	50	66	40	41	25	66	70	44	20	108	2150
150	50	66	41	41	25	66	70	45	20	115	2330
225	50	71	50	41	30	71	75	54	20	127	2810
300	50	71	50	41	30	71	75	54	20	136	3200
500	50	79	52	41	30	71	83	56	20	170	4200
750	64	82	56	41	30	71	86	60	20	242	5390
1000	64	82	59	41	30	71	86	63	20	305	7120
1500	64	76	90	42	29	71	80	94	24	356	9980
2000	72	76	90	42	29	71	80	94	24	520	11079
2500	72	79	97	42	29	71	83	101	24	550	13340
3000	84	88	98	49	29	78	92	102	24	625	14820
3750	84	88	103	49	29	78	92	107	24	671	17640
5000	84	99	108	50	30	80	103	112	24	910	21750
7500	94	100	108	48	48	96	104	112	24	1017	25100
10000	94	100	120	48	48	96	104	124	24	1500	38900

<sup>1</sup> Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.

\* Add 9" for Bay-O-Net fusing.

Table 7. Fluid-Filled—Aluminum Windings 75 °C Rise<sup>1</sup>

kVA	A	B	C	D	E	F	G	H	I	GALLONS	WEIGHT
45	50	66	40	41	25	66	70	44	20	102	1990
75	50	66	40	41	25	66	70	44	20	102	1990
112.5	50	66	40	41	25	66	70	44	20	104	2150
150	50	66	40	41	25	66	70	44	20	106	2310
225	50	70	40	41	29	70	74	44	20	120	2710
300	50	70	50	41	29	70	74	54	20	132	3160
500	50	70	53	41	29	70	74	57	20	168	4090
750	64	70	57	41	29	70	74	61	20	237	5300
1000	64	70	58	41	29	70	74	62	20	284	6650
1500	64	71	64	42	29	71	75	68	24	347	9840
2000	64	71	68	42	29	71	75	72	24	393	10790
2500	64	71	91	42	29	71	75	95	24	406	13300
3000	72	71	108	42	29	71	75	112	24	559	14560
3750	72	78	102	46	32	78	82	106	24	634	17440
5000	84	85	112	47	38	85	89	116	24	755	20645
7500	84	88	120	48	40	88	92	124	24	890	23060
10000	84	88	130	48	40	88	92	134	24	990	27300

<sup>1</sup> Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.

\* Add 9" for Bay-O-Net fusing.

**Standard features**

**Connections and neutral configurations**

- Delta-Wye: Low voltage neutral shall be a fully insulated X0 bushing with removable ground strap.
- Grounded Wye-Wye: High voltage neutral shall be internally tied to the low voltage neutral and brought out as the HOX0 bushing in the secondary compartment with a removable ground strap.
- Delta-Delta: Transformer shall be provided without a neutral bushing.
- Wye-Wye: High voltage neutral shall be brought out as the H0 bushing in the primary compartment and the low voltage neutral shall be brought as the X0- bushing in the secondary compartment.
- Wye-Delta: High voltage neutral shall be brought out as the H0 bushing in the primary compartment. No ground strap shall be provided (line to line rated fusing is required).

**High and low voltage bushings**

- 200 A bushing wells (15, 25, 35 kV)
- 200 A, 35 kV large Interface
- 600 A (15, 25, 35 kV) integral bushings (dead-front)
- Electrical-grade wet-process porcelain bushings (live-front)

**Tank/cabinet features**

- Bolted cover for tank access (45-1750 kVA)
- Welded cover with hand hole (2000-12,000 kVA)
- Three-point latching door for security
- Removable sill for easy installation
- Lifting lugs (4)
- Stainless steel cabinet hinges and mounting studs
- Steel divider between HV and LV compartment
- 20" deep cabinet (45-1000 kVA)
- 24" deep cabinet (1500-7500 kVA)
- 30" deep cabinet (34.5/19.92 kV)
- Pentahead captive bolt
- Stainless steel 1-hole ground pads (45-500 kVA)
- Stainless steel 2-hole ground pads (750-10,000 kVA)
- Parking stands

**Valves/plugs**

- One-inch upper filling plug
- One-inch drain plug (45-500 kVA)
- One-inch combination drain valve with sampling device in low voltage compartment (750-12,000 kVA)
- Automatic pressure relief valve

**Nameplate**

- Laser-scribed anodized aluminum nameplate



Figure 3. Drain valve with sampler.



Figure 4. Automatic pressure relief valve.



Figure 5. Liquid level gauge.



Figure 6. External Gauges.



Figure 7. External visible break with gauges.

