TESCO METERING

Current Transformers and Ratio, Burden and Admittance Testing

TESCO's Meter School
TESCOOL
July 21-24, 2024

July 24, 2024
10:30 AM – 12 PM
Rob Reese

AGENDA

CT Functionality Basics
The Faceplate: Terminology and Specifications
Ratio Testing
Burden Testing
Admittance Testing

Meter Forms and Applications

1S
14S
39S
17S
2S
3S
12S
35S
4S
25S
10S
76S
46S
66S
45S
11S
32S
5S
26S
6S
16S
9S
15S
56S
24S
13S

METER FORMS AND APPLICATIONS

SELF-CONTAINED

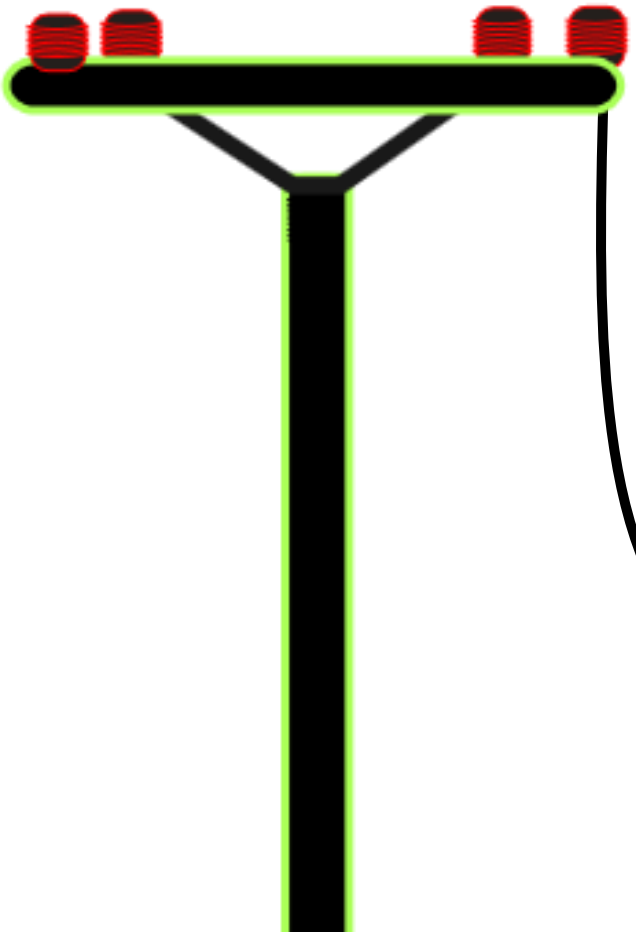
1S
14S
2S
12S
25S
16S
17S
13S
15S
32S

TRANSFORMER RATED

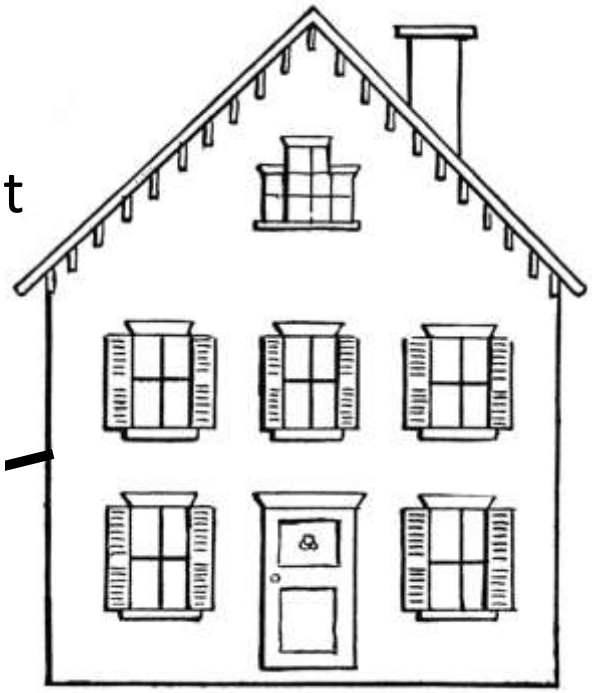
39S
36S
7S
3S
29S
76S
5S
35S
4S
46S
8S
26S
11S
66S
45S
6S
9S
10S
56S
24S

Self-Contained Metering

Primarily Residential
(1S, 2S, 12S)



Relatively Low Current
Example: 100A



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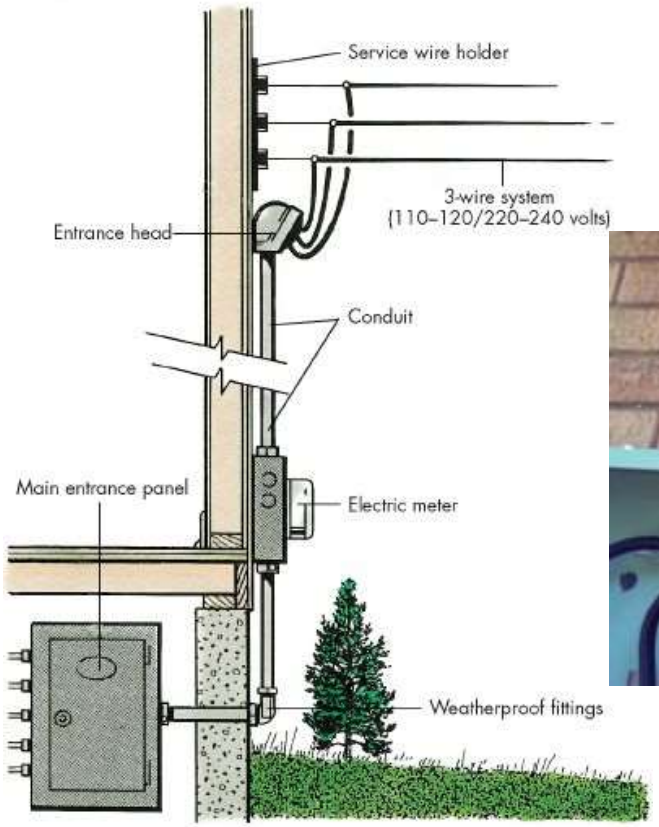
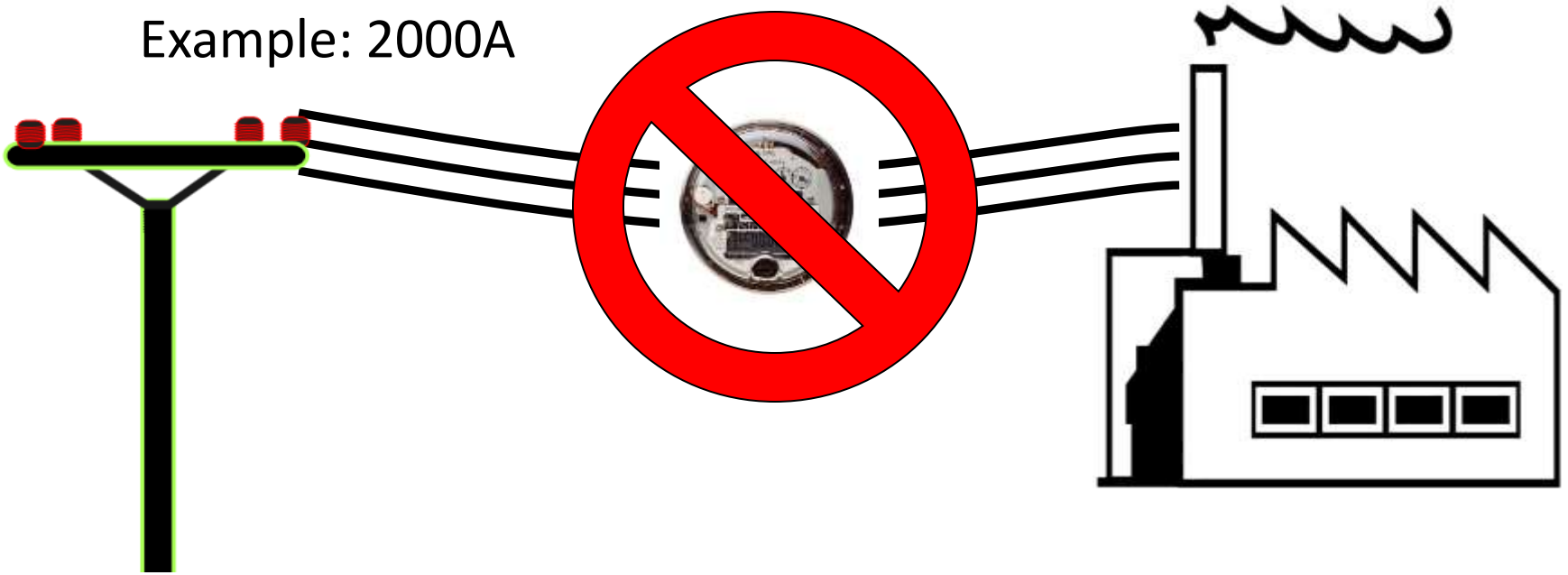


