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Intro to Self Contained Metering,Transformer Rated Metering, and Testing

Pennsylvania Rural Electric Association

PREA
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TOPICS

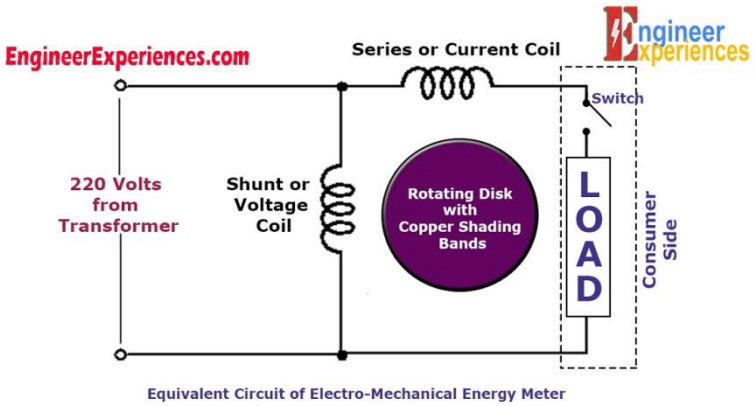
- What is a meter?
- Electro-mechanical versus Solid State
- Forms and Services
- Self Contained Metering
- Transformer Rated Metering

METERS 101 – WHAT IS A METER?

Energy Revenue Billing Meter

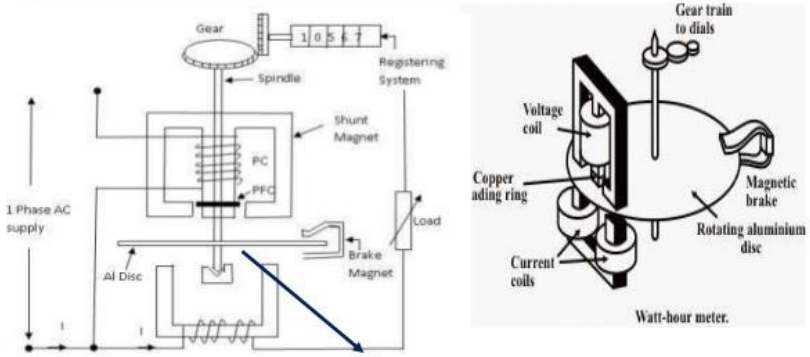
- Measures Watt-hours (Wh)
- Used to quantify the amount of energy that was provided to the customer for billing purposes
- NIST Traceability – Verification of Accuracy

METERS 101 – ELECTRO-MECHANICAL



Equivalent Circuit of Electro-Mechanical Energy Meter

Electromechanical energy meter continue...



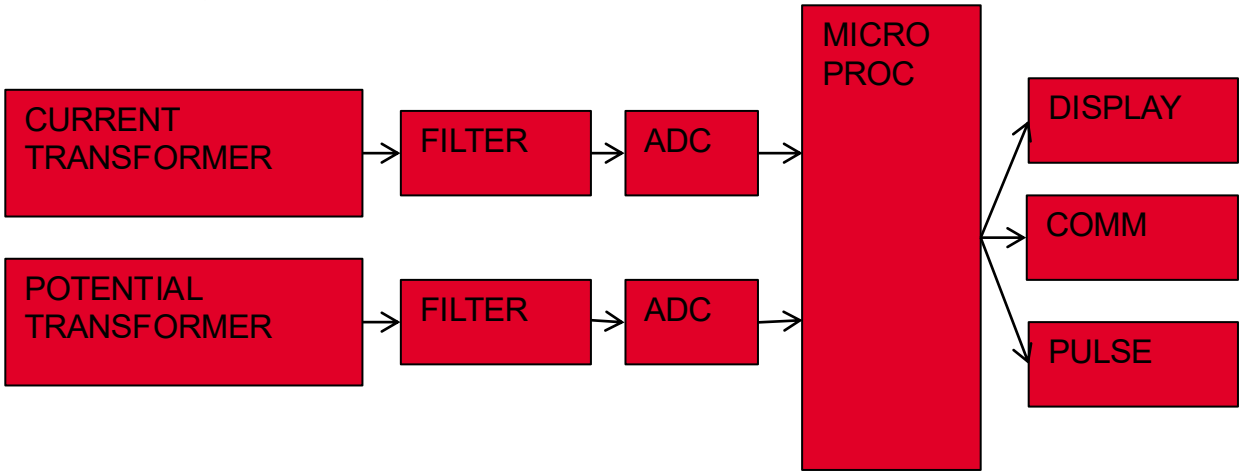
Disk to rotate

Overview of Functionality

- The electromechanical induction meter operates through electromagnetic induction
- A non-magnetic, but electrically conductive, metal disc which is made to rotate at a speed proportional to the power passing through the meter
- The disc is acted upon by two sets of induction coils, which form, in effect, a two phase linear induction motor.
- One coil is connected in such a way that it produces a magnetic flux in proportion to the voltage
- The other coil produces a magnetic flux in proportion to the current.
- The field of the voltage coil is delayed by 90 degrees, due to the coil's inductive nature, and calibrated using a lag coil
- This produces eddy currents in the disc and the effect is such that a force is exerted on the disc in proportion to the product of the instantaneous current and instantaneous voltage
- A permanent magnet acts as an eddy current brake, exerting an opposing force proportional to the speed of rotation of the disc
- The equilibrium between these two opposing forces results in the disc rotating at a speed proportional to the power or rate of energy usage
- The disc drives a register mechanism which counts revolutions, much like the odometer in a car, in order to render a measurement of the total energy used.
- The amount of energy represented by one revolution of the disc is denoted by the symbol Kh which is given in units of watt-hours per revolution.
- A Kh of 7.2 is typical. In this example, each full rotation of the disk is equivalent to 7.2Wh of energy.