## Optional features

### High and low voltage bushings

- 200 A (15, 25 kV) bushing inserts
- 200 A (15, 25 kV) feed thru inserts
- 200 A (15, 25 kV) (HTN) bushing wells with removable studs
- High-voltage 600 A (15, 25, 35 kV) deadbreak one-piece bushings
- Low-voltage 6-, 8-holes spade
- Low-voltage 12-, 16-, 20-holes spade (750-2500 kVA)
- Low-voltage bushing supports

### Tank/cabinet features

- Stainless steel tank base and cabinet
- Stainless steel tank base, cabinet sides and sill
- 100% stainless steel unit
- Service entrance (2 inch) in sill or cabinet side
- Touch-up paint (domestic)
- Copper ground bus bar
- Kirk-Key provisions
- Nitrogen blanket
- Bus duct cutout

### Special designs

- Triplex
- High Altitude
- K-Factors
- Step-up
- Critical application
- Modulation transformers
- Seismic applications (including California Office of Statewide Health Planning and Development, OSHPD)

### Switches

- 100 A, 150 A, 300 A tap-changers
- Dual-voltage switch
- One, two, or three On/Off loadbreak switches
- 4-position loadbreak V-blade switch or T-blade switch
- Delta-wye switch
- 3-position V-blade selector switch
- Visible break with VFI interrupter interlock
- External visible break (15, 25, and 35 kV, up to 3 MVA)
- External visible break with gauges (15, 25, and 35 kV, up to 3 MVA)

### Gauges and devices

- Liquid level gauge (optional contacts)
- Pressure vacuum gauge (optional contacts and bleeder)
- Dial-type thermometer (optional alarm contacts)
- Cover-mounted pressure relief device
- Ground connectors
- Hexhead captive bolt
- Breaker mounting provisions
- External gauges in padlockable box

### Overcurrent protection

- Cartridge fusing in series with a partial-range under-oil ELSP current-limiting fuse (above 23 kV)
- MagneX™ interrupter with ELSP current-limiting fuse
- Visible break window
- Fuse/switch interlock

### Valves/plugs

- Drain/sampling valve in high-voltage compartment
- Globe-type upper fill valve

### Overvoltage protection

- Distribution-, intermediate-, or station-class surge arresters
- Elbow arresters (for dead-front connections)

### Metering/fan/control

- Full metering package
- Metering socket
- NEMA® 4 control box (optional stainless steel)
- NEMA® 7 control box (explosion proof)
- Fan packages

### Testing

- Customer test witness
- Customer final inspection
- Zero sequence impedance test
- Heat Run Test
- ANSI® Impulse Test
- Audible Sound Level Test
- RIV (Corona) Test
- Dissolved Gas Analysis (DGA) Test
- 8- or 24-Hour Leak Test

### Coatings (Paint)

- ANSI® bell green
- ANSI® #61 light gray
- ANSI® #70 sky gray
- Special paint (available per request)

### Nameplate

- Stainless steel nameplate

### Decals and labels

- High-voltage warning signs
- Mr. Ouch decal
- Bi-lingual warning
- DOE compliant
- Customer stock code
- Customer stenciling
- Shock and arc flash warning decal
- Non-PCB decal



## 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

Pad-mounted 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

Pad-mounted transformer core and coil assemblies are braced with heavy steel ends to prevent the rectangular coil from distorting under short-circuit 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 pressure-tested to withstand 7 psig without permanent distortion and 15 psig without rupture.

### Tank finish

An advanced multi-stage finishing process exceeds the IEEE Std C57.12.28™-2005 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 two 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.

## Insulating fluid

Transformers from Eaton's Cooper Power Systems are available with Envirotemp™ FR3™ fluid. 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.

Eaton's Cooper Power Systems 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 (UL®) Classified "Less-Flammable" per NEC® Article 450-23, fitting the definition of a Listed Product per NEC®.



## Special application transformers

### Data center transformer

With focus rapidly shifting from simply maximizing uptime and supporting demand to improving energy utilization, the data center industry is continually looking for methods to increase its energy efficiency and reliability. Utilizing cutting edge technology, Eaton's Cooper Power Systems Envirotran™ Hardened Data Center (HDC) transformers are the solution. Designed with special attention given to surge protection, HDC liquid-filled transformers provide superior performance under the harshest electrical environments. Contrary to traditional dry-type units, HDC transformers provide unsurpassed reliability, overloadability, operational life, efficiency, thermal loading and installed footprint. These Eaton's Cooper Power Systems units have reliably served more than 100 MW of critical data center capacity for a total of more than 6,000,000 hours without an hour of downtime caused by a thermal or short-circuit coil failure.

The top priority in data center operations is uninterrupted service. Envirotran HDC transformers from Eaton's Cooper Power Systems, having substantially higher levels of insulation, are less susceptible to voltage surges. Eaton's Cooper Power Systems has experienced zero failures due to switching transients. The ANSI® and IEEE® standard impulse withstand ratings are higher for liquid-filled transformers, making them less susceptible to insulation failure. The Envirotran HDC transformer provides ultimate protection by increasing the BIL rating one level higher than standard liquid-filled transformer ratings. The cooling system of liquid-filled transformers provides better protection from severe overloads—overloads that

can lead to significant loss of life or failure.

Data center design typically includes multiple layers of redundancy, ensuring maximum uptime for the critical IT load. When best in class transformer manufacturing lead times are typically weeks, not days, an unexpected transformer failure will adversely affect the facility's reliability and profitability. Therefore, the ability to determine the electrical and mechanical health of a transformer can reduce the probability of costly, unplanned downtime. Routine diagnostic tests, including key fluid properties and dissolved gas analysis (DGA), can help determine the health of a liquid-filled transformer. Although sampling is not required for safe operation, it will provide the user with valuable information, leading to scheduled repair or replacement, and minimizing the duration and expense of an outage. With a dry-type transformer, there is no reliable way to measure the health or likelihood of an impending failure.