TRANSFORMER-RATED METERING

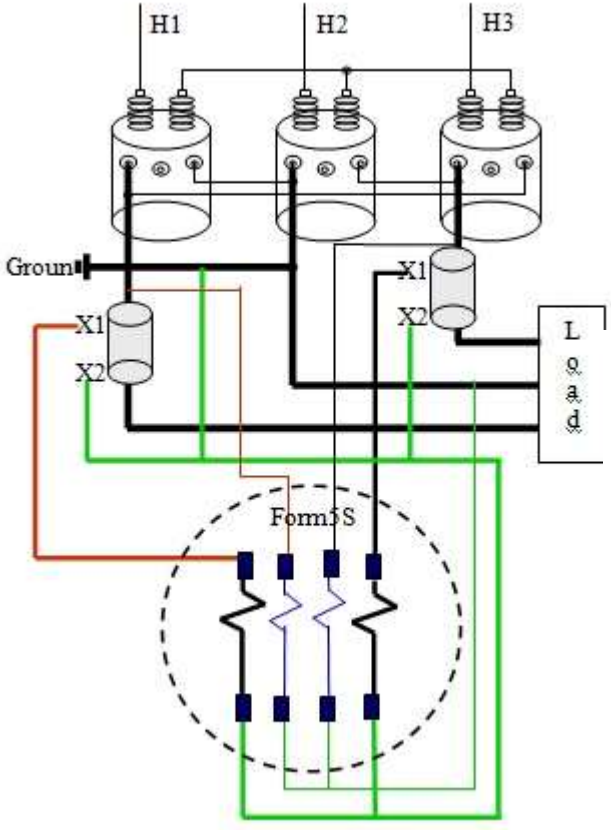
Primarily Commercial/Industrial

Relatively High Current
Example: 2000A



TRANSFORMER-RATED METERING

Primarily Commercial/Industrial



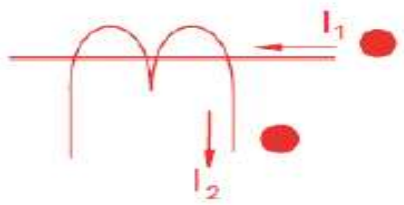
WHAT IS A CT?

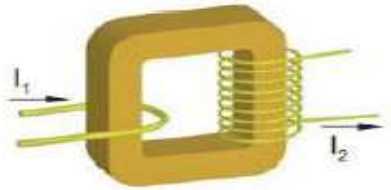
"A **current transformer** (**CT**) is used for measurement of alternating electric currents. Current transformers, together with voltage (or potential) transformers (VT or PT), are known as **instrument transformers**. When current in a circuit is too high to apply directly to measuring instruments, a current transformer produces a reduced current accurately proportional to the current in the circuit, which can be conveniently connected to measuring and recording instruments. A current transformer isolates the measuring instruments from what may be very high voltage in the monitored circuit. Current transformers are commonly used in metering and protective relays in the electrical power industry." - Wikipedia

CURRENT TRANSFORMERS CONCEPTUAL REPRESENTATION

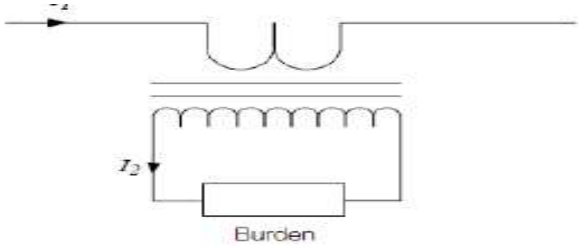
As current is applied in the primary, it produces a magnetic flux in the core. This flux flows through the core and induces a current in the secondary windings and circuit that is proportional to the number of turns.

