

Pad-Mounted, Small Power Transformers

**75–20,000 kVA, 2.5–46 kV Primary Voltage, 120 V–25 kV Secondary Voltage
Class 7230**

Retain for future use.

Introduction

Three-phase, pad-mounted transformers, for use on underground power distribution systems, are best suited for commercial applications in public access areas and where underground service is required. These transformers meet modern design requirements for flexibility and provide a visually pleasing installation. Construction allows installation in locations accessible to the general public without the need for protective fencing or vaults. These units are ideally suited for apartment buildings, schools, hospitals, shopping centers, commercial buildings, or industrial sites. Standard, liquid-filled sizes range from 75–20,000 kVA, with primary ratings from 2.5–46 kV.



Environmental Information

- Sealed tank construction
- Special waste disposal considerations

Ratings

- 75–20,000 kVA
- Primary voltage: 2.5–46 kV
- Secondary voltage: 120 V–25 kV
- Insulation temperature limit: 120 °C
- Temperature rise: 65 °C (standard); 55 °C, 75 °C, 55/65 °C, 55/75 °C, or 65/75 °C (optional)

NOTE: All 75 °C rise options require FR3 fluid.

Certifications

- ISO 9001 registered
- UL (standard); CSA (optional)
- Optional Factory Mutual listing
- DOE 2016 Energy Efficient (75–2500 kVA)

Special Design Options

- Special sound requirements
- Special altitude requirements
- Retrofit designs
- Higher efficiency requirements
- Special ambient conditions

Applicable Standards

- IEEE C57.12.00™—Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
- IEEE C57.12.34™—Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 2,500 kVA and Smaller: High Voltage, 34,500 GrdY/19,920 V and Below; Low Voltage, 480 V and Below
- IEEE C57.12.28™—Standard for Pad-Mounted Equipment—Enclosure Integrity
- IEEE C57.12.70™—Standard for Terminal Markings and Connections for Distribution and Power Transformers
- IEEE C57.12.80™—Standard Terminology for Power and Distribution Transformers
- IEEE C57.12.90™—Standard Test Code for Liquid-Immersed Distribution, Short-Circuit Testing of Distribution and Power Transformers
- IEEE C57.13™—Requirements for Instrument Transformers
- ANSI/IEEE 386—Separable Insulated Connector Systems for Power Distribution Systems Above 600 V
- ASTM D877—Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
- NEMA AB1—Molded Case Circuit Breakers
- NEMA TR1—Transformers, Regulators, and Reactors

Specifications

- A. The transformer(s) shall be compartment type, self-cooled, for mounting on a pad and shall comply with the latest applicable standards.
- B. The average temperature rise of the windings, measured by the resistance method, shall be [55] [65] [75] [55/65] [55/75] [65/75] °C when the transformer is operated at the rated kVA output in a 40 °C ambient. (All 75 °C rise options require FR3 fluid.) The transformer shall be capable of being operated at the rated load in a 30 °C average, 40 °C maximum ambient, as defined by IEEE C57.12.00™, without loss of service life expectancy.
- C. Content and insulating fluid shall be [inhibited mineral oil] [less flammable seed oil-based fluid].
- D. The high and low voltage compartments shall be located side by side, separated by a steel barrier. When facing the transformer, the low voltage compartments shall be on the right. Terminal compartments shall be full-height, air-filled, with individual doors. The high voltage door fastenings shall not be accessible until the low voltage door has been opened.
- E. The following accessories shall be provided as standard on all transformers:
 - 1. Nameplate in low voltage compartment.
 - 2. One-inch upper filter press and filling plug.
 - 3. Drain plug provided on 75–500 kVA. Drain valve provided on units rated above 500 kVA.
 - 4. Tap changer, for de-energized operation only, which is externally operable and padlockable.
 - 5. The front of both compartments shall be removable to allow the transformer to be rolled or skidded into position over conduit stubs.
 - 6. ANSI tank grounding provisions shall be furnished in both compartments.
- F. The transformer(s) shall be rated [_____] kVA, self-cooled (ONAN). Primary voltage _____ [delta] [wye]. Secondary voltage _____ [delta] [wye], [3-wire] [4-wire], 60 Hz with two 2½% full capacity above normal taps and two 2½% below normal taps. Impedance shall be [_____ %] [manufacturer's standard impedance], ±7½%. Basic impulse level of the primary winding shall be [_____ kV] [as specified in IEEE C57.12.00™ for comparable kV class].
- G. The transformer shall be of sealed-tank construction or sufficient strength to withstand a pressure of 7 psi without permanent distortion. The cover shall be welded and the fastenings tamper-resistant. The transformer shall remain effectively sealed for a top oil temperature of -5 °C to 105 °C. Lifting eyes and packing pads will be provided.
- H. Coils shall be wound with [copper] [aluminum] conductors.
- I. Core and coil assembly shall be manufactured using high grade, grain-oriented silicon steel laminations. Magnetic flux is to be kept well below the saturation point.
- J. Transformers connected wye-wye shall be built with four- or five-legged core-type design to avoid the tank heating problems sometimes associated with wye-wye connections.
- K. The high voltage terminations and equipment shall be [live front] [dead front].
- L. Live front bushings shall be porcelain with [clamp-type connector] [blade terminals incorporating a two-hole drilling pattern]. Bushings shall be externally clamped and front removable.