**Solar transformer**

As a result of the increasing number of states that are adopting aggressive Renewable & Alternative Energy Portfolio Standards, the solar energy market is growing—nearly doubling year over year. Eaton's Cooper Power Systems, a key innovator and supplier in this expanding market, is proud to offer Envirotran transformers specifically designed for Solar Photovoltaic medium-voltage applications. Eaton's Cooper Power Systems is working with top solar photovoltaic developers, integrators and inverter manufacturers to evolve the industry and change the way we distribute power.

In accordance with this progressive stance, every Eaton's Cooper Power Systems Envirotran Solar transformer is filled with non-toxic, biodegradable Envirotemp™ FR3™ dielectric fluid, made from renewable seed oils. On top of its biodegradability, Envirotemp™ FR3™ fluid substantially extends the life of the transformer insulation, saving valuable resources. What better way to distribute green power than to use a green transformer. In fact, delaying conversion to Envirotran transformers places the burden of today's environmental issues onto tomorrow's generations. Eaton's Cooper Power Systems can help you create a customized transformer, based on site specific characteristics including: temperature profile, site altitude, solar profile and required system life. Some of the benefits gained from this custom rating include:

- Reduction in core losses
- Improved payback on investment
- Reduction in footprint
- Improved fire safety
- Reduced environmental impact

For the solar photovoltaic industry, Eaton's Cooper Power Systems is offering standard step up transformers and dual secondary designs, including 4-winding, 3-winding (Low-High-Low) and 3-winding (Low-Low-High) designs.

**Wind transformer**

Eaton's Cooper Power Systems is offering custom designs for renewable energy power generation. Eaton's Cooper Power Systems manufactures Generator Step-Up (GSU) transformers for installation at the base of every wind turbine. Additionally, grounding transformers are available for wind power generation.

**DOE efficiency**

The United States Department of Energy (DOE) has mandated efficiency values for most liquid type, medium voltage transformers. As a result, all applicable Eaton's Cooper Power Systems transformers are designed to meet or exceed the standard efficiency values per DOE 2010; Final Ruling, 10 CFR Part 431.

**K-Factor transformer**

With a drastic increase in the use of ferromagnetic devices, arcing devices, and electric power converters, higher frequency loads have increased significantly. This harmonic loading has the potential to generate higher heat levels within a transformer's windings and leads by as much as 300%. Harmonic loading has the potential to induce premature failure in standard-design distribution transformers.

In addition to standard UL® "K-Factor" ratings, transformers can be designed to customer-provided specifications detailing precise loading scenarios. Onsite measurements of magnitude and frequency, alongside harmonic analysis of the connected load can be performed by Eaton's Cooper Power Systems engineers or a third party consultant. These field measurements are used to determine exact customer needs and outline the transformer specifications.

Eaton's Cooper Power Systems will design harmonic-resistant transformers that will be subjected to the unique harmonic loads. These units are designed to maintain normal temperature rise under harmonic, full-load conditions. Standard UL® "K-Factor" designs can result in unnecessary costs when the "next-highest" K-Factor must be selected for a calculated design factor. To save the customer these unnecessary costs, Eaton's Cooper Power Systems can design the transformer to the specific harmonic spectrum used in the application. K-factor transformers from Eaton's Cooper Power Systems are filled with mineral oil or Envirotemp™ FR3™ fluid and enjoy the added benefits of dielectric cooling such as higher efficiencies than dry-type transformers.

**Modulation transformer**

Bundled with an Outboard Modulation Unit (OMU) and a Control and Receiving Unit (CRU), a Modulation Transformer Unit (MTU) is designed to remotely achieve two way communication.

The use of an MTU reduces travel time and expense versus traditional meter reading performed by high voltage electricians. Additionally, with MTU it is possible to manage and evaluate energy consumption data, providing reduced metering costs and fewer tenant complaints.

An MTU utilizes existing utility infrastructure, therefore eliminating the need to engineer and construct a dedicated communication network.



**Figure 8. Modular transformer.**

### Inverter/rectifier bridge

Eaton's Cooper Power Systems complements its range of applications for transformers by offering dual winding designs. These designs are intended for connection to 12-pulse rectifier bridges.

### Product attributes

To set us apart from other transformer manufactures, Eaton's Cooper Power Systems includes the following guarantees with every three-phase pad-mounted transformer.

#### Engineered to order (ETO)

Providing the customer with a well developed, cost-effective solution is the number one priority at Eaton's Cooper Power Systems. Using customer specifications, Eaton's Cooper Power Systems will work with the customer from the beginning to the end to develop a solution to fit their needs. Whether it is application specific, site specific, or a uniquely specified unit, Eaton's Cooper Power Systems will provide transformers with the best in class value and performance, saving the customer time and money.

#### Made in the U.S.A.

Eaton's Cooper Power Systems three-phase pad-mounted transformers are produced right here in the United States of America. Our manufacturing facilities are positioned strategically for rapid shipment of products. Furthermore, should the need arise, Eaton's Cooper Power Systems has a broad network of authorized service repair shops throughout the United States.