Ideal. No losses

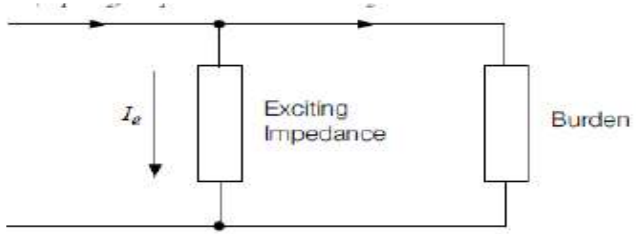




$$I_1 \times N_1 = I_2 \times N_2$$



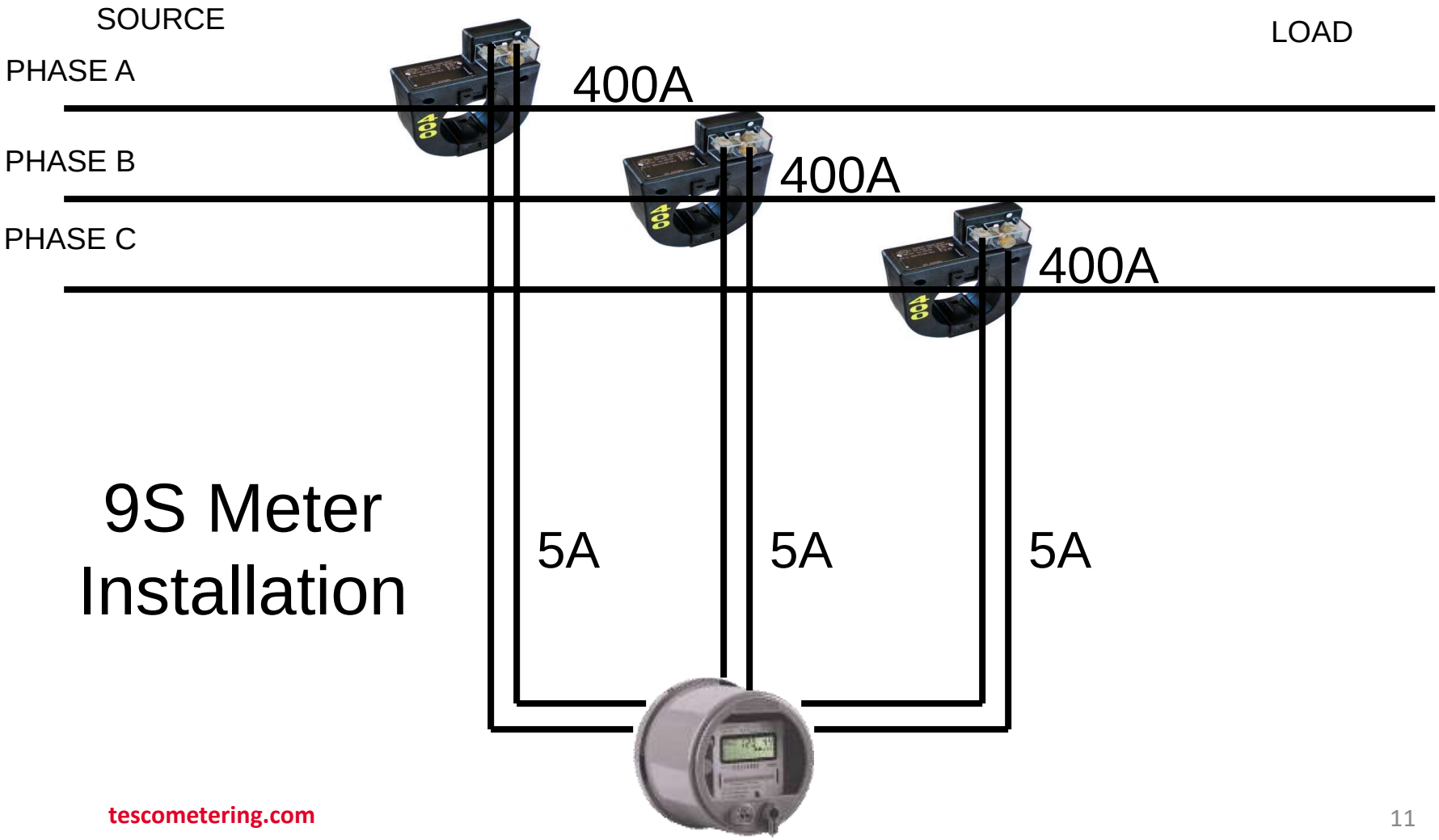
$$I_2 = \frac{N_1}{N_2} \times I_1$$



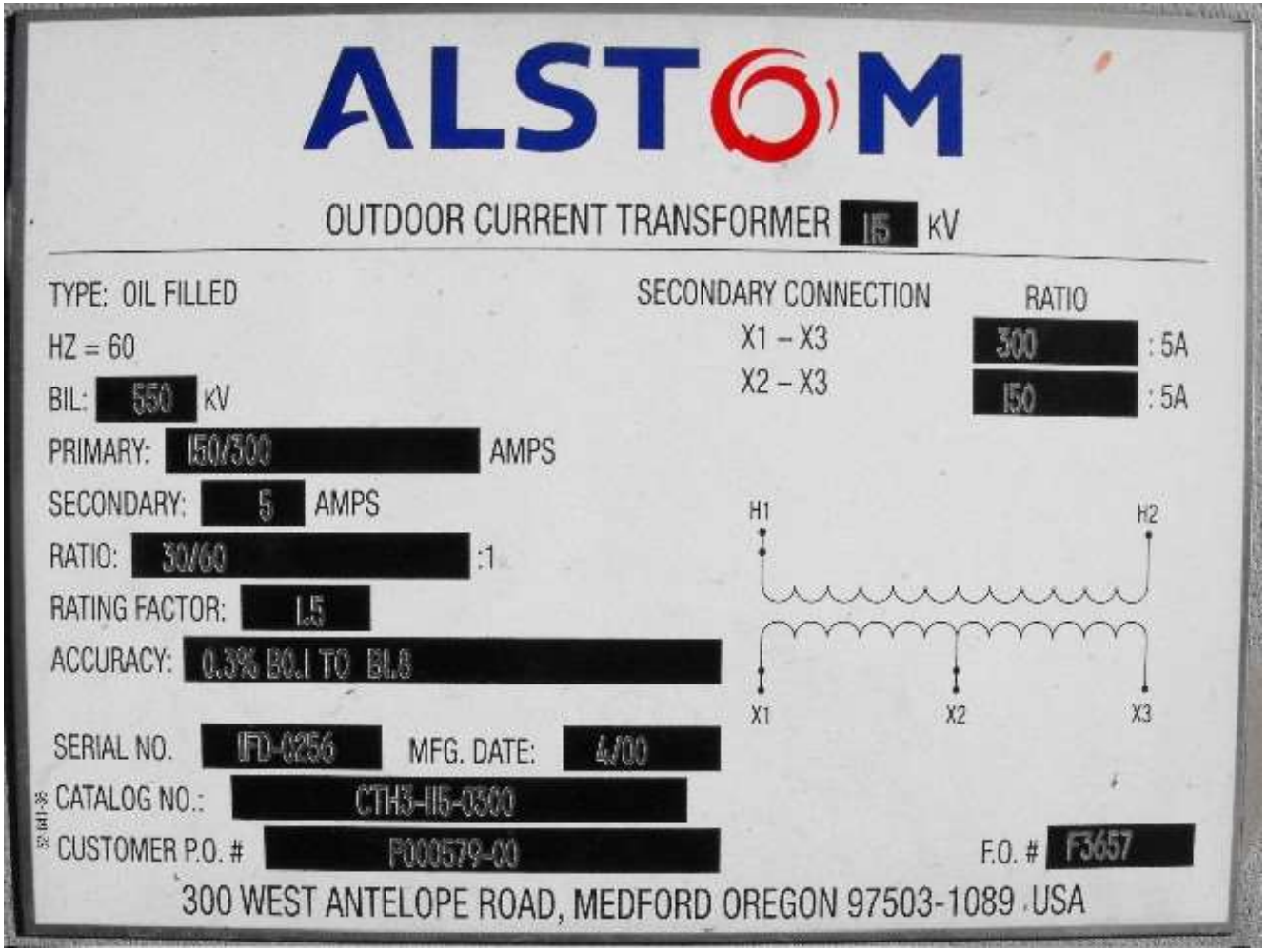
$$I_2 = \frac{N_1}{N_2} \times I_1 - I_e$$