- M. Dead front bushings shall be 200 A, either universal wells or wells with inserts for use with separable connectors. Bushings shall be externally clamped and front removable.
- N. Dead front bushings shall be 600 A, one-piece integrated, with removable stud, for use with separable connectors. Bushings shall be externally clamped and front removable.
- O. The low voltage bushings shall be molded epoxy, and provided with blade-type spade terminals with NEMA standard hole spacing arranged for vertical take-off. The low voltage neutral shall be an insulated bushing, grounded to the tank by a removable ground strap.
- P. Wye-wye transformers shall have the high and low voltage neutrals internally tied with a removable strap.
- Q. A load break, gang-operated, liquid-immersed switch shall be provided that is externally operable from the high voltage compartment through the use of a distribution hot stick.
- R. Switch to be [two-position "OFF/ON" type for use on a radial feed system] [three-position type for use on an alternate feed system with feed-from-the-left, feed-from-the-right, or OFF] [four-position "sectionalizing" type for use on an extended radial or loop-feed system with feed-from-the-left, feed-from-the-right, isolated-from-either-side, or through-feed-to-both-sides] [(3) two-position switches to be used as "sectionalizing" switches on extended radial or loop-feed systems with feed-from-the-left, feed-from-the-right, isolated-from-either-side, or through-feed-to-both-sides].
- S. Liquid-immersed switch to be rated at [200] [300] [600] A.
- T. Select one of the following options for fusible protection:
 - 1. Internal, liquid-immersed, cartridge fuses sized at _____ A [approximately three times the full-load primary current]
 - 2. Bay-O-Net™ liquid-immersed fuses that are externally replaceable with a hot stick without opening the transformer tank
 - 3. Bay-O-Net liquid-immersed fuses in series with oil-immersed, current-limiting fuses. Bay-O-Net fuses are to be externally replaceable with a hot stick without opening the transformer tank
 - 4. Bay-O-Net liquid-immersed, current-limiting fuses that are externally replaceable with a hot stick without opening the transformer tank.
 - 5. Dry-well, canister-mounted, current-limiting fuses that are externally replaceable with a distribution hot stick without opening the transformer tank
- U. Provide three _____ kV distribution class lightning arresters for surge protection. Arresters are to be mounted in the high voltage compartment.

V. Accessories

1. One-inch drain valve with sampling device, 75–500 kVA only; standard on units above 500 kVA
2. Dial-type thermometer [contacts]
3. Magnetic liquid-level gauge [contacts]
4. Pressure vacuum gauge [contacts] [bleeder] [contacts and bleeder]
5. Pressure relief valve [with band] [with cap]
6. Automatic pressure relief device (self-resealing with indicator)
7. Mounting provisions for low voltage current transformers and potential transformers
8. Busway opening into the low voltage compartment to accommodate Square D™ brand I-Line™ busway
9. Molded case circuit breaker in the low voltage compartment rated _____ A, with a 2000 A maximum rating
10. Sudden pressure relay [Seal-in Relay (AC)] [Seal-in Relay (DC)] [without Seal-In Relay]
11. Key interlock to high voltage door
12. kWh meter socket with meter, provided with a hinged, padlockable cover externally mounted on the side of the low voltage compartment
13. Pressure relief diaphragm [contacts]
14. Nitrogen blanket (standard on less flammable seed oil units)
15. Winding temperature indicator with contacts

W. Tests shall be conducted in accordance with IEEE C57.12.90™, and shall include, as a minimum, the following tests:

1. Ratio
2. Polarity
3. Phase rotation
4. No-load loss
5. Excitation current
6. Impedance voltage
7. Load loss
8. Applied potential
9. Induced potential
10. Quality control impulse

Technical Data

Table 1: Standard Transformer Ratings, Primary Voltage Class 2.5–46 kV, 65 °C Rise, 30 °C Ambient

kVA Self-Cooled	Secondary Voltage			
	208Y/120 V	240 V Delta	480Y/277 V 480 V Delta 600 V Delta	4160Y/2400 V 4160 V Delta 2400 V Delta
75	X	X	X	
112.5	X	X	X	
150	X	X	X	
225	X	X	X	X
300	X	X	X	X
500	X	X	X	X
750	X	X	X	X
1000	X	X	X	X
1500	X	X	X	X
2000		X	X	X
2500		X	X	X
3000			X	X
3750			X	X
5000			X	X

The above combinations are based on standard designs. Voltages above 35 kV and KVA ratings above 5,000, or other than standard designs may place further restrictions on the availability of voltage and kVA combinations. Consult the factory for final determination.