#### Superior paint performance

Protecting transformers from nature's elements worldwide, Eaton's Cooper Power Systems E-coat system provides unrivaled transformer paint life, and exceeds IEEE Std C57.12.28™-2005 and IEEE C57.12.29™-2005 standards. In addition to the outside of the unit, each transformer receives a gray E-coat covering in the interior of the tank and cabinet, providing superior rust resistance and greater visibility during service.

If the wide range of standard paint selections does not suit the customer's needs, Eaton's Cooper Power Systems will customize the paint color to meet their requirements.

#### Rectangular coil design

Eaton's Cooper Power Systems utilizes a rectangular coil design. This winding technique results in a smaller overall unit footprint as well as reducing the transformer weight. The smaller unit size does not hinder the transformer performance in the least. Units have proven short circuit withstand capabilities up to 12 MVA.

### Testing

Eaton's Cooper Power Systems performs routing testing on each transformer manufactured including the following tests:

- **Insulation Power Factor:** This test verifies that vacuum processing has thoroughly dried the insulation system to required limits.
- **Ratio, Polarity, and Phase Relation:** Assures correct winding ratios and tap voltages; checks insulation of HV and LV circuits. Checks entire insulation system to verify all live-to-ground clearances.
- **Resistance:** This test verifies the integrity of internal high-voltage and low-voltage connections; provides data for loss upgrade calculations.
- **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:** 3.46 times normal plus 1000 volts for reduced neutral designs.
- **Loss Test:** These design verification tests are conducted to assure 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 7 psig assures a complete seal, with no weld or gasket leaks, to eliminate the possibility of moisture infiltration or fluid oxidation.

#### Design performance tests

The design performance tests include the following:

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

#### Thomas A Edison Research and Test Facility

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 Systems 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. Headquarters for the Systems Engineering group of Eaton's Cooper Power Systems, this research facility is fully available for use by our customers to utilize our advanced electrical and chemical testing labs.





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For Eaton's Cooper Power Systems PEAK pad-mounted transformer product information call 1-877-277-4636 or visit: [www.cooperpower.com](http://www.cooperpower.com).

# PEAK™ substation transformers



## General

Eaton's Cooper Power Systems PEAK™ Substation Transformers are a class of transformer technologies that are designed to improve performance in terms of kVA rating, compact dimensions, lighter weight, safety, and sustainability.

Flexibility in design, combined with the highest quality manufacturing processes, equipment, and testing procedures, enable Eaton's Cooper Power Systems 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.

PEAK substation transformers are available with cover-mounted bushings or enclosed sidewall-mounted bushings for connections to primary and/or secondary switchgear. Conventional transformers operate at 65 °C for the Average Winding Rise (AWR) at full load. PEAK transformers are currently available with ratings up to 75 °C AWR.

PEAK transformers are IEEE Std C57.154™-2012 standard compliant, available with all current conventional transformer options. They are offered in either 65/75 °C or 55/75 °C slash ratings or 75 °C rise rated configurations. A 65/75 °C rated PEAK transformer is comparable in size to a conventional transformer but has nameplated overload capability. A 75 °C rise rated PEAK transformer is smaller in size but delivers the same kVA as its conventional counterpart.

All PEAK transformers use Envirottemp™ FR3™ dielectric fluid. Envirottemp™ FR3™ has a higher flash point than conventional transformer fluids which increases PEAK transformers fire protection. Envirottemp™ FR3™ fluid increases the life span of the transformer insulation to a point where the overall life expectancy for PEAK transformers is significantly increased.

In addition, PEAK transformers meet Occupational Safety and Health Administration (OSHA) and Section 450.23, 2008 NEC® requirements.

Electrical codes recognize the advantages of using Envirottemp™ FR3™ fluid both indoors and outdoors for fire-sensitive applications.

