CTs Transformed – Inside the Winding

Current Transformers (CTs) play a crucial role in electricity metering by enabling the accurate measurement of current flowing through power lines, particularly where currents are above 100A and conductors are too large to connect directly to a meter. CTs operate on the principle of electromagnetic induction; the primary conductor, usually the live supply cable, passes through the CT core (often as a single turn) and induces a proportional, lower current in the secondary winding. This produces a safe, manageable signal suitable for standard metering and protection equipment.

The transformer ratio of a CT ensures a linear relationship between primary and secondary current. For example, a 100:5A CT carrying a primary current of 50A will deliver 2.5A to the secondary output. When the meter is correctly configured, it will calculate and display the true primary current without directly connecting to the high voltage supply. This results in a safe, manageable and retrofittable secondary current that can be easily measured and monitored. Beyond metering, CTs are also integral to protective relay systems, providing essential data for the safe operation of electrical networks.

As simple devices with no moving parts, CTs are generally robust and existing hardware can usually be retained when meters are replaced, provided correct procedures are followed. A common question is whether existing CTs can be reused during a meter change; in most cases the answer is yes, as long as they are properly shorted during disconnection.

Please note leaving CTs open-circuit under load can generate dangerously high voltages, permanently damage the CT, and present a serious risk to life.

CTs must be appropriate for the application, including the correct current ratio and accuracy class. Smaller supplies require proportionally smaller CTs to maintain accuracy. Common formats include moulded case CTs, which require cables to be threaded through the core, and split-core CTs, which are easier to install on existing, preconnected supplies. In three-phase installations, three single-phase CTs are often preferred over combined three-phase blocks, as they better accommodate imperfect conductor alignment.

While the underlying physics is straightforward, there are several operational and safety-critical considerations that installers, project managers, and stakeholders must be aware of:

Polarity
Correct polarity is essential. CT polarity markings are often subtle and easily overlooked. In three-phase systems, a single CT installed with reversed polarity can effectively subtract energy, leading to significant under-recording—commonly visible as a reduction of approximately 66% in total consumption.

Open-circuit CTs
CTs that are not connected to a load (such as a meter), whether powered or not, can silently develop extremely high voltages due to induced current and no impedance. These voltages can

degrade insulation, cause fire, permanently damage the CT, and pose a serious, often unseen, risk to even experienced electrical workers.

Commissioning and scaling
CT installations require correct scaling within the electricity meter and any associated AMR or monitoring systems. Meter fuses and CT shorting links should be installed during wiring and only removed once the meter is fully connected. If shorting links are left in place, the meter will not see any energy consumption. Installed CTs may not match the nominal rating of the upstream switchgear—for example, a 125A breaker may be fitted with a 150:5A CT due to availability. During commissioning, it is essential to verify the actual CT ratio and ensure meter configuration matches. Best practice includes photographic evidence and documented verification of CT ratings at installation.

Error and opportunity cost
Getting CT installation right first time will require both experienced suppliers and installers. Cutting corners by using cheap equipment and inexperienced installers can be more costly in the long run. Rectifying CT issues almost always requires additional shutdowns and the involvement of fully competent electrical personnel. The resulting costs in labour, travel, time, and disruption—whether borne by the client, contractor, or both—are significant. Beyond direct costs, incorrect CT installation risks loss of goodwill, strained relationships, project delays, and damage to trust and perceived competence.