Real, with core losses

EXAMPLE APPLICATION



FACEPLATE SPECIFICATIONS



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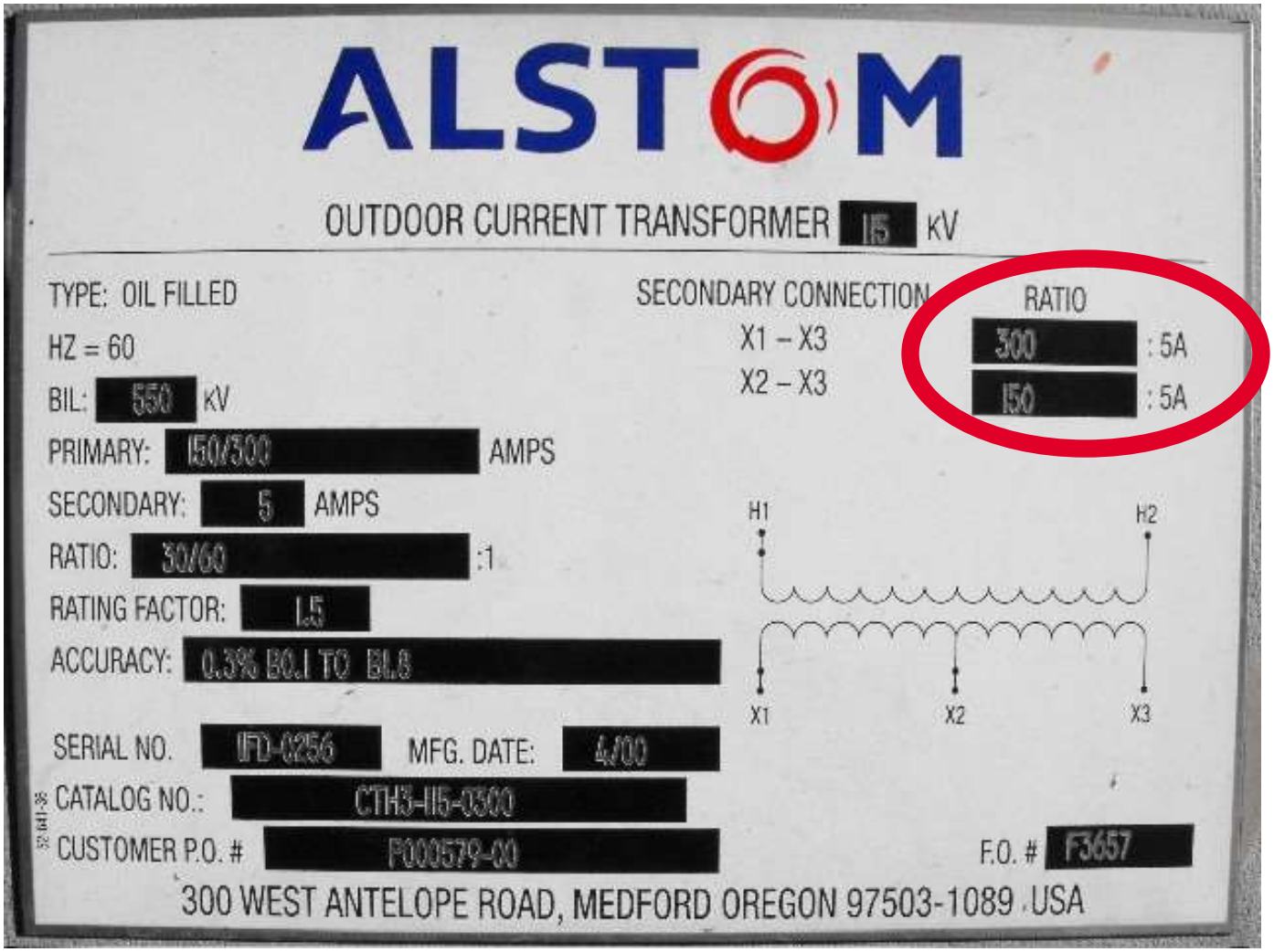
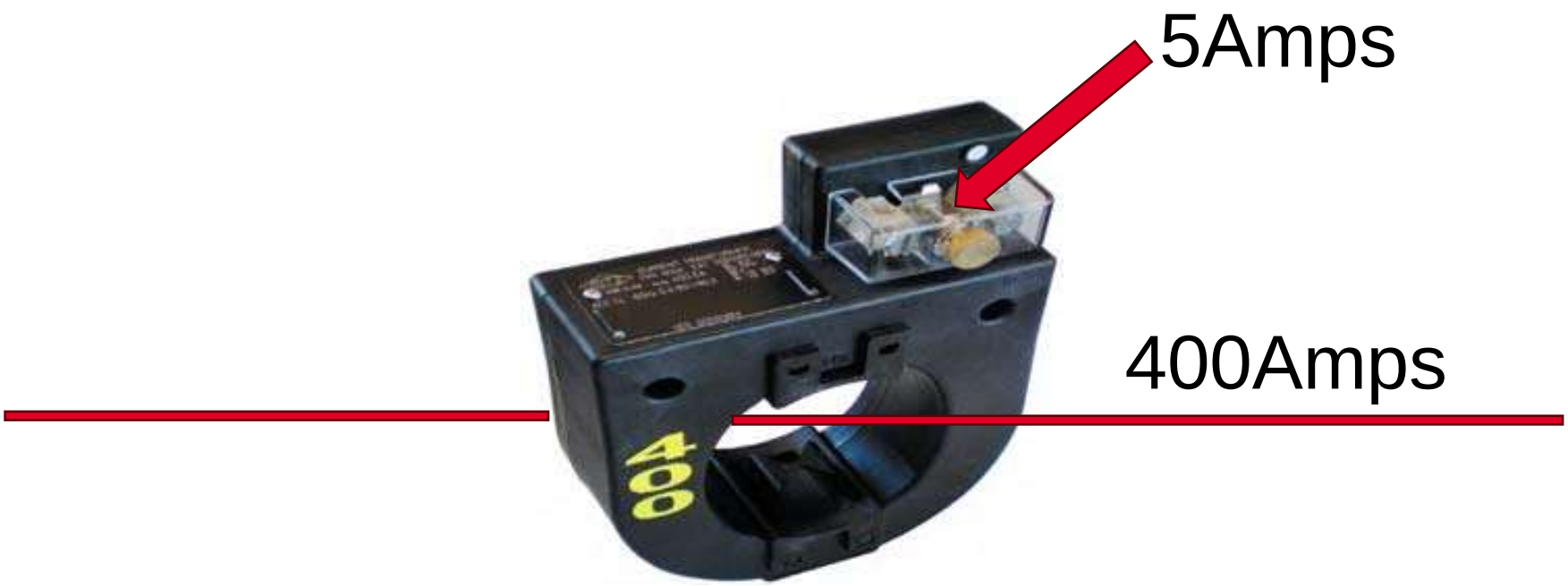