Overview of Functionality

- Potential and Current is scaled down and conditioned with transformers and filters
- ADC's (analog to digital converters) digitize the signals
- A micro-processor or DSP executes the calculations
- Resulting data is displayed, sent externally via the communication circuits, and used for the calibrated pulse output



METERS 101 – A-BASE, K-BASE, S-BASE

K-base

A-base

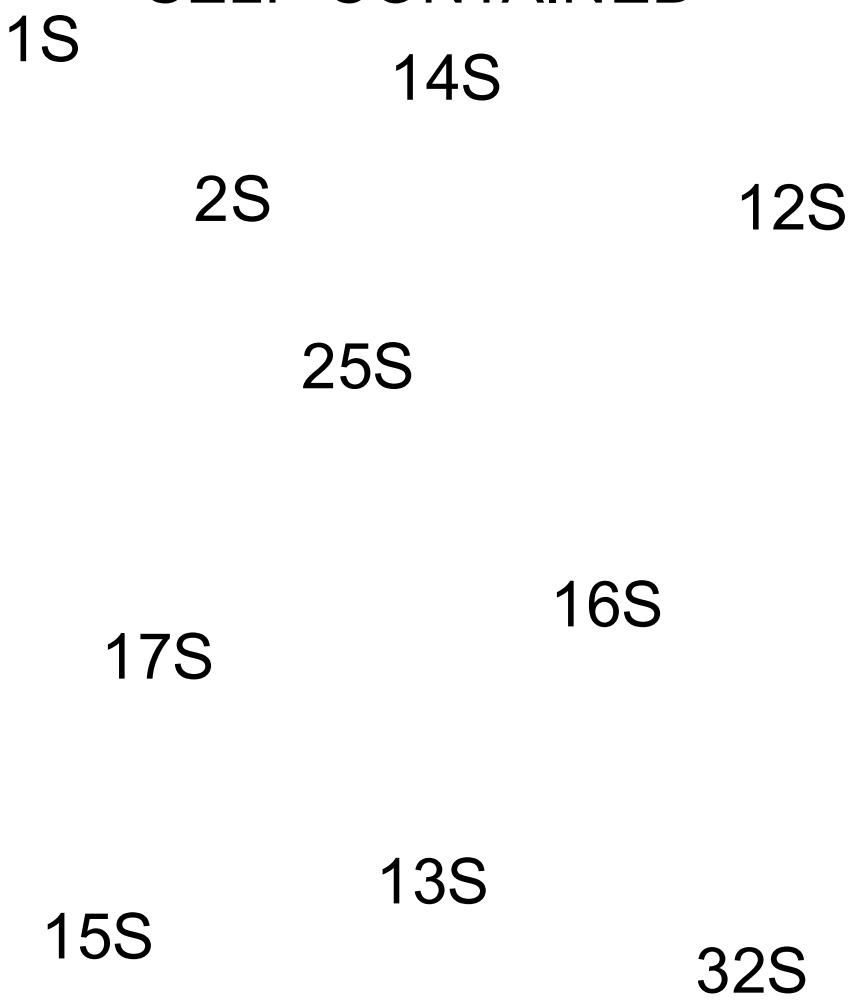
S-base

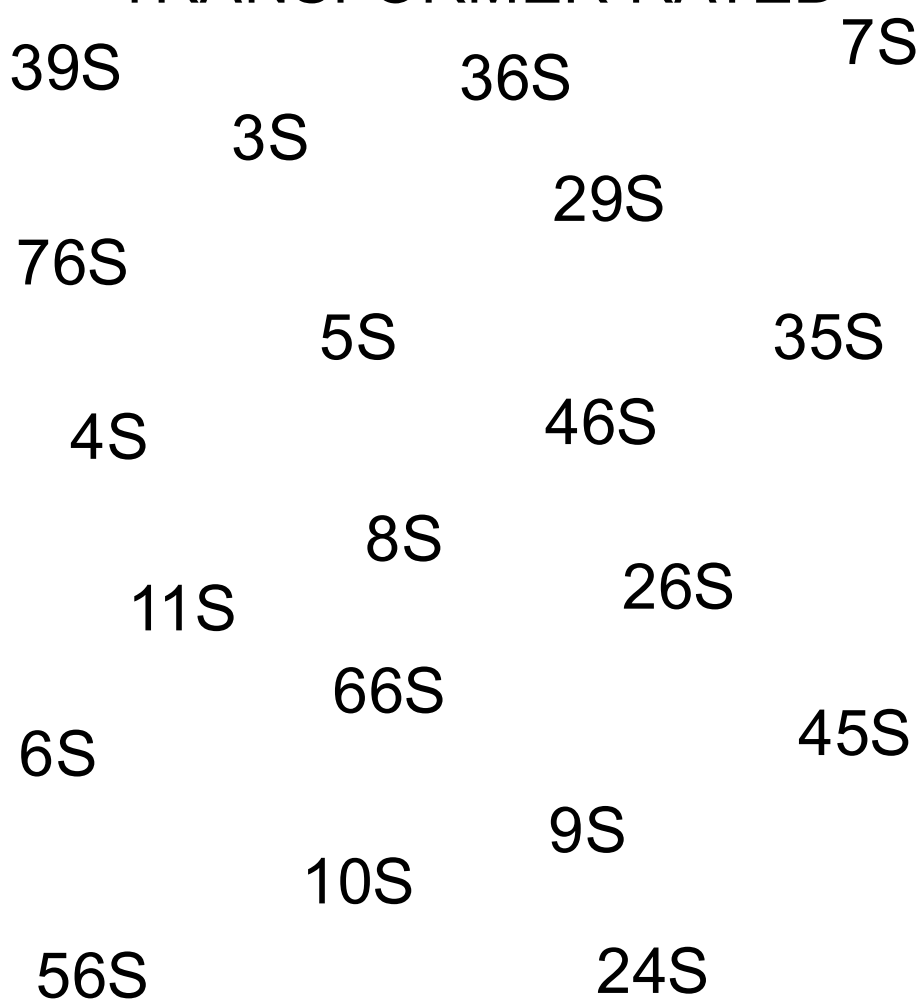
SELF-CONTAINED VS. TRANSFORMER-RATED

PAGES 19-22, 31-50

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

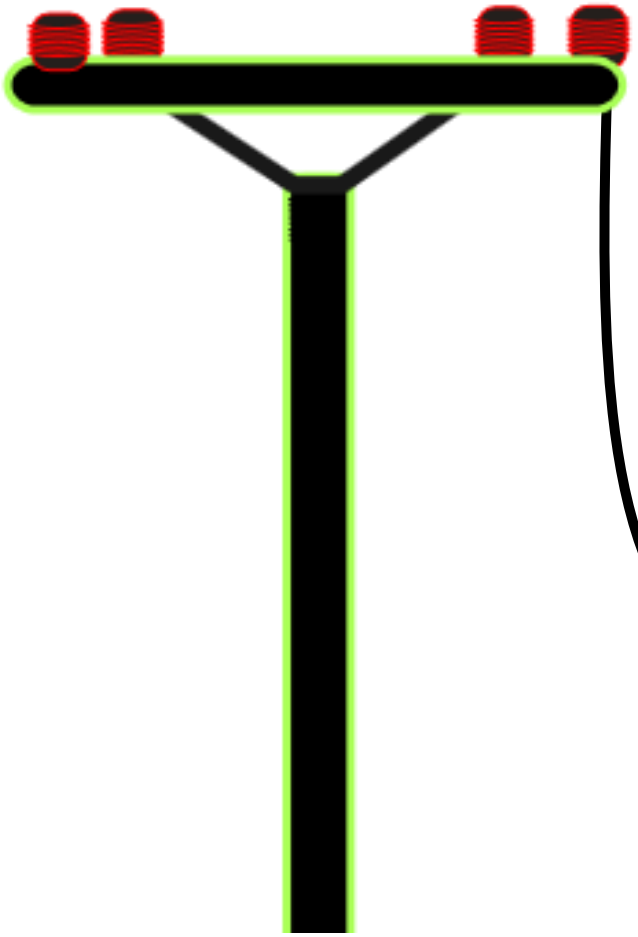
SELF-CONTAINED VS. TRANSFORMER-RATED



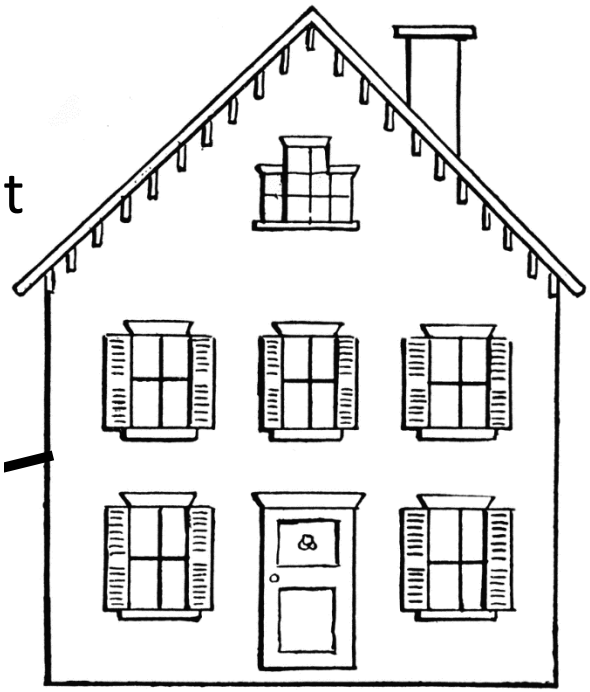


Self-Contained vs. Transformer-Rated