**Cooper  
Power Systems**  
by **EAT•N**

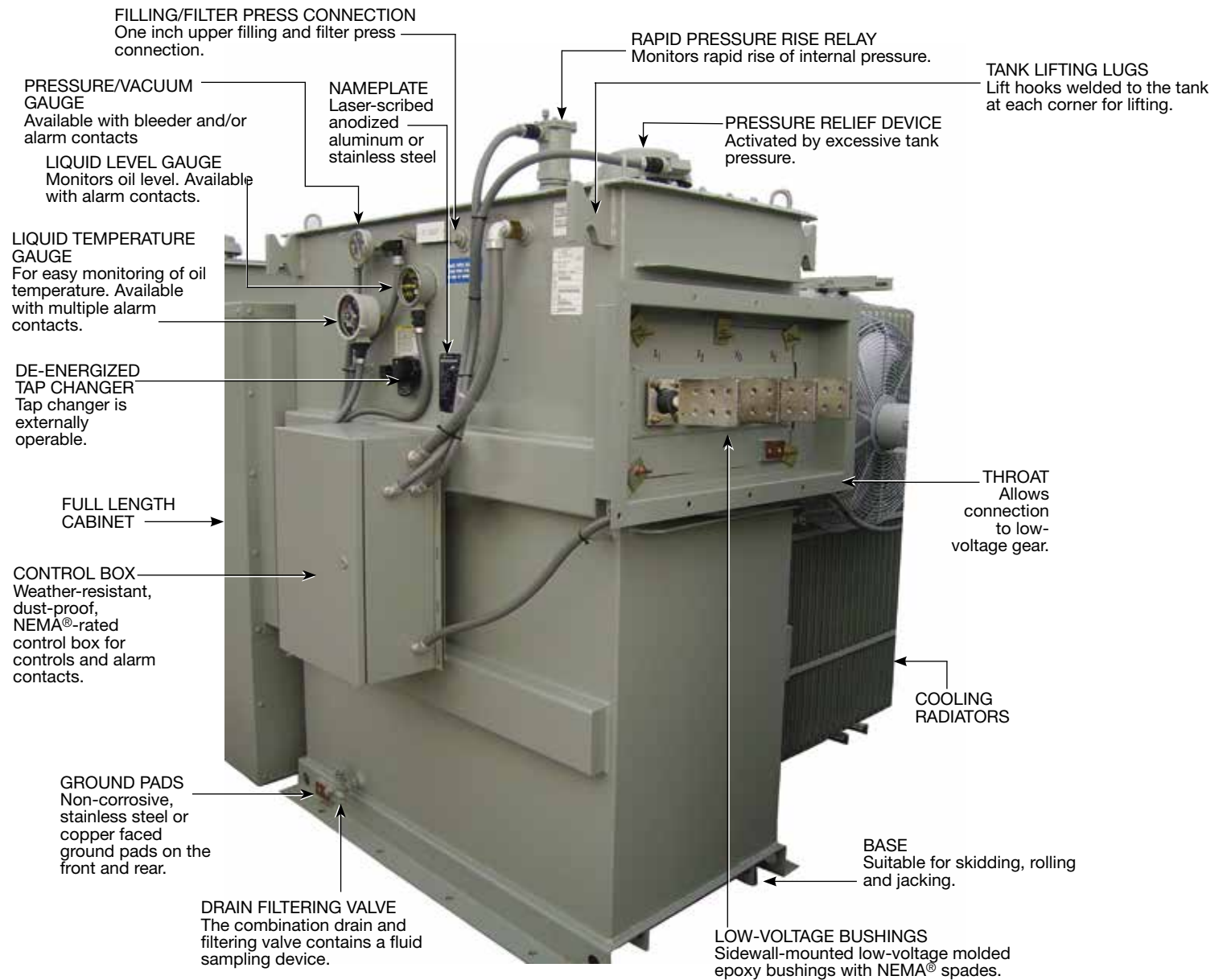


Figure 1. PEAK substation transformer with standard features and optional accessories.

**Product Scope**

<b>Type</b>	Three-Phase or Single-Phase, 50 or 60 Hz (65/75 °C, 55/75 °C, or 75 °C)
<b>Fluid Type</b>	Envirotemp™ FR3™ fluid
<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) Solar/Wind Designs Variable Speed Drives or Rectifier Duty Mining/Skid-Mounted Applications



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

Three-Phase kVA Self-Cooled and Forced-Air Cooled with 75 °C Temperature Rise

75 °C Rise KNAN	75 °C Rise KNAN/KNAF
500	N/A
750	863
1000	1150
1500	1725
2000	2300
2500	3125
3750	4688
5000	6250
7500	9375
10000	12500
12000	16000

+15% (between 1000 and 2500)  
+25% (between 2500 and 7500)  
+33% (between 7500 and 12000)

**Table 4. Three-Phase, Dual or Triple Temperature kVA Ratings<sup>1</sup>**

Three-Phase kVA Self-Cooled and Forced-Air Cooled with PEAK Triple Rated 55 °C/65 °C/75 °C Temperature Rise

55 °C Rise KNAN	65 °C Rise KNAN	75 °C Rise KNAN	55 °C Rise KNAN/KNAF	65 °C Rise KNAN/KNAF	75 °C Rise KNAN/KNAF
500	560	610	N/A	N/A	N/A
750	840	916	863	966	1053
1000	1120	1221	1150	1288	1404
1500	1680	1831	1725	1932	2106
2000	2240	2442	2300	2576	2808
2500	2800	3052	3125	3500	3815
3750	4200	4578	4688	5250	5723
5000	5600	6104	6250	7000	7630
7500	8400	9156	9375	10500	11445
10000	11200	12208	12500	14000	15260
12000	13440	14650	16000	17920	19533

+12% (between 2500 and 3750)  
+9% (between 3750 and 5000)

<sup>1</sup> If 65 °C Rise is the base rating, the 75 °C slash rating will increase the kVA capacity by 12%.