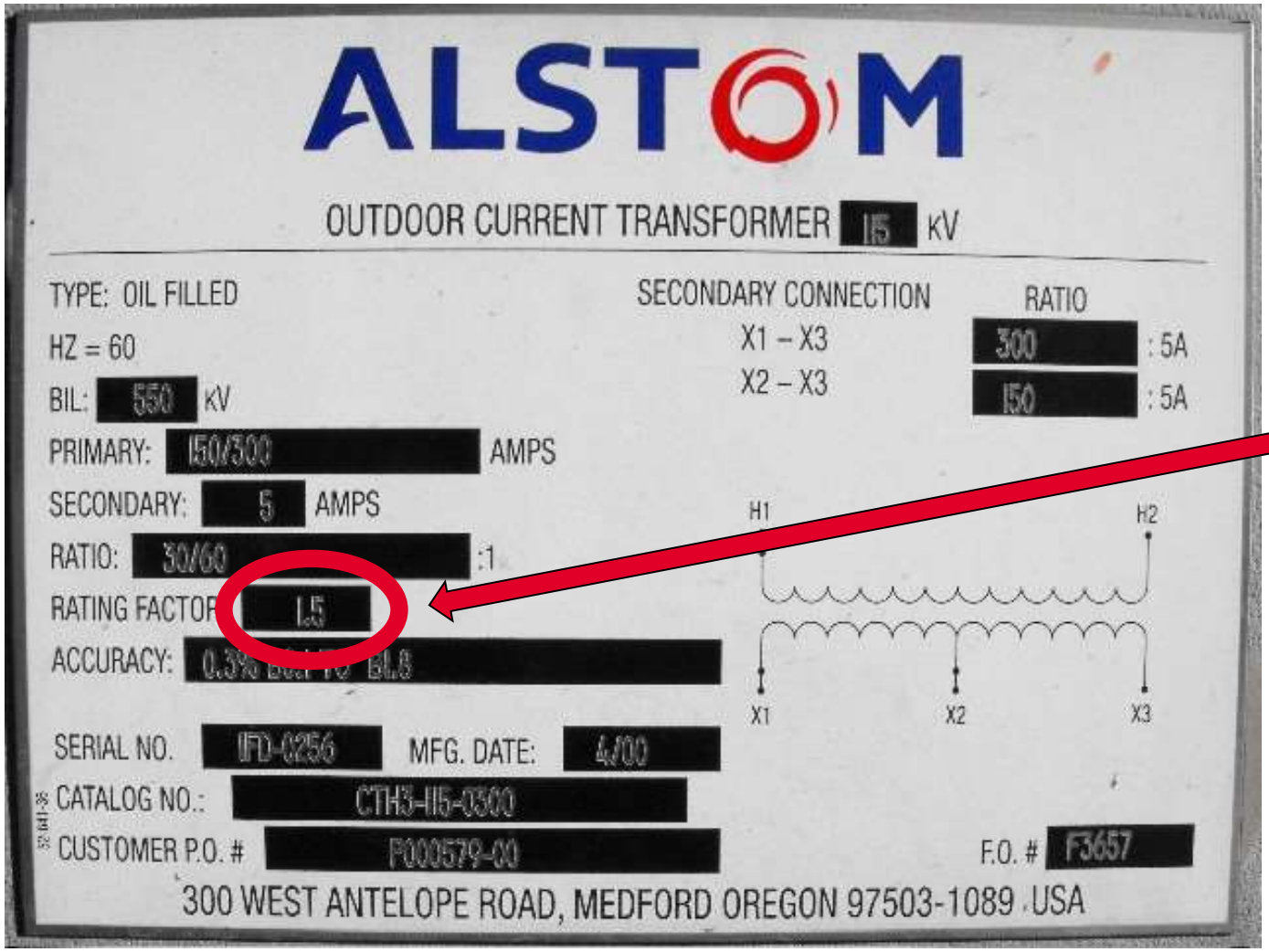
Ratio

CT's Ratio



For instance, a CT with a 400:5 ratio will produce 5A on the secondary, when 400A are applied to the primary.

FACEPLATE SPECIFICATIONS



Thermal factor

CT's – Functions and Terminology

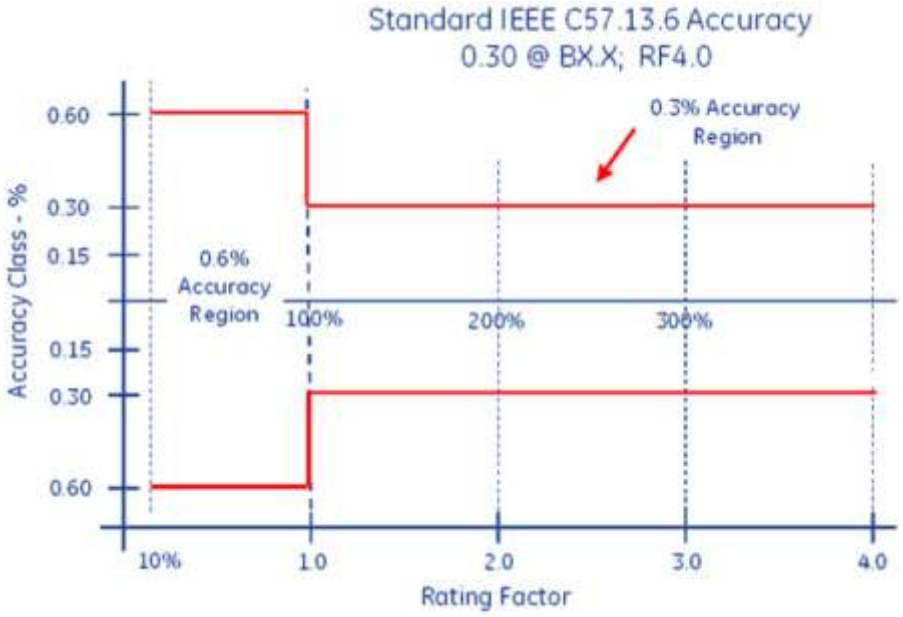
Thermal Rating factor

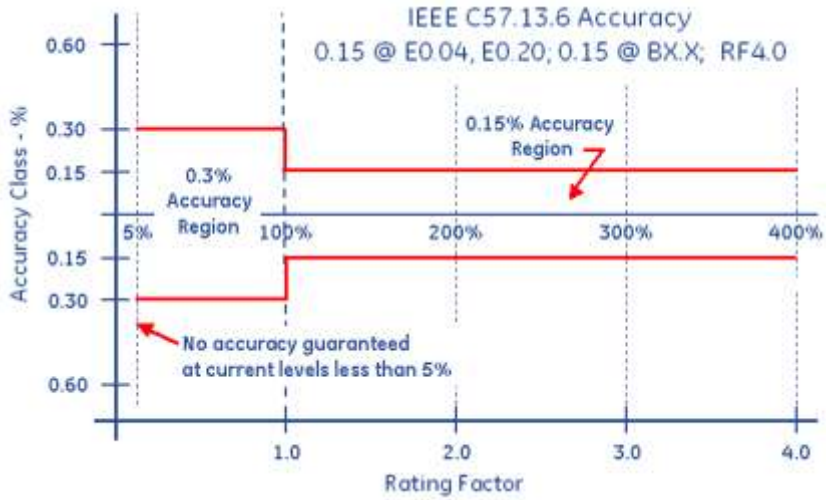
A value representing the amount by which the primary current can be increased without exceeding the allowable temperature rise. For instance, a RF of 4.0 at 30° ambient on a 400:5 ratio CT would allow for a primary current up to 1600A.