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

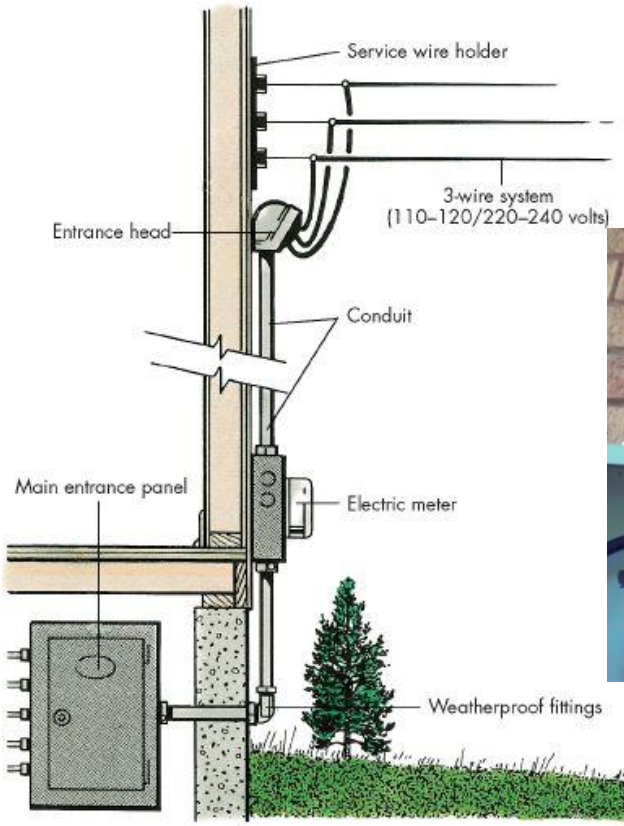


Relatively Low Current
Example: 100A



SELF-CONTAINED VS. TRANSFORMER-RATED

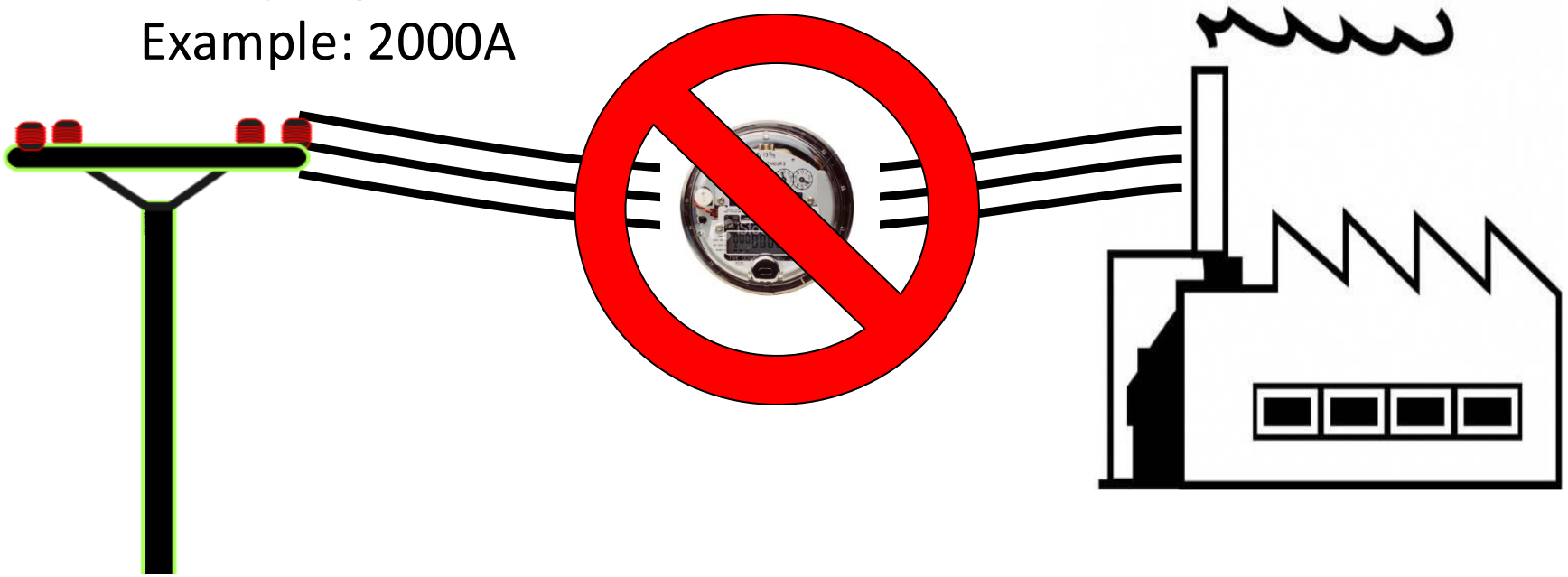
Primarily Residential
(1S, 2S, 12S)



Self-Contained vs. Transformer-Rated

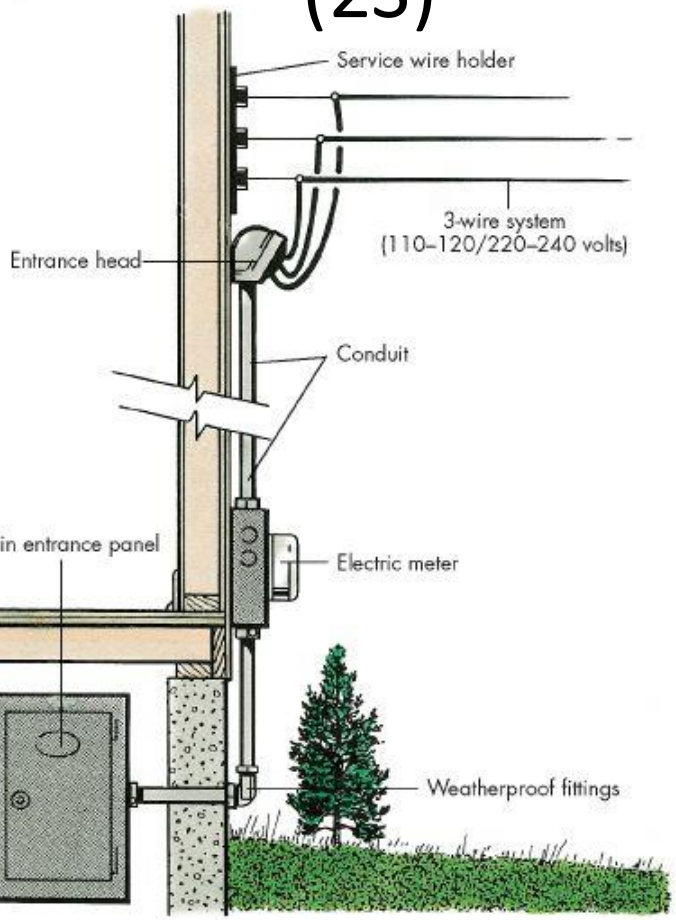
Primarily Commercial/Industrial
(9S)

