HIGH RISE TRANSFORMER SPECIFICATION GUIDE

This document is a guide to create a high-rise transformer specification in accordance with installation and system requirements.

Medium voltage distribution circuits (typically 15 kV to 25 kV) in high-rise buildings offer higher efficiency and lower overall cost. Federal Pacific's high-rise type transformers were developed specifically for these special power distribution systems. In these systems, power circuits branch from the main high voltage bus to high-rise transformers which then step the voltage down to feed individual customers panels.

Using a medium voltage main bus is a cost advantage because it is less expensive than a low voltage bus which uses much larger cables and junction boxes. It also offers superior voltage regulation and lower operating costs due to lower losses in the high voltage bus.

Federal Pacific high-rise transformers also offer other useful features such as sound levels far below standard for quiet operation, high voltage bushings or bushing wells, incoming high voltage fuses with optional disconnecting means, provisions for lightning arresters, continuous overload capability, hinged panel access to high voltage compartment and an energy saving DOE 2016 efficient design. The most unique feature for high-rise transformers is a special trip device designed to blow fuses and isolate the transformer in the event of overheating. Finally, unlike liquid filled transformers, these transformers are dry-type so there is no need to worry about the possibility of expensive leaks, special maintenance and cumbersome installation requirements.

Federal Pacific high-rise transformers are the perfect power transformer solution for high-rise condominiums, apartments, office or other similar building.

Scope and Application

This specification covers medium voltage single and three-phase ventilated self-cooled dry-type dead-front distribution transformers specifically designed for indoor installation in high-rise apartment, condominium or office buildings.

Applicable Industry Standards

- IEEE C57.12.01 - IEEE Standard for General Requirements for Dry-Type Distribution and Power Transformers
- IEEE C57.12.91 - IEEE Standard Test Code for Dry-Type Distribution and Power Transformers

Design Requirements

Standard Transformer Ratings

Phase	1 or 3
Frequence	60 Hz
Primary Voltage	Up to 15 kV
Primary Basic Impulse Level (BIL)	60 kV or 95 kV as specified
Secondary Voltage	600 V Class
Connections	Single, Delta or Wye as applicable
Secondary Basic Impulse Level (BIL)	10 kV
Temperature Rise	80°C (Optional 115°C)
Conductor	Aluminum (Optional Copper)
Impedance	4% to 7%
Ambient Temperature	30°C 24 hour average, 40° C maximum

Voltage Taps

Voltage taps are +2, -2 x 2.5%

Transformer Construction

Cooling

The transformer shall be ventilated, open wound dry-type resin encapsulated construction cooled by the natural circulation of air through the windings.

Insulation Material

The insulation system for the transformer windings shall be a UL® listed 220°C (Class R). Winding layer insulation shall be DuPont Nomex®.

Core and Core Assembly

The core shall be constructed of non-aging, cold-rolled, high permeability silicon steel. All core laminations shall be step-lap mitered cut, free of burrs and stacked without gaps. The core framing structure shall be of rigid construction to provide full clamping pressure upon the core and provide the support points for the coils. Coils shall be adequately braced for full short circuit capability.

Vibration Dampening

The core and coil shall be supported by vibration isolation pads to effectively dampen vibration transferred to the transformer enclosure.

Vacuum Pressure Impregnation (VPI)

Transformer coils shall undergo a vacuum pressure impregnation process to eliminate air voids within the windings using a high build polyester or epoxy resin.

Final Core and Coil Assembly

Upon placement of coils on the core legs, the top core yoke is stacked, the core is tightly clamped and all necessary leads are connected to the bus components for customer connections. Protective coatings for the core and metal bracing components are applied.

General Enclosure and Base Construction

A. The enclosure shall include provisions for rolling, skidding, lifting, and jacking for installation.

B. The cabinet metal must be at least 14-gauge thickness.

C. An expanded metal mesh or equivalent shall cover the bottom of the enclosure to provide ventilation and prevent entry by rodents.

D. Removable front and rear panels shall be furnished with handles for easy removal.

E. Left and right side panels shall have cutout openings on the lower side for cable entrance, approximately centered with the secondary terminals. Two cover plates shall be provided for the openings. One cover plate shall be a solid blank cover and the other with a slotted opening on a 10° angle to accept a 5 inch conduit bushing. A slotted insulating cable guide shall also be provided for

the cutout openings for interchangeable use for either opening.

F. Lifting provisions shall be of corrosion resistant material and so arranged to provide a suitably balanced lift for the completely assembled unit.

Single Phase Enclosure Construction

A. The enclosure rear shall have removable panels for inspection and service composed of a top section overlapping a bottom section.

B. The enclosure front shall have removable panels for inspection and service composed of three sections (top, middle and bottom)

C. The top front section shall serve as the high voltage compartment door used to access fuses, arresters, shorting switches and internal bushing well connections. It shall be attached to the middle section with hinges and secured with winged bolts or hex style nuts.

D. The middle section shall overlap the bottom section covering the low voltage compartment.

E. The bottom section shall be installed above the base support runners (feet) and shall extend approximately 8 inches above the secondary phase terminal X3.

F. A removable insulated 3/16" minimum thick barrier shall separate the secondary compartment from the primary compartment. Steel channel guides shall be installed for sliding the barrier into place. These guides shall be located so the barrier may be installed with the top section of the front panel in place. Hooks shall be provided on either side of the transformer enclosure for storing the barrier.