FACEPLATE SPECIFICATIONS

Accuracy Classifications

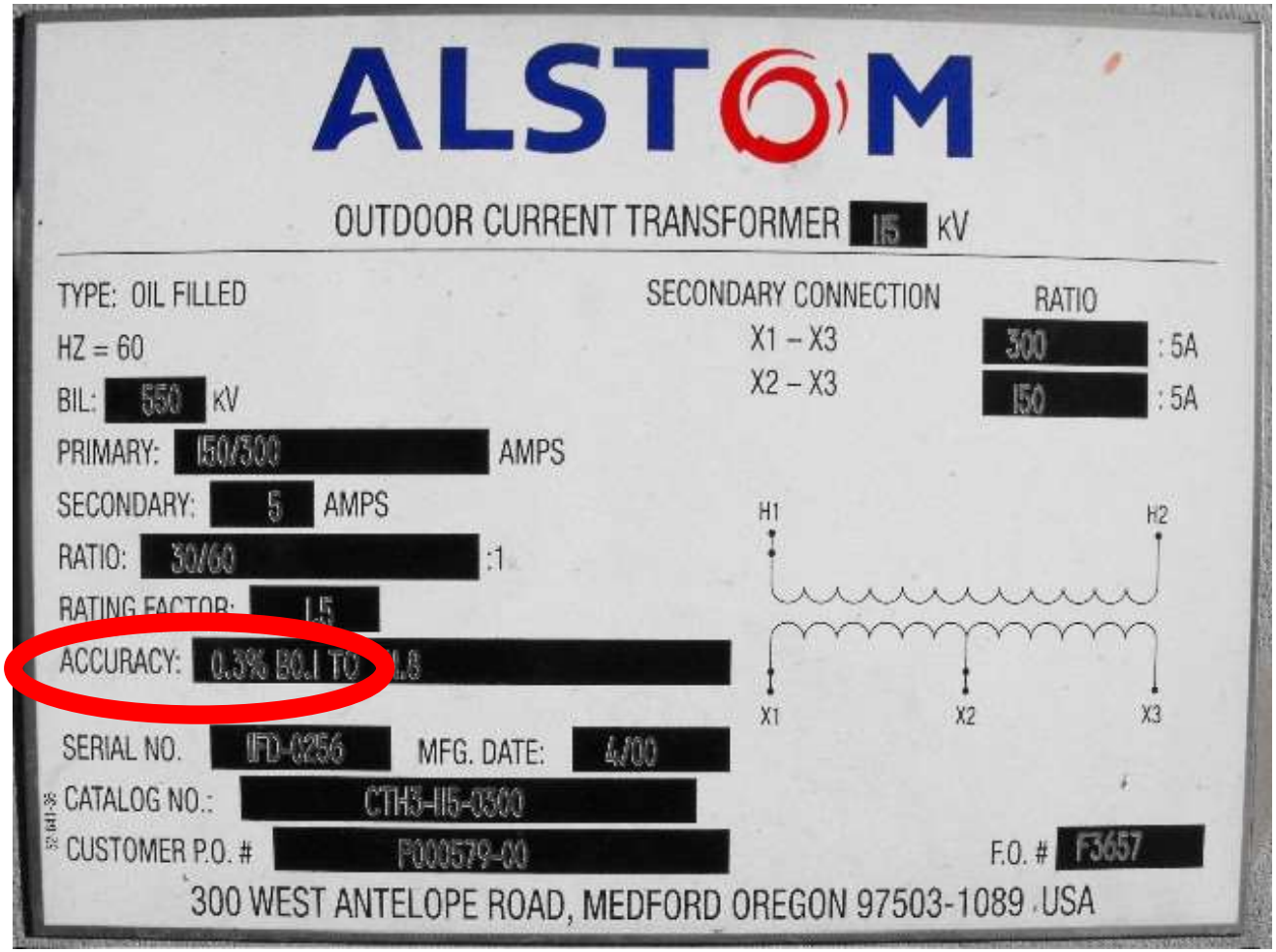
All CT's fall within an accuracy class.
IEEE Standards have defined accuracy classes.





FACEPLATE SPECIFICATIONS

Burden Rating

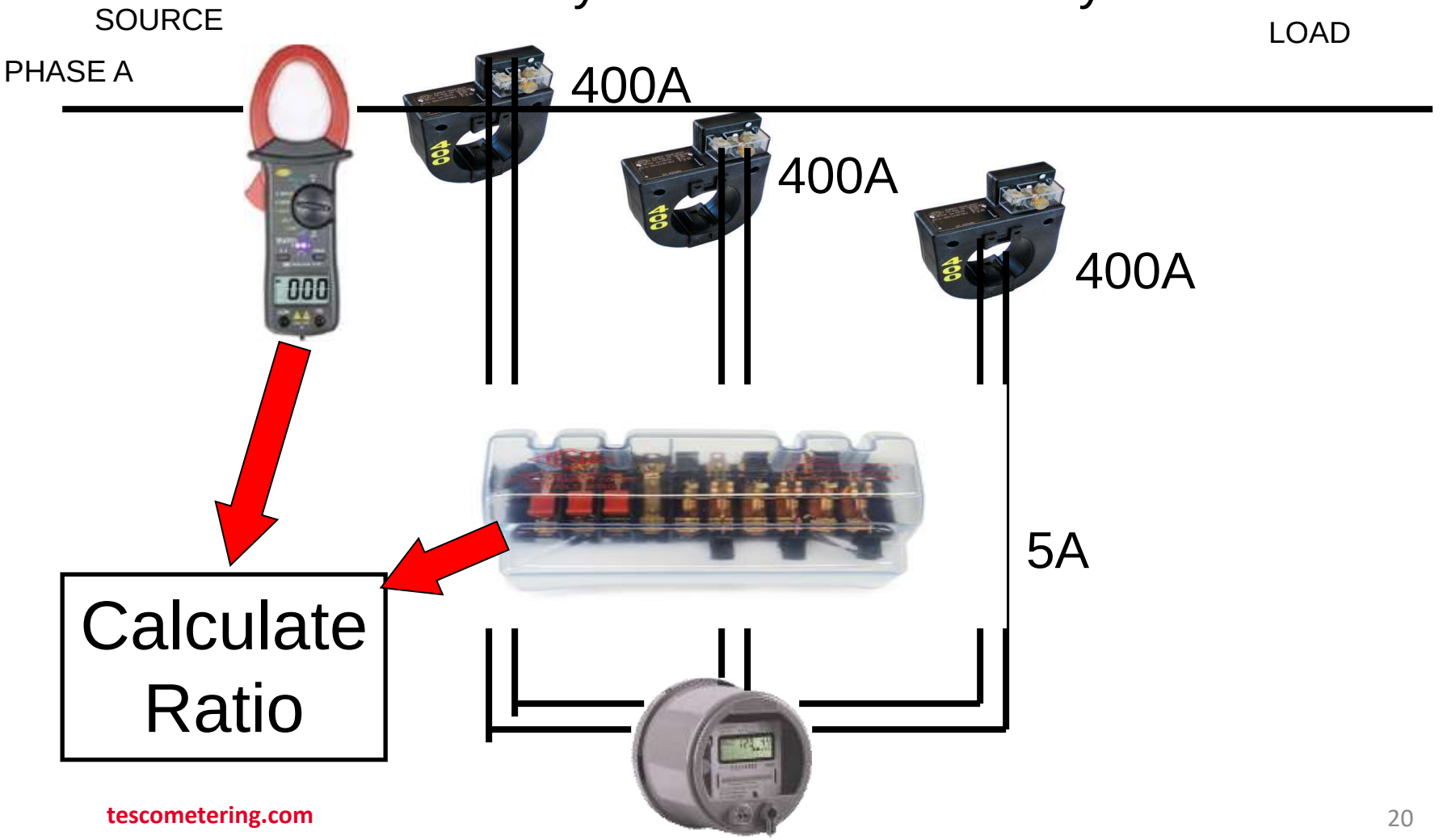


BURDEN RATING

The burden range, present in the secondary circuit, that the manufacturer will guarantee their CT's will still accurately function, in regards to the ratio specification.