Relatively High Current
Example: 2000A



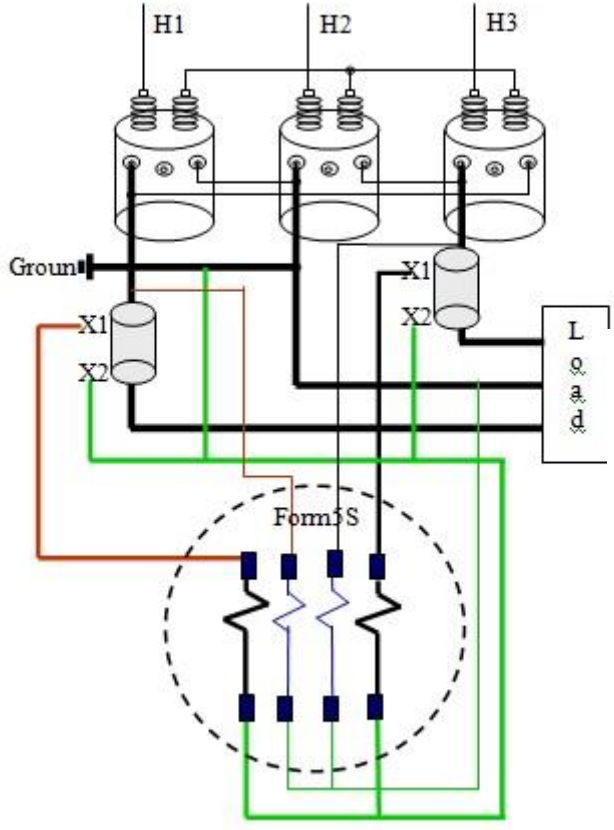
Self-Contained Metering

Primarily Residential (2S)



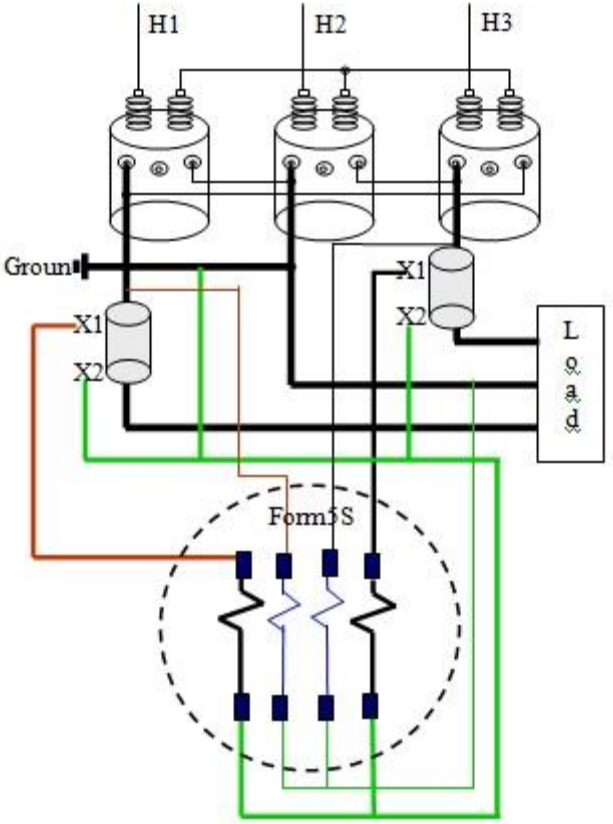
TRANSFORMER-RATED METERING

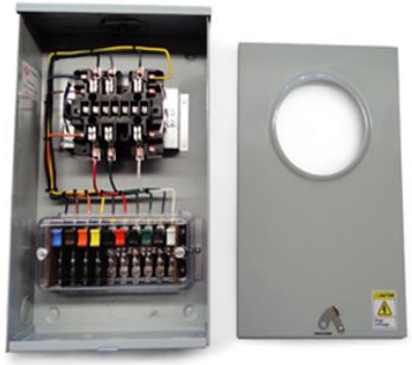
Primarily Commercial/Industrial (9S)