Three Phase Enclosure Construction

A. The enclosure front shall have removable panels for inspection and service.

B. The bottom section shall be installed above the base support runners (feet) and shall extend approximately 8 inches above the secondary phase terminal X1.

C. Three phase transformers shall be provided with a removable fuse chamber also containing shorting switches, bushing wells and arrester mounting brackets.

D. A hinged door shall provide front access to the fuse chamber. The door shall be hinged along bottom such that door opens out and swings downward. The door shall be secured with winged bolts.

Enclosure Finish

Metal components of the enclosure shall undergo a seven stage treatment process before paint application consisting of (1) weld grind preparation as necessary (2) alkaline spray wash (3) rinse (4) chemical wash for enhanced bonding (zirconization) (5) de-ionized water rinse (6) aqueous sealer application (7) drying. Once parts are completely dry, enclosure parts are painted with electrostatically applied polyurethane powder coat paint then baked for optimum hardness and finish. Paint color shall be ANSI 61 grey.

Grounding Facilities

A grounding pad shall consist of a corrosion-resistant metallic surface 2 inches by 3-1/2 inches installed on the outside of the side panels above each of the cable knockouts openings. Each pad shall be provided with two holes horizontally spaced on 1-3/4" centers and tapped for ½"-13 NC thread. Internal connection (by removable strap or cable of #4/0 copper capacity) shall be made from the core frame to either case grounding pad.

Bushings

A. The high voltage shall be supplied with Federal Pacific or equivalent 200 amp bushings with removable stud on each ungrounded phase. Bushing shall be installed with a keeper plate / clamping ring furnished with grounding provisions.

B. Bushing wells shall be installed in a top mounted removable fuse chamber for three-phase units and in the top fuse compartment section for single-phase units.

C. Single-phase wye connected transformers shall have one 600 volt bushing with eye bolt connector for primary neutral to be supplied with single phase transformers. The well and bushing shall be installed on the right side of the transformer and have provisions for installation on the left side.

Low Voltage Terminals

The secondary shall be terminated with tinned or silver plated spade type terminations sized to carry maximum nameplate loads. Terminals shall be located near the front of the enclosure at the base of the core and coil assembly in a horizontal configuration. Terminals shall have a minimum air clearance of 1.5 inches to the front panel.

The terminals shall be vertically offset from one another as much as possible but no less than 2 inches. The uppermost terminal should be vertically positioned no less than 8 inches from the top edge of the lower panel.

Nameplate
Nameplate shall be anodized aluminum with ratings shown as required in IEEE C57.12.01.

Stenciling or Labeling
The following special labeling shall be required, except as noted, in addition to standard markings and labeling in accordance with IEEE standards.

1. Catalog ID (optional)
2. Shipping detail instructions where applicable
3. The fuse symbol shall be displayed on the fuse access panel. Below the symbol, stencil **"DANGER - De-energize this transformer before opening or removing this panel or operating the fuse".**
4. Barcode labeling (optional)

Accessories and Equipment
Shorting Switch
A thermally operated spring shorting switch shall be installed in the fuse compartment on the enclosure for each ungrounded phase in a manner which insures positive grounding of the load side of the fuse clip when the thermal switch is actuated. The thermal shorting switch assembly shall be shipped from the factory with the fusible link disengaged. Three phase shorting switches shall be designed to mechanically trigger all three switches simultaneously. A bare #2 copper ground wire shall be installed connecting the shorting switch to the ground bus or terminal.

Fuses and Mountings
Primary high voltage fast clearing current limiting type fuses shall be located horizontally in the upper fuse compartment for over-current protection. Three phase transformer fuse compartments shall be removable. Fuses may be "clip-style" or incorporate load-breaking capability. Fuse ratings shall be specified by the customer to meet system and code requirements.

Surge Arresters
Mounting provisions for distribution class surge arresters shall be provided in the upper fuse compartment.

Performance
Efficiency
The transformer efficiency must meet or exceed the latest U.S. Department of Energy regulations for dry-type transformers in 10 CFR 431.196 computed at 50% load and 75°C.

Sound Level
Transformer sound levels shall not exceed those given in table 2 as laboratory tested per IEEE C57.12.91.

Table 2 - Maximum Sound Levels

Single Phase (15 - 500 KVA)	Three Phase (30- 500 KVA)
45 dBA	50 dBA

Overload
Transformers shall be capable of continuous overloads in accordance with Table 3 without exceeding the temperature limits of the insulation system. Overload ratings shall be identified on the nameplate.

Table 3 - Continuous Overload Capability

Temperature Rise	Overload
80°C	130%
115°C	115%

Quality Assurance
Quality System
The manufacturing facility shall be an ISO 9001:2015 registered facility.

Testing
The following tests shall be performed on each transformer in accordance with IEEE C57.12.91.

1. Resistance	7. Induced voltage
2. Ratio	8. Insulation resistance (Megger)
3. Polarity and phase relation	9. Partial discharge
4. No load loss and excitation current	10. QC Impulse (50% & 100% full wave)
5. Impedance voltage and load loss	11. Sound level
6. Applied voltage (Hipot)	

Final Test Reports in the proper IEEE format shall be furnished for each unit upon request.

Packing and Shipping
Transformers shall be wrapped in a weatherproof covering as required and mounted on suitable skids. All temporary shipping hardware and brackets shall be painted red for ease of identification for future removal. Instruction manuals shall be shipped with each transformer.