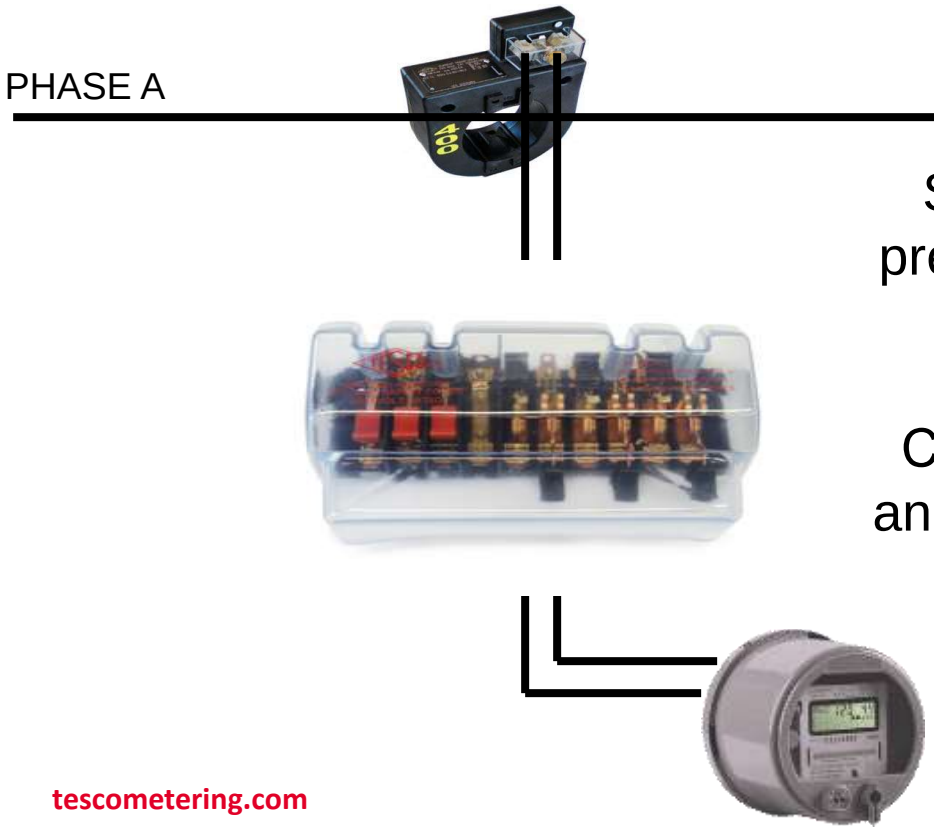
RATIO TESTING

Ratio of Primary Current to Secondary Current



BURDEN TESTING

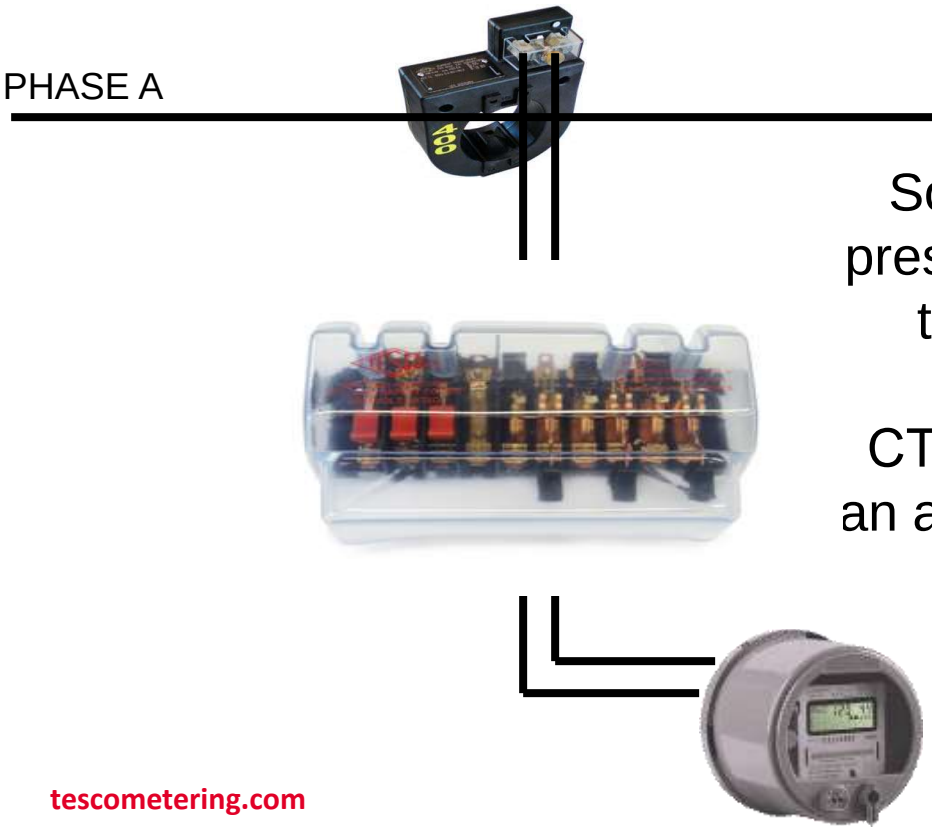
Functionality with Burden Present on the Secondary Loop



Some burden will always be present – junctions, meter coils, test switches, cables, etc.

CT's must be able to maintain an accurate ratio with burden on the secondary.

Functionality with Burden Present on the Secondary Loop



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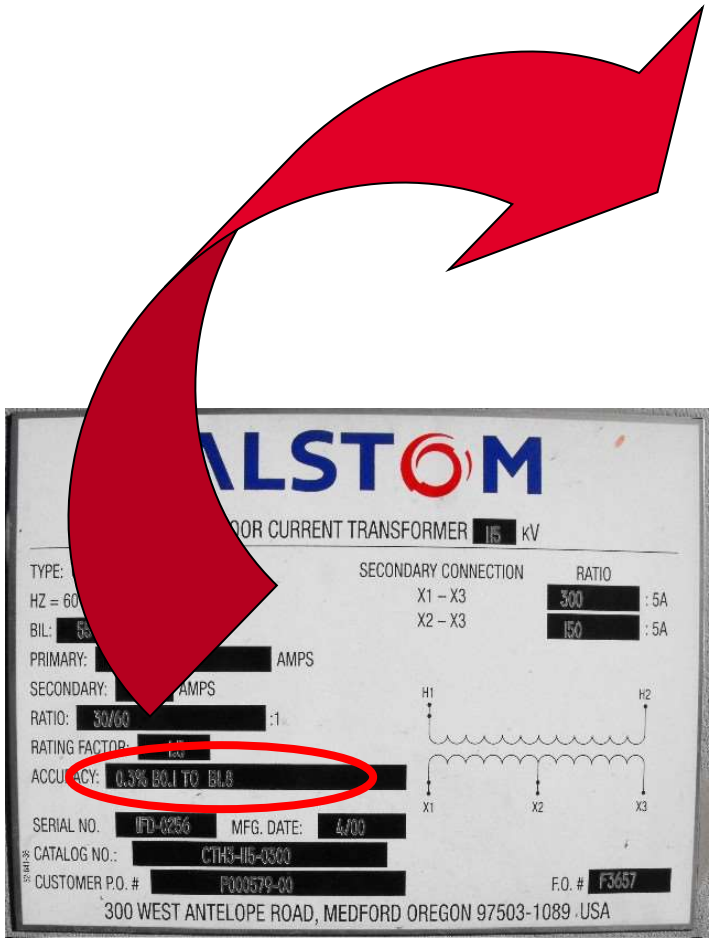


