

Sales Engineering Technical Paper Series

Ringless Metering: CT Metering

From Cooper B-Line Technical Papers BLTPS-05, BLTPS-15 and BLTPS-16, the reader understands the theory of self-contained metering: that the revenue meter *directly* measures and records the amount of electricity used by the customer. This type of electrical metering is used mainly by customers not requiring more than 400 A electrical service. However, high-end residential, commercial, and industrial applications sometimes require electricity usage consistently higher than this. When measuring current above 400 A, (sometimes as high as 2000 amps), self-contained (direct) metering equipment cannot withstand the heat generated by this high current. The use of current transformers (CT's) is then required.

Current transformers do just as their name describes, they transform a high (primary) current into a low (secondary) current. The primary current at the CT is the ampacity being used by the customer. The secondary current is the stepped down current being measured by the revenue meter, see Figure 1.

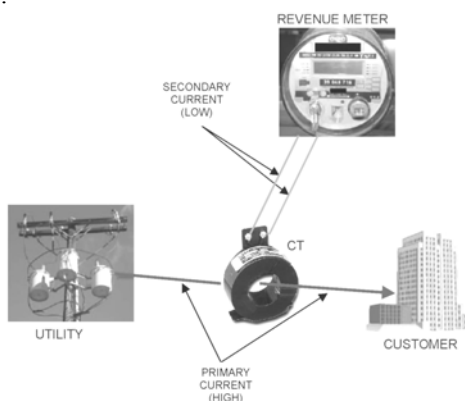


Figure 1. Schematic of Current Transformer operation

CT Metering System Configurations

CT metering is a system of components; CT's, CT-rated meter and socket, test switch, and the enclosure(s). The following discussion explains three of the most common configurations for CT metering and the interaction of the components. Common elements to CT metering include lockable NEMA 3R enclosures, 20-ampere meter sockets, and test switches that adhere to ANSI C12.9 standards. Ring and ringless designs are available with pre-wired test switches or a test switch provision for field assembly. These systems and components can all be customized with different material or finish, wiring colors, and special components, etc., if necessary.



See **BLTPS-05: Ring vs. Ringless Metering**, and **BLTPS-07: NEMA Ratings for Electrical Enclosures**



The **All-In-One** CT metering cabinet houses all CT metering components in one enclosure (CT's are purchased separately and installed and wired by customer). The advantages to this configuration are that the meter is visible from the outside, only one enclosure is required, and maintenance is easily performed by removing a single cover.



Trans-sockets are a special type of CT metering system very similar to the 'All-In-One' unit, but with the difference that the revenue meter is inside the cabinet. CT's are installed and wired at the factory per the utilities specification. The main advantages are easy customization, one-cover access to the interior, and a single enclosure housing all components.

The **Standard Configuration** of CT metering will be the focus of the remainder of this document. The standard configuration includes two separate enclosures, one for the CT's and the other for the meter socket and test switch. These enclosures are then connected by a single conduit. One advantage to this configuration is that the meter socket enclosure can be located above, beside, or even in front of the larger CT cabinet. The typical layout showing cabinets, conduit, and basic operation is shown in Figure 2.

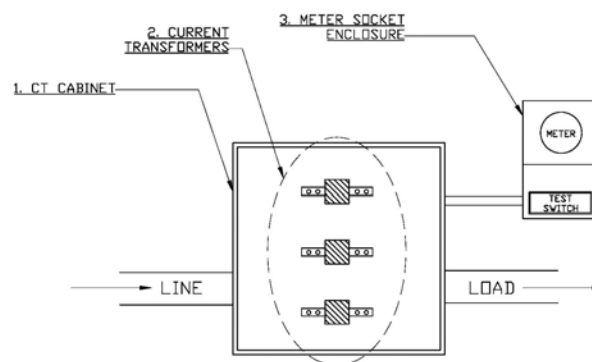


Figure 2. Standard CT Metering Configuration showing CT Enclosure and CT Meter Socket Enclosure.

1. **CT Cabinet:** This enclosure provides physical and environmental protection to the CT's as well as protection to passersby from the electrical shock hazards that exist inside. Numerous sizes and configurations are available. Typical dimensions for a cabinet are 30 inches wide, 30 inches tall, and 10 inches deep. However, cabinets up to 60 inches in

height and width by 20 inches deep have been used. Use of non-standard sizes is dependent on the level of current, conductor size and quantity, and utility specifications. Other attributes that might be specified by the utility or end user are single or double doors, CT mounting provisions, plywood back panel, provisions for mounting voltage/potential transformers (VT's & PT's), lockable hasp, special NEMA ratings, etc. Depending on the utility's preference and/or installation constraints, specially designed CT cabinets may be necessary.