TRANSFORMER-RATED METERING

Typical Components of an Installation



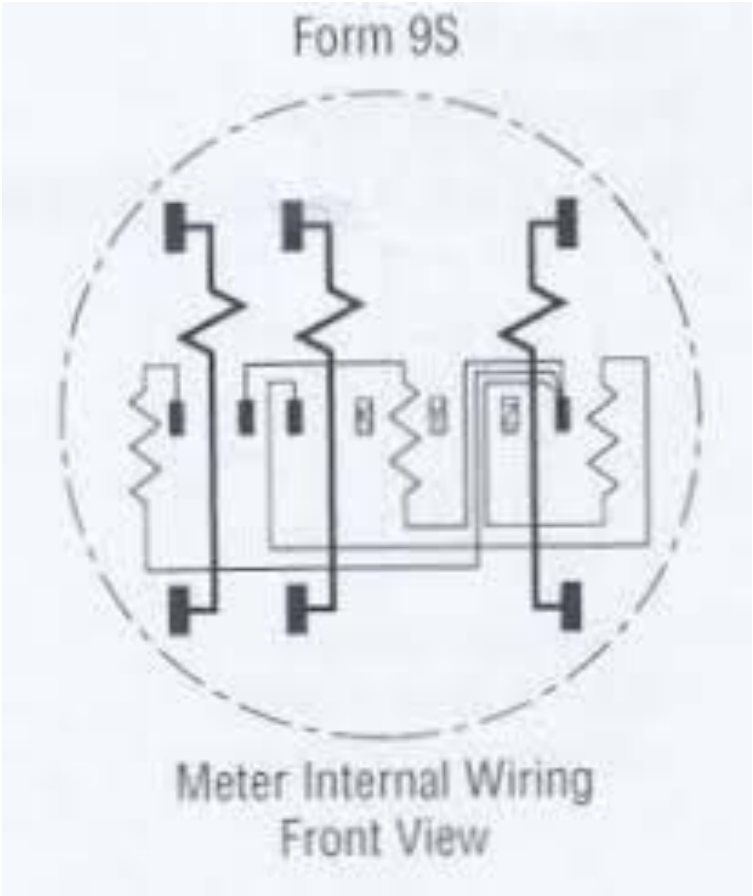


TRANSFORMER-RATED METERING

Meter

TRANSFORMER-RATED METERING

Meter



TRANSFORMER-RATED METERING

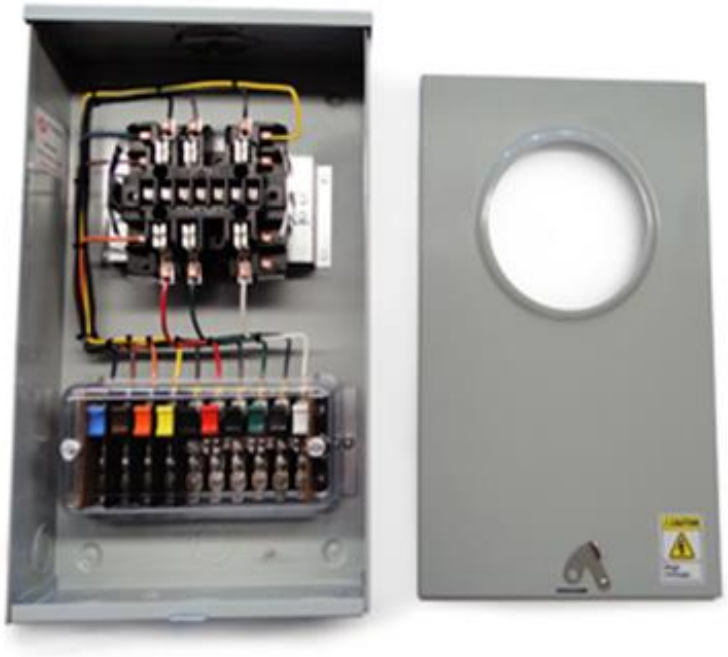
Enclosure, Socket, Test Switch

TRANSFORMER-RATED METERING

Enclosure, Socket, Test Switch

Enclosure

- Painted Steel or Aluminum
  - One or Two Piece Lid