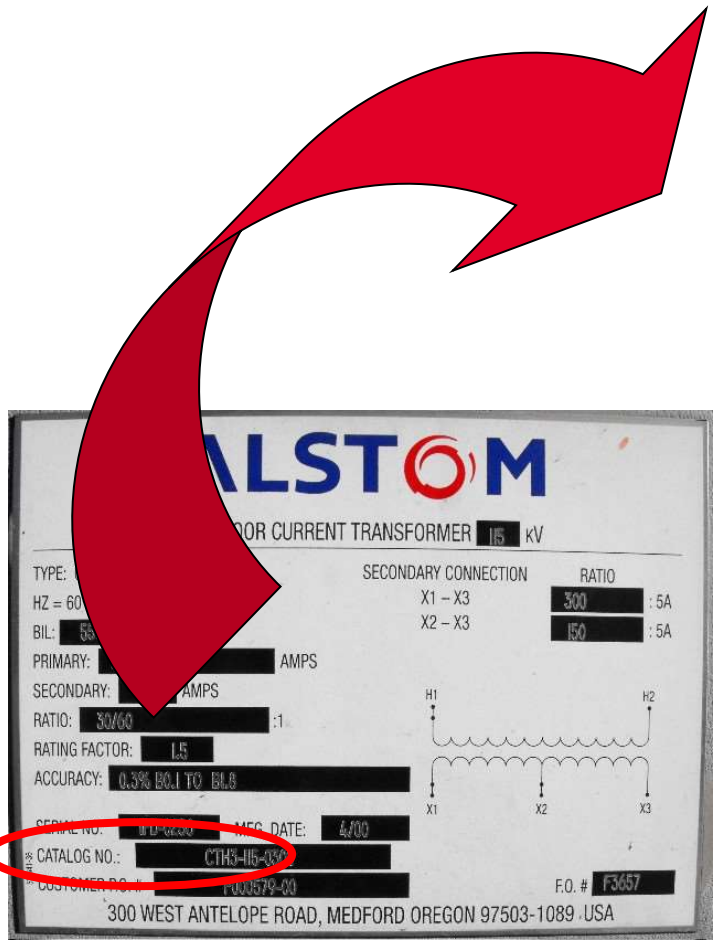
Example Burden Spec:
0.3% @ B0.1, B0.2, B0.5

or

There should be less than the 0.3% change in secondary current from initial (“0” burden) reading, when up to 0.5Ohms of burden is applied

BURDEN TESTING

Functionality with Burden Present on the Secondary Loop

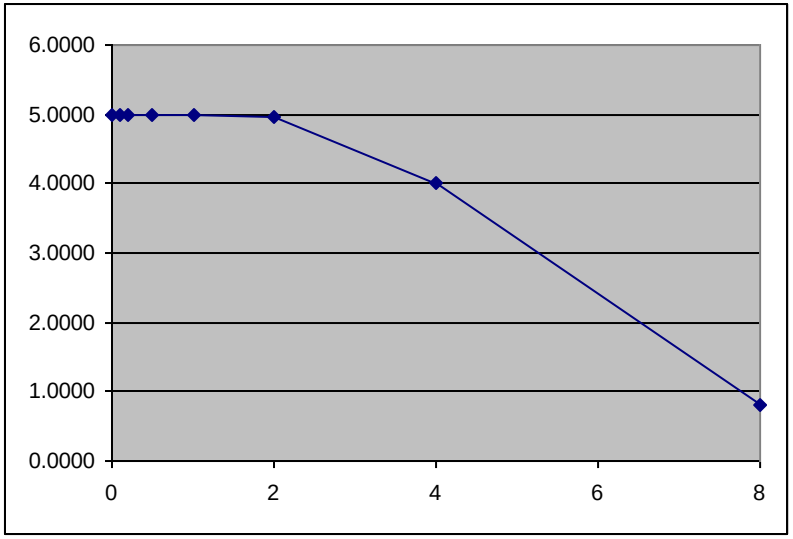


ANSI Burden Values

0.1 Ohms
0.2 Ohms
0.5 Ohms
1 Ohms
2 Ohms
4 Ohms
8 Ohms

BURDEN TESTING

0.3% @ B0.1, B0.2, B0.5

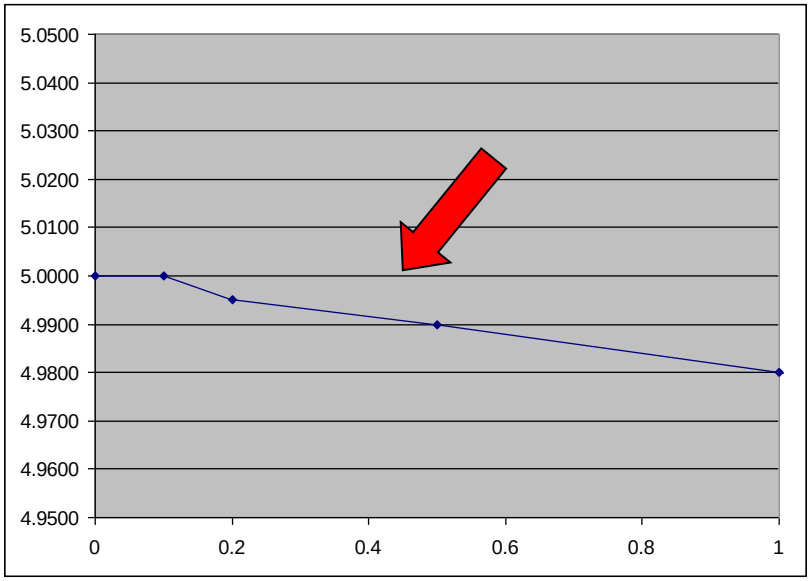


Initial Reading = 5Amps
0.3% x 5A = 0.015A
5A – 0.015 = 4.985A

Burden	Reading
0	5.0000
0.1	4.9999
0.2	4.9950
0.5	4.9900
1	4.9800
2	4.9500
4	4.0000
8	0.8000

BURDEN TESTING

0.3% @ B0.1, B0.2, B0.5



At 0.5Ohms of Burden
the secondary current is still at
4.990A – Less than 0.3% change –
Good CT!

Initial Reading = 5Amps
0.3% x 5A = 0.015A
5A – 0.015 = 4.985A

Burden	Reading
0	5.0000
0.1	4.9999
0.2	4.9950
0.5	4.9900
1	4.9800
2	4.9500
4	4.0000
8	0.8000

ADMITTANCE TESTING

- What is Admittance?
- Admittance testing measures the overall “health” of the secondary loop of the CT.
- Measured in units of MiliSiemens (mS)
- Admittance is the inverse of impedance.
- Impedance is the opposition to current.
- Therefore, admittance testing measures the overall “health” of the secondary loop of the CT.

Admittance Testing

- Admittance testing devices inject an audio sine wave signal into the secondary loop of the CT.
- The resulting current is measured.
- The voltage of the initial signal is known.
- From these two parameters, the impedance, and thus the admittance can be calculated.

ADMITTANCE TESTING

- Admittance test results are not immediately intuitive.
- Some analysis and interpretation is need.
- What do all these mS values mean?

ADMITTANCE TESTING

Three phase process is recommended.

1. Test each CT individually
2. Test the matched sets
3. Test over time

Questions and Discussion

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