

Howard Smart Transformer Specification Guide

General Requirements

Overhead pole-type smart distribution transformers shall be single phase, 60 Hz, mineral-oil filled and self-cooled and shall conform as applicable to the latest revision of the following IEEE standards: C57.12.00, C57.12.20, C57.12.28, C57.12.70, C57.12.80 and C57.12.90.

Size and Ratings

The transformer shall have a kVA rating of one of the following sizes: 15, 25, 37.5, 50, 75, 100, 167, 250, 333 and 500kVA based on not exceeding a 65°C average winding temperature rise. Transformers shall have two primary bushings with ratings per Table I.

Coil Bonding and Terminating

Coils shall be tightly bonded utilizing double adhesive insulation paper or tape and heat cured for bonding.

Hardened aluminum tabs shall be welded to soft aluminum secondary leads to assure a durable connection at the bushings. Tabs shall have embossed markings. Any alternate shall have prior approval of the Avista Utilities Engineering Department.

Clamping and Bracing

Transformer coils shall be clamped, and leads supported in such a manner as to be capable of withstanding, without injury, the mechanical and thermal stresses of short circuits defined in ANSI C57.12.00 and C57.12.90.

Parallel Connection Operation

Transformer to be used in 120/208 banks shall have windings factory connected in parallel across X1 and X2. The X3 bushing will float and the X3 CT will be out of the circuit. At the time of order a “-P” will be added to the stock number. The “-P” designation is intended to assist for tracking by manufacturer. Because 120/208 connected units are physically identical to 120/240 units, they will not have a different stock number for Avista inventory.

Parallel Connected Identification

Units shipped from the factory shall be identified by covering the X3 bushing with electrical tape.

Secondary Arresters

Shall include double pole secondary arrester, Cooper ASZ175B2 or equivalent. The arrester shall be installed on the tank and connected to secondary bushings. If the transformer has the windings connected in parallel, both arrester poles shall be connected across the coils.

General Smart Transformer Requirements

Shall be equipped with a computer circuit board in a weather tight enclosure mounted to the exterior of the transformer. Shall monitor the operation of the transformer and report data to Avista DMS system via cellular radio.

Sensing Capabilities

- Senses the temperature of the transformer using thermocouples
- Measures both low voltage half-winding temperatures via thermocouples embedded in the coils
- Measures top-oil temperature via a thermocouple mounted inside the transformer at the top level of the oil
- Measures ambient temperature outside the transformer via a thermocouple mounted on the circuit board's enclosure
- Calculates the coil hot-spot temperature using a mathematical model based on the above temperature readings
- Measures the temperature inside the electronics enclosure
- Measures both secondary RMS voltages
- Measures both secondary RMS currents
- Measures secondary watts, volt-amperes, and power factor
- Measures cumulative kWatt-hours

Analysis Capabilities

- Estimates the remaining insulation life of the transformer
- Uses ANSI equation for insulation aging, based on hot-spot temperature of coil over time
- Keeps up with percent of insulation life used

Reporting Capabilities

The following values can be reported on demand or automatically on a customer-selected interval.

- Temperature of both low voltage half-windings
- Temperature of top-oil
- Temperature of ambient outside of the transformer
- Temperature inside the circuit board enclosure
- Calculated current hot-spot temperature of the coil
- Peak hot-spot coil temperature recorded
- Minimum hot-spot coil temperature recorded
- Percent insulation life used
- Secondary RMS voltages
- Secondary RMS currents
- Secondary watts, volt-amperes, and power factor
- Cumulative kWatt-hours
- Power fail indication if transformer loses power
- Current date and time

- Serial number of transformer
- Catalog number of transformer
- Primary voltage rating of transformer
- Power rating of transformer in KVA
- Structure number (customer entered)
- Location of transformer (GPS coordinates)
- Firmware version of Smart Transformer circuit board

Controllable/Configurable Settings

- Reset peak and minimum temperature readings
- Enable or disable periodic reporting of data
- Change the time interval for periodic data reporting
- Set insulation life consumption value
- Set custom coefficients for the ANSI insulation aging formula
- Set normal expected insulation life value
- Communications retry time interval
- Communications retry attempt count

Hardware/Firmware Features

- Low power circuit board that draws its power from the transformer secondary
- Front-end surge suppression to protect the circuit board
- Long-life, industrial-grade circuit components
- Long-life super capacitors are used instead of batteries to keep the circuit board powered for over a minute in the event of a power failure. This provides sufficient time to send a power fail notification message to the customer's SCADA system, indicating the location of the power fails.
- Cellular radio board with embedded or external antenna to communicate with customer's cellular network and SCADA system
- Industry-standard DNP3 protocol is used for communications
- Non-metallic, weather-tight enclosure mounted to the exterior of the transformer tank encloses the circuit boards
- Thermocouple wires and power / voltage sense wires routed from the interior of the transformer through a sealed feed-through or connector on the transformer tank wall to the circuit board enclosure

Radio Board Configuration

Radio Board shall be preconfigured to operate on the Avista Smart Grid wireless mesh system using the provided network configuration information. This includes, but is not limited to, a static IP address, subnet mask, default gateway, service set identifier (SSID) and DNP3 port of 20500. This information shall be cross-reference to the transformer stencil number. All information shall be provided to Avista in electronic form.