- Many, Many Configurations

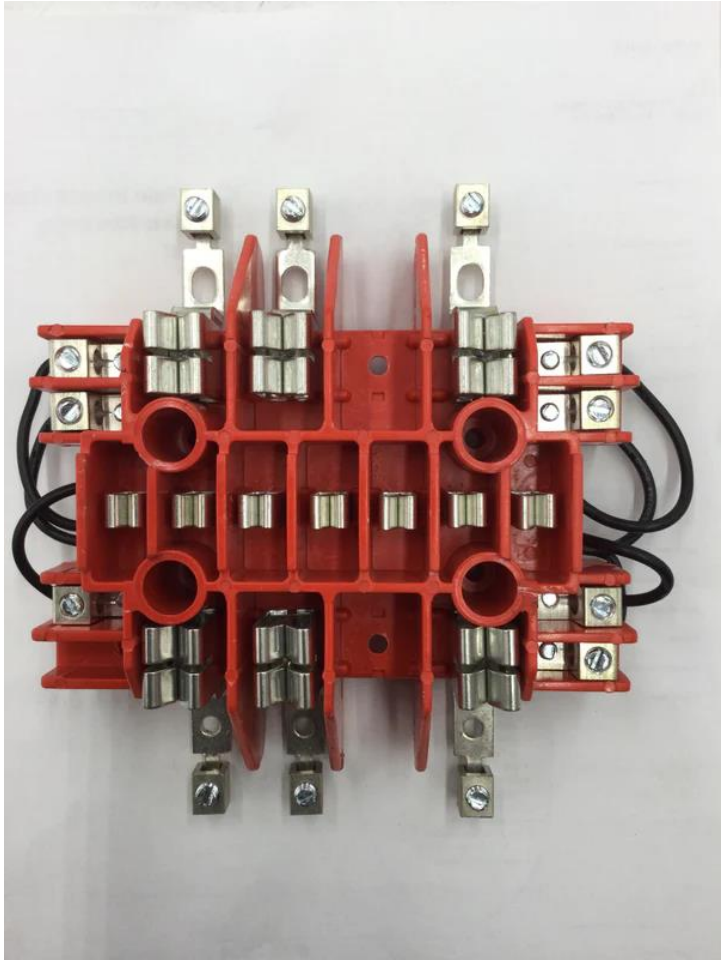


Transformer-Rated Metering

Enclosure, Socket, Test Switch

Socket

- Configured for Specific Form



TRANSFORMER-RATED METERING

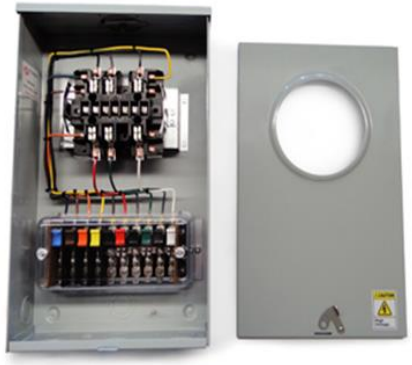
Enclosure, Socket, Test Switch

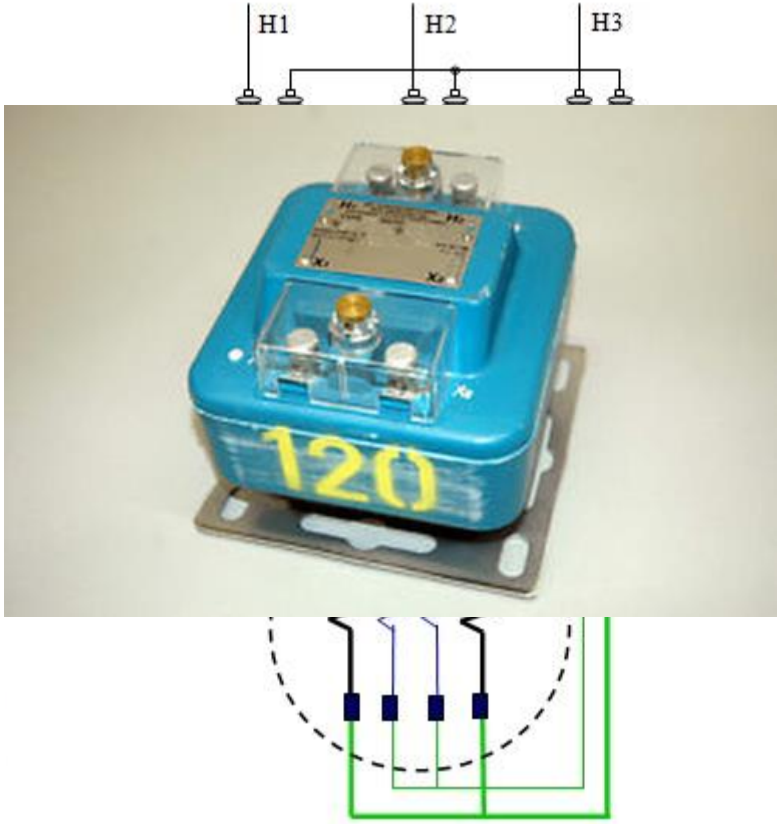
Test Switch

- Upmost Safety
- Shuts the CT
- Isolates the Meter from the Service During Testing