Table 2: Audible Sound Levels

kVA Rating	Decibels (dB)	kVA Rating	Decibels (dB)
75	51	1000	58
112.5	55	1500	60
150	55	2000	61
225	55	2500	62
300	55	3000	63
500	56	3750	64
750	57	5000	66

Table 3: System Voltages and Transformer BIL Ratings

Nominal System Voltage (kV)	Standard and Optional Transformer BIL Ratings									
	30	45	60	75	95	110	125	150	200	250
1.2	S	1								
2.5		S	1							
5.0			S	1						
8.7				S	1					
15.0					S	1				
25.0							S	1		
34.5							2	S	1	
46.0									2	S

S = Standard value.

1 = Optional higher levels where exposure to overvoltage occurs and improved protective margins are required.

2 = Lower levels where protective characteristics of applied surge arresters have been evaluated and found to provide appropriate surge protection.

Table 4: Performance Data

Typical Performance Data					Regulation			
kVA	%IZ	%IR	%IX	X/R	1.0 PF	0.9 PF	0.8 PF	0.7 PF
75	3.50	1.63	3.10	1.91	1.67	2.84	3.17	3.36
112.5	3.50	1.22	3.28	2.69	1.27	2.56	2.96	3.21
150	3.75	1.19	3.56	2.98	1.26	2.66	3.11	3.39
225	4.00	1.13	3.84	3.40	1.20	2.73	3.23	3.55
300	4.00	0.99	3.87	3.90	1.07	2.63	3.15	3.48
500	4.50	1.14	4.35	3.82	1.23	2.98	3.56	3.93
750	5.75	1.00	5.66	5.66	1.16	3.48	4.28	4.80
1000	5.75	0.86	5.68	6.59	1.02	3.37	4.18	4.72
1500	5.75	0.77	5.70	7.38	0.93	3.29	4.12	4.67
2000	5.75	0.84	5.69	6.78	1.00	3.35	4.17	4.71
2500	5.75	0.66	5.71	8.62	0.83	3.20	4.04	4.60
3000	5.75	0.95	5.37	5.98	1.11	3.44	4.24	4.77
3750	5.75	0.93	5.68	6.11	1.09	3.42	4.23	4.76
5000	6.00	0.66	5.96	9.03	0.84	3.32	4.20	4.79

Table 5: Standard % Impedance

kVA	IEEE Standard (Nominal)	Square D (Nominal)	Optional Range
75	1.10–5.75	3.50	2.00–5.00
112.5	1.40–5.75	3.50	2.00–5.00
150	1.40–5.75	3.75	2.00–5.00
225	1.40–5.75	4.00	3.00–5.50
300	1.40–5.75	4.00	3.00–5.50
500	1.70–5.75	4.50	3.50–5.50
750–3750	5.75	5.75	5.00–8.00
5000	6.00	6.00	5.00–8.00

Table 6: Typical Performance Data: High Voltage—15 kV Class; Low Voltage—600 V Class

kVA	No Load Losses (Watts)	Full Load Losses ¹ (Watts)	Total Losses (Watts)	Efficiency ¹				
				112%	100%	75%	50% ¹	25%
75	175	796	971	98.62	98.72	98.91	99.03	98.82
112.5	212	1213	1425	98.64	98.75	98.95	99.11	98.99
150	269	1547	1816	98.70	98.80	99.00	99.16	99.03
225	327	2315	2642	98.73	98.84	99.04	99.23	99.17
300	451	2760	3211	98.85	98.94	99.12	99.27	99.18
500	624	4271	4895	98.94	99.03	99.20	99.35	99.29
750	842	5854	6696	99.03	99.12	99.27	99.40	99.36
1000	996	7832	8828	99.04	99.12	99.28	99.43	99.41
1500	1532	9880	11412	99.18	99.24	99.37	99.48	99.43
2000	1782	12987	14769	99.20	99.27	99.40	99.51	99.48
2500	2438	14356	16794	99.28	99.33	99.44	99.53	99.47
3000	5385	28450	33835	98.79	98.88	99.06	99.17	99.05
3750	7700	34850	42550	98.79	98.88	99.04	99.13	98.96
5000	8240	33020	41250	99.12	99.18	99.29	99.34	99.18

¹ Full load losses and efficiencies are at a reference temperature of 85 °C in accordance with IEEE Standard C57.12.91. The efficiencies of transformers with a 75–2,500 kVA rating at 50% load are at a reference temperature of 55 °C in accordance with DOE Test Procedure 10 CFR, Part 431, Subpart K, Appendix A.

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