OTA Firmware Update Capabilities

The radio board shall support Over-the-Air (OTA) firmware updates through Tropos Control or OpenWay Control.

Mesh Network Capabilities

Smart transformers shall have the ability to actively participate in the mesh network, supporting mesh links to downstream Itron and/or Tropos routers.

Terminals

High and low voltage terminals shall accommodate conductor sizes specified in ANSI C57.12.20. Two external tank ground terminals shall be provided and shall accommodate conductor sizes up to #2 stranded copper or aluminum. One tank ground shall be under H2 low on the tank. The second tank ground shall be three to four inches below the X2 terminal. The primary terminals shall accommodate the use of a box end ratchet wrench (Fargo) for tightening the connector nut.

Neutral Ground Strap

A low voltage neutral ground shall be provided from X2 to the tank wall for all units with 120/240 volt secondaries.

Arrester Mounting Provisions

The top arrester mounting nut shall be located a nominal distance of 5" down from the top of the tank. The spacing to the bottom arrester mounting nut shall be 2.5" center to center after beading to accommodate a standard 10.5" arrester mounting bracket

Auxiliary Devices

Transformers shall not have secondary breakers, overload lights or internal fuses. Transformers shall have lightning arrester mounting bosses provided for each primary bushing. Mounting bosses shall be 1/2 x 13 thread size, spaced vertically 2.5" on center with a 5/8" depth.

Mounting Cleats

For transformers 100kVA and larger, two mounting cleats shall be provided on the bottom of the tank. These shall be located 45° relative to the X2 bushing. The cleats shall be drilled with a 9/16" bolt to accommodate half inch mounting hardware.

Hanger Brackets

Hanger brackets shall be provided on transformers up through 100kVA. No brackets are required for 167kVA and larger.

Pressure Relief Valve

Each unit shall be equipped with an automatic pressure relief valve (PRV) having a minimum flow rate of 35 SCFM at 15 PSIG. The valve shall be located above the oil level.

Paint Finish

The transformer shall have a gray (ANSI-70) corrosion resistant finish that will endure the following paint tests: Salt Spray, Adhesion, Humidity, Impact, Oil Resistance, Weathering and Abrasion, all as prescribed in the IEEE C57.12.31.

Nameplate

The transformer nameplate shall be so labeled to indicate that at the time of manufacture the transformer liquid contained less than one part per million PCB's.

Labeling

Shall include the following labels as shown on Page 1 of this specification as follows:

- Two sequential Stencil Numbers. 8" x 2-1/2" nominal dimensions, black on silver 3M engineering reflective background. One shall be on the side of the unit and the second shall be on the bottom.
- Non-PCB per Avista Specification 6620.220
- Two kVA rating per Avista specification 6411.500. One shall be on the side of the unit and the second shall be on the bottom.
- Secondary Voltage (if coils are connected in parallel for 120/208 operations for example) per Avista Specification 6411.500
- Smart Transformer Identification Decal, 2.5" high x 6" wide with 1/4" high black letters on silver reflective background. Shall read: All 120/240 and 120/208 connected units shall have an additional label located under the X2 bushing. The label shall read "Smart" transformer board is powered from X1 and X2. When paralleling secondaries for 120/208 operation, always use X1 and X2 bushing, float the X3 bushing for parallel operation and leave the X3 CT out of the circuit

Losses and Tests

Core and coil losses shall be in accordance with Avista Utilities current statement of Cost of Losses. Each transformer shall be tested for actual no load and load losses, percent impedance, and exciting current (100% voltage).

The purchaser shall reconcile the certified test results with the quoted values using the formula: (Average total cost of actual losses - quoted total cost of losses) X (number of transformers) X 1.15 (Administrative Overheads) = penalty cost. (Average per IEEE C57.12.00.9.3).

Insulating oil test for PCB's shall be per ASTM D4059.

Shipping and Identification

Transformers shall be shipped on a pallet. Units shall be appropriately protected during shipment to ensure they are delivered clean and free of surface contamination.