TRANSFORMER-RATED METERING

PT/VT –Voltage Transformer





TRANSFORMER-RATED METERING

PT/VT –Voltage Transformer

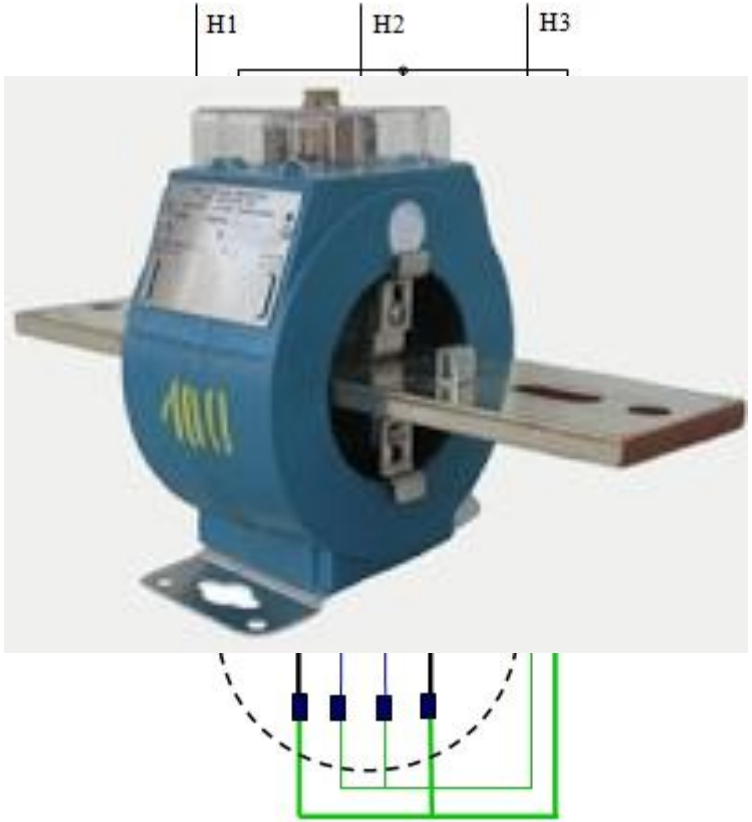
PT/VT

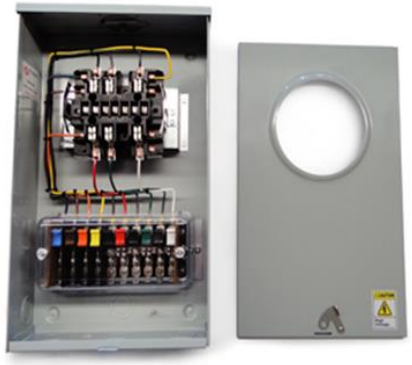
- Scales Down the Voltage
  - 4:1
  - 480V:120V

PAGES 23-26

TRANSFORMER-RATED METERING

CT – Current Transformer





PAGES 23-26

TRANSFORMER-RATED METERING

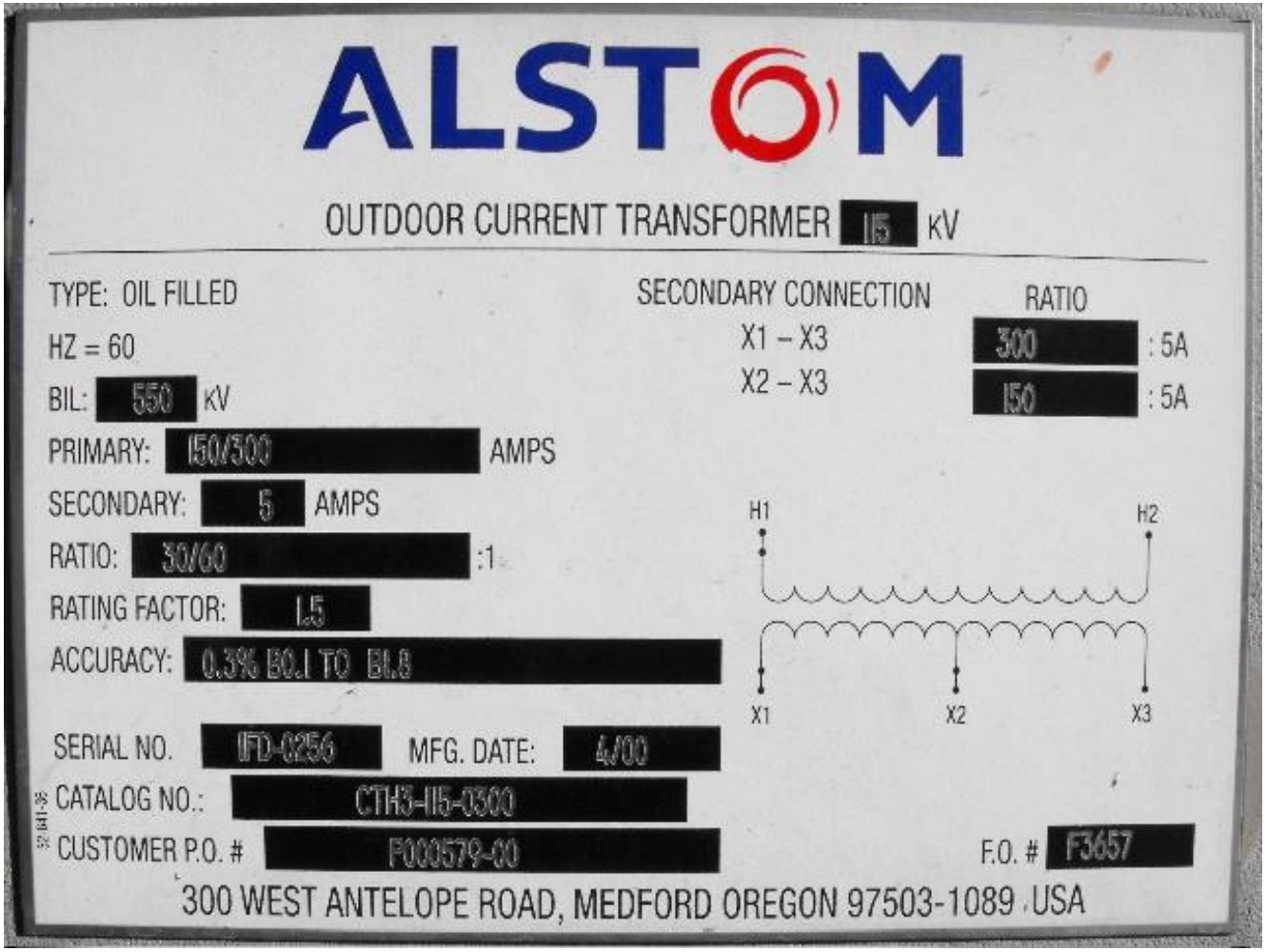
CT – Current Transformer

CT

- Scales Down the Current
  - 400:5
  - 800A:10A

PAGES 23-26

FACEPLATE SPECIFICATIONS



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