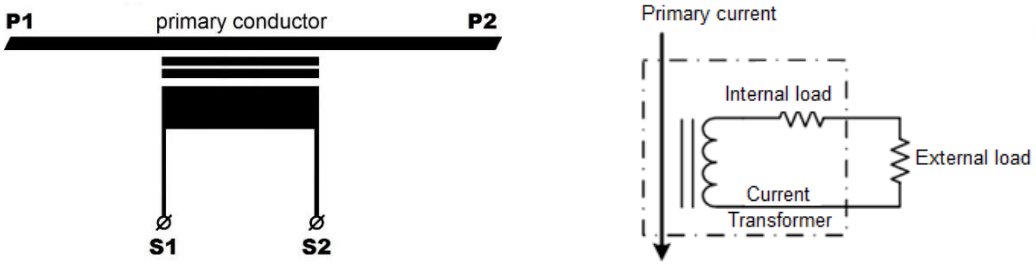
Whitepaper
Burden of a Current Transformer

A current transformer converts a high primary current with a secondary winding around a magnetisable core to a lower secondary current. A current transformer is passive, therefore no external power supply is connected, and what is secondary connected forms a load for the current transformer. In short, the connecting wires and the connected meter form the load of the current transformer. In technical terms this is called load in VA[1]. This load is of influence on the accuracy of the current transformer.

Illustration 1: Wiring diagram current transformer



In the design of the current transformer, internal losses and the external load of the current transformer are taken into account. The current transformer acts as a current source. The optimal aim of the manufacturer is to issue the secondary current in a relationship with the primary current. However, a lowering of the secondary current may occur. This is caused by the magnetic properties of the used core and the resistance of the winding, together with the external load. The used core and the resistance of the winding are a given, while the external load is bound to a maximum. Therefor, the manufacturer takes the external load of the current transformer into account.

A current transformer for measuring purposes is designed so that it satisfies the specified class when the load is between 25% and 100% of its nominal load.

IEC 61869-2
The IEC 61869-2 standard for current transformers specifies the following about the load of the current transformer:

- *The load of a measuring transformer is between 25% and 100% of its nominal load.*

The idea behind this is that when the load of the current transformer is too low, it may no longer comply with the class and can return a value that is too positive. As a result, it may happen that the customer wrongly pays too much.

External load of the current transformer
In the practical use of the CT, the installer must ensure that the load of the meter, together with the length of the cable, meet the foregoing requirements. The following issues are important:

- Length and diameter of the connecting wires;
- Connection wires must be sufficiently thick to be able to conduct the secondary current; with a secondary current of 5A it should be at least 1.5mm2;
- Load kWh meters.

Previously, mechanical kWh meters were used. Hereby a mechanical counter was powered. The current transformer is thus usually sufficient charged in order to meet the minimum load or ¼ VA requirement.

Illustration 2: kWh measurement instrument

[1] This is the power in Volts Ampere being dissipated at nominal secondary current in the external load.

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In modern kWh meters the mechanical counter has been replaced with electronics for reading an LCD screen or a digital output. The current to be measured is converted inside the meter into a voltage. When using modern electronics, this voltage can be measured accurately to within a few tenths of millivolts. This way, the current transformer is minimally loaded by the meter. The load on the kWh meter alone is thus not only sufficient to meet the minimum load of the current transformer.

Illustration 3: Modern kWh measurement instrument

When using a modern kWh meter the installer/engineer has to take this into account. A solution which is often used is the use of load resistors. With the in series connected current transformer load resistor an additional load is added to the current transformer, in such a way that the conditions of the measurement code mentioned above are met. Another possibility is equipping the current transformer with extra-long connectors. The cabling between the current transformer and the kWh meter then provides an additional load. However, in practice, the kWh meter is often placed very close to the current transformer.

Current Transformer 0..VA

Based on the foregoing, it is desirable from both a technical and a commercial point of view to choose the load of the current transformer as low as possible. Namely, when the current transformer still meets the class when the load is equal to the load on the kWh meter, the installer could use any cable length up to the maximum load of the current transformer. In short, the engine ring and the connection become easier. Also, the current transformer can thus become more compact.

The load of a modern kWh meter is approximately 0,1VA in practice. When a current transformer is designed in such a way that it complies to the class from 0VA, load resistors or extra-long connectors are no longer needed. The customer thus saves money and connection time, because load resistors and the length of the connector don't have to be taken into account. In short, the risk at a too low load of the current transformer is ruled out.

For more information, please contact ELEQ by calling +31 (0) 521 533 333 or by sending an email to sales@eleq.com