2. **Current Transformers:** The 2 main styles of CT's are bar type and window type (also known as donut type).



Figure 3. Actual photos of Bar Type CT's and Window Type CT's.

Whichever style of CT being used, the unit must meet all national design standards, including ANSI®, UL®, and NEC®, for physical size, ampacity ratings, services, etc. The governing utility will normally specify which type of CT is required.

As discussed earlier, the CT scales the primary current into a measurable secondary current to be read by the meter. Current transformers operate on the principles of magnetism, inductance, and flux (discussion on these is beyond the scope of this document). The correlation between primary and secondary currents is known as the step-down ratio. A typical ratio used is 300:5, which means that when 300 A is flowing to the customer, the revenue meter will have 5 A flowing through it. If the current is increased to 600 A, the meter then sees 10 A of current. Accordingly, the revenue meter logs the secondary current and then uses the appropriate factor (based on the step-down ratio) to calculate the total amount of primary current that was used. Finally, the customer is charged for the total energy consumption of the billing period.

3. **Meter Socket Enclosure:**

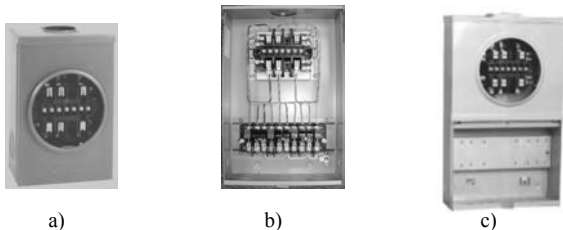


Figure 4. CT socket enclosures; a) CT socket-only version, b) Factory pre-wired unit w/o cover, Un-wired unit w/ test switch provision.

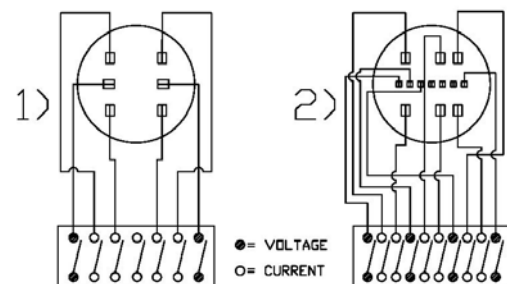
The main function of this enclosure is to provide the socket for the revenue meter and to secure and protect the meter once it is installed. The specific parts that can be included in

this enclosure are the meter socket (4, 6, 8, 13, or 15 jaw, depending on service type and utility preference), test switch mounting provision, test switch (4, 7, or 10 pole, depending on meter socket used), and one- or two-piece covers.

When selecting the proper CT meter socket enclosure, the electrical service supply and customer requirement must be fully known. This information will help determine the number of jaws required for the CT socket. The number of jaws available will vary, but most common are 6, 8, or 13 jaw layouts. Depending on the utility's preference, and its testing and maintenance procedures, the utility might choose a 6 or 8 jaw unit for 1Ø/3w or 3Ø/3w service. Six or eight jaw sockets differ in how the potential is referenced: phase to phase or each phase to ground. If the system is a 3Ø/4w, a 13-jaw CT meter socket may be used. The meter measures the secondary currents from the three CT's and references the potential from all three phases to ground.

The test switch works directly with the socket. Test switches are available in numerous configurations with options including different handle colors, barriers between poles/handles, single or ganged handles, and with a cover or without. Again, utility preference drives the specification on test switches. Depending on the number of socket jaws and the service being metered, four to ten pole test switches are used. The purpose of the test switch is to bypass the meter for maintenance and/or calibration of the meter without interrupting the primary current through the CT's. By opening the handles of the test switch in a certain sequence, the current and voltage jaws of the socket are bypassed. This procedure allows the meter to be removed and reinstalled without arcing, and more importantly, prevents a buildup of potential at the jaws from the uninterrupted inductance/flux from the CT's. This buildup of potential could be catastrophic when the meter is replaced and could cause the CT's to overheat and burn up if the test switch was not used properly.

Two common socket-test switch setups are: **1)** [1Ø/3w]: 6-jaw socket wired to an 8-pole test switch: 2 handles tied to voltage, 4 to current, and 1 open, **2)** [3Ø/4w]: 13-jaw socket wired to a 10-pole test switch: 4 handles tied to voltage, and 6 to current; see the following diagram.



CT metering is a complex system of components for measuring high amperage electrical services. Properly trained utility personnel perform regular maintenance and calibration of these components. Proper servicing leads to accurate electricity measurement, which then leads to accurate billing of customers.