**Table 2. Impedance Voltage**

kVA Rating (1PH and 3PH)	Impedance Voltage <sup>1</sup>		
	HV BIL (kV)	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 3. 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	TWICE RATED VOLTAGE	30	45	10
2.5		45	60	15
5		60	75	19
8.7		75	95	26
15		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
Unit Rating	75 °C, 65/75 °C, 55/75 °C
Maximum Ambient Temperature Rise	40 °C, 65/75 °C, 55/75 °C
Ambient Temperature 24 Hour Av.	30 °C, 65/75 °C, 55/75 °C
Temperature Rise Winding <sup>1</sup>	75 °C, 65/75 °C, 55/75 °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 2. Fluid-Filled—Aluminum Windings 75 °C Rise<sup>1</sup>**

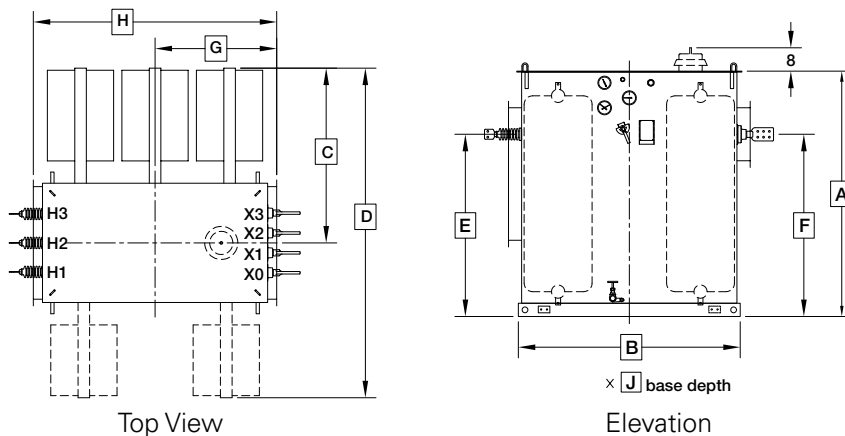
kVA	Drawing Dimensions (in.)									Gallons	Weight
	A	B	C	D	E	F	G	H	J		
500	66	51	26	47	45	45	29	58	35	290	5400
750	66	55	26	52	55	55	31	62	35	330	6200
1000	66	59	26	52	55	55	33	66	35	360	7200
1500	75	59	26	52	55	55	33	66	35	370	9200
2000	75	63	50	78	55	55	35	70	35	400	11000
2500	75	67	56	85	55	55	37	74	37	460	12300
3750	85	75	64	95	65	65	41	82	41	730	18500
5000	85	83	66	107	65	65	45	90	45	820	22600
7500	99	87	67	120	75	75	47	94	47	1100	31000
10000	99	95	70	142	75	75	51	102	53	1360	38000
12000	99	103	75	152	75	75	55	110	57	1550	45000

<sup>1</sup> Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.

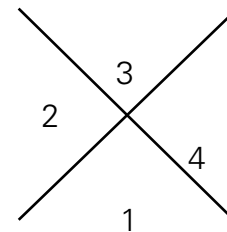
**Table 3. Fluid-Filled—Copper Windings 75 °C Rise<sup>1</sup>**

kVA	Drawing Dimensions (in.)									Gallons	Weight
	A	B	C	D	E	F	G	H	J		
500	66	47	26	47	45	45	27	54	35	280	5200
750	66	51	26	52	55	55	29	58	35	340	6300
1000	66	55	26	52	55	55	31	62	35	360	7400
1500	75	59	26	52	55	55	33	66	35	410	9700
2000	75	59	55	83	55	55	33	66	35	420	11200
2500	75	63	61	89	55	55	35	70	35	460	12800
3750	75	71	64	95	55	55	39	78	41	590	17200
5000	85	79	66	105	65	65	43	86	45	880	23700
7500	85	87	67	120	75	75	47	94	47	990	30800
10000	99	91	69	140	75	75	49	98	51	1310	37000
12000	99	95	74	150	75	75	51	102	55	1430	43000

<sup>1</sup> Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.



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



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

**Table 4. Fluid-Filled—Aluminum Windings 65/75 degree C Rise<sup>1</sup>**

kVA	Drawing Dimensions (in.)									Gallons	Weight
	A	B	C	D	E	F	G	H	J		
500	66	51	26	45	45	45	29	58	35	300	5500
750	66	55	26	52	55	55	31	62	35	350	6600
1000	66	59	26	52	55	55	33	66	35	390	7800
1500	75	59	50	78	55	55	33	66	35	400	9400
2000	75	63	55	84	55	55	35	70	37	450	11600
2500	85	67	62	91	55	55	37	74	35	520	14000
3750	85	75	64	104	65	65	41	82	41	770	19600
5000	85	83	66	120	65	65	45	90	45	920	24000
7500	99	91	68	137	75	75	49	98	49	1260	33300
10000	99	99	70	141	75	75	53	106	53	1550	40000
12000	99	103	75	152	75	75	55	110	57	1670	47000

<sup>1</sup> Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.

**Table 5. Fluid-Filled—Copper Windings 65/75 degree C Rise<sup>1</sup>**

kVA	Drawing Dimensions (in.)									Gallons	Weight
	A	B	C	D	E	F	G	H	J		
500	66	47	26	45	45	45	27	54	35	290	5600
750	66	55	26	52	55	55	31	62	35	360	7000
1000	66	59	26	52	55	55	33	66	35	390	8200
1500	75	55	50	78	55	55	31	62	35	410	9900
2000	75	63	61	89	55	55	35	70	35	450	12000
2500	75	67	61	89	55	55	37	74	35	480	13600
3750	85	75	65	110	65	65	41	82	43	740	20000
5000	85	83	66	120	65	65	45	90	45	960	25000
7500	99	91	68	137	75	75	49	98	49	1250	34000
10000	99	95	70	141	75	75	51	102	53	1520	41000
12000	99	103	75	152	75	75	55	110	57	1740	46000

<sup>1</sup> Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton's Cooper Power Systems for exact dimensions.

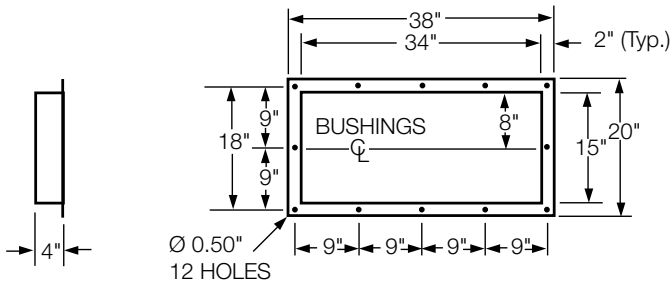


Figure 4. Throat.

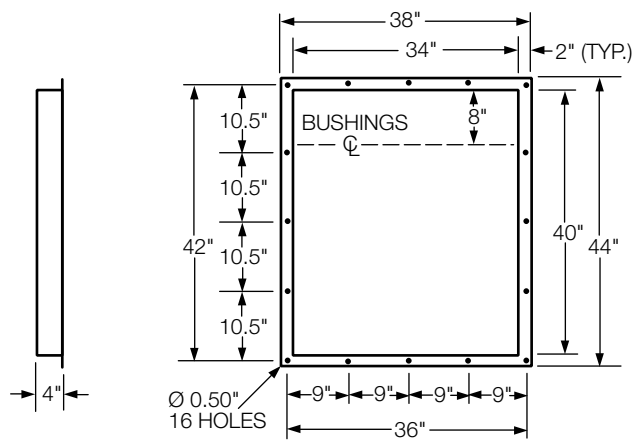


Figure 7. Flange.

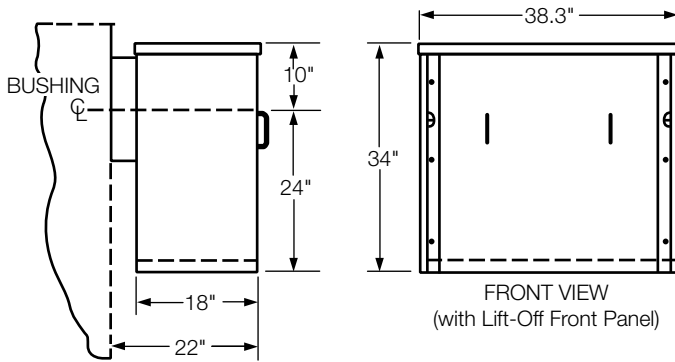


Figure 5. Air terminal chamber-bottom entry.

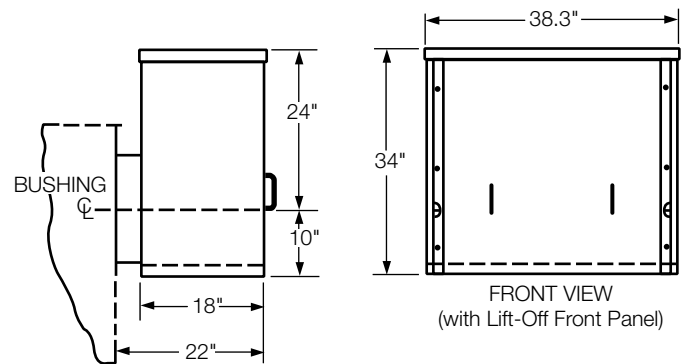


Figure 8. Air terminal chamber-top entry.

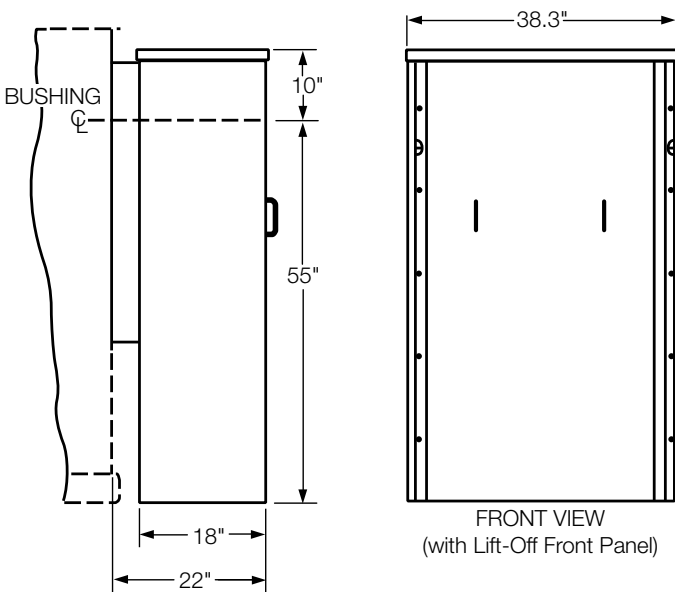


Figure 6. Full length cabinet-bottom entry.

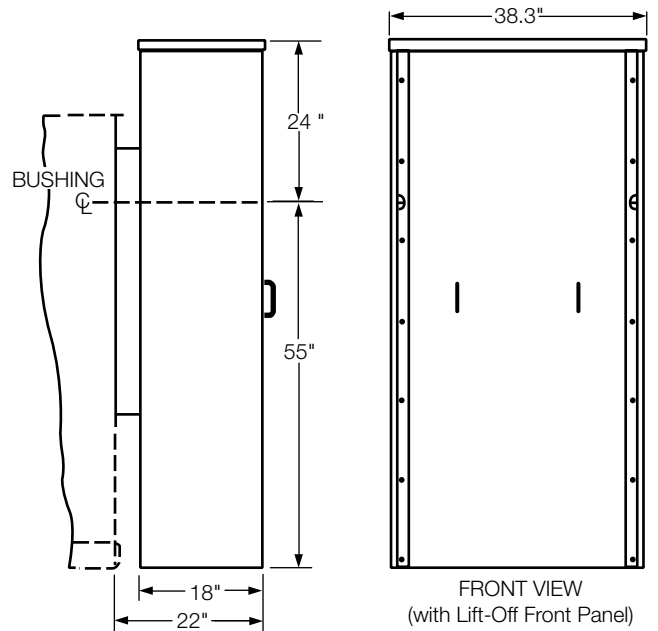


Figure 9. Full length cabinet-top entry.

## Standard features

### Fluid

- Envirotemp™ FR3™ fluid

### Mechanical Features

- De-energized tap changer, externally operable

### High- and Low-Voltage Bushings

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

### Tank

- Tank bases designed for skidding or rolling in any direction
- Extra-heavy, welded-in-place lifting lugs and jack pads (4)
- Stainless steel grounding pads (4)
- Cooling radiators 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" drain valve with sampler combination (2500 kVA and below)
- 2" drain valve with sampler (over 2500 kVA)
- 1" upper filter valve (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

- 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

## 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™-2005 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) cooling 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

Transformers from Eaton's Cooper Power Systems are available with Envirotemp™ FR3™ fluid. The highly refined fluid is 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.

Eaton's Cooper Power Systems 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.

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

The Envirotran™ Transformer from Eaton's Cooper Power Systems 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, 2008 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.



### 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! HDC liquid filled transformers are engineered with higher electrical withstand, increased levels of insulation, and greater electrical clearance. All 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 bio-based Envirotemp™ FR3™ fluid that carries FM Approved® 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's Cooper Power Systems 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's Cooper Power Systems 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.

#### K-Factor

Eaton's Cooper Power Systems is designing transformers with appropriate K-factor correction to mitigate the effects of non-linear harmonic loading conditions.

#### Solar/Wind Designs

Eaton's Cooper Power Systems is offering custom designs for renewable energy power generation. Eaton's Cooper Power Systems manufactures 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's Cooper Power Systems is offering inverter step-up transformers, as well as dual secondary designs to isolate a two-inverter input.

### Special protection features

#### Primary Air Disconnect Switch

- Provides economical, visible disconnect primary load break switching.
- Fully coordinated and packaged with the transformer by Eaton's Cooper Power Systems.
- Meets IEEE Std C37.20.3™-2013 standard, NEMA® 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's Cooper Power Systems performs routine testing on each transformer manufactured including the following tests:

- **Insulation Power Factor:** This test verifies that vacuum processing has thoroughly dried the insulation system to required limits.
- **Ratio, Polarity, and Phase Relation:** Assures correct winding ratios and tap voltages; checks insulation of HV and LV circuits. Checks entire insulation system to verify all live-to-ground clearances.
- **Resistance:** This test verifies the integrity of internal high-voltage and low-voltage connections; provides data for loss upgrade calculations.
- **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:** 3.46 times normal plus 1000 volts for reduced neutral designs.
- **Loss Test:** These design verification tests are conducted to assure 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 7 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® and IEEE® temperature rise criteria.
- **Audible Sound Level:** Ensures compliance with NEMA® 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 Systems Transformer Products is 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. Headquarters for the Systems Engineering Group of Eaton's Cooper Power Systems, this research facility is fully available for use by our customers to utilize our advanced electrical and chemical testing labs.



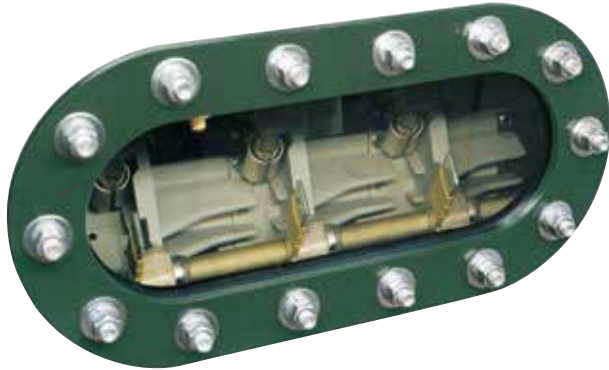


Figure 12. Substation transformer with visible break technology.



Figure 14. Triplex Indoor Power Center comprised of energy efficient and low noise single-phase substation transformers in a ganged setup.



Figure 13. Substation transformer with customer-specific coordination and accessories.



Figure 15. Class 1 Div 2 hazardous duty substation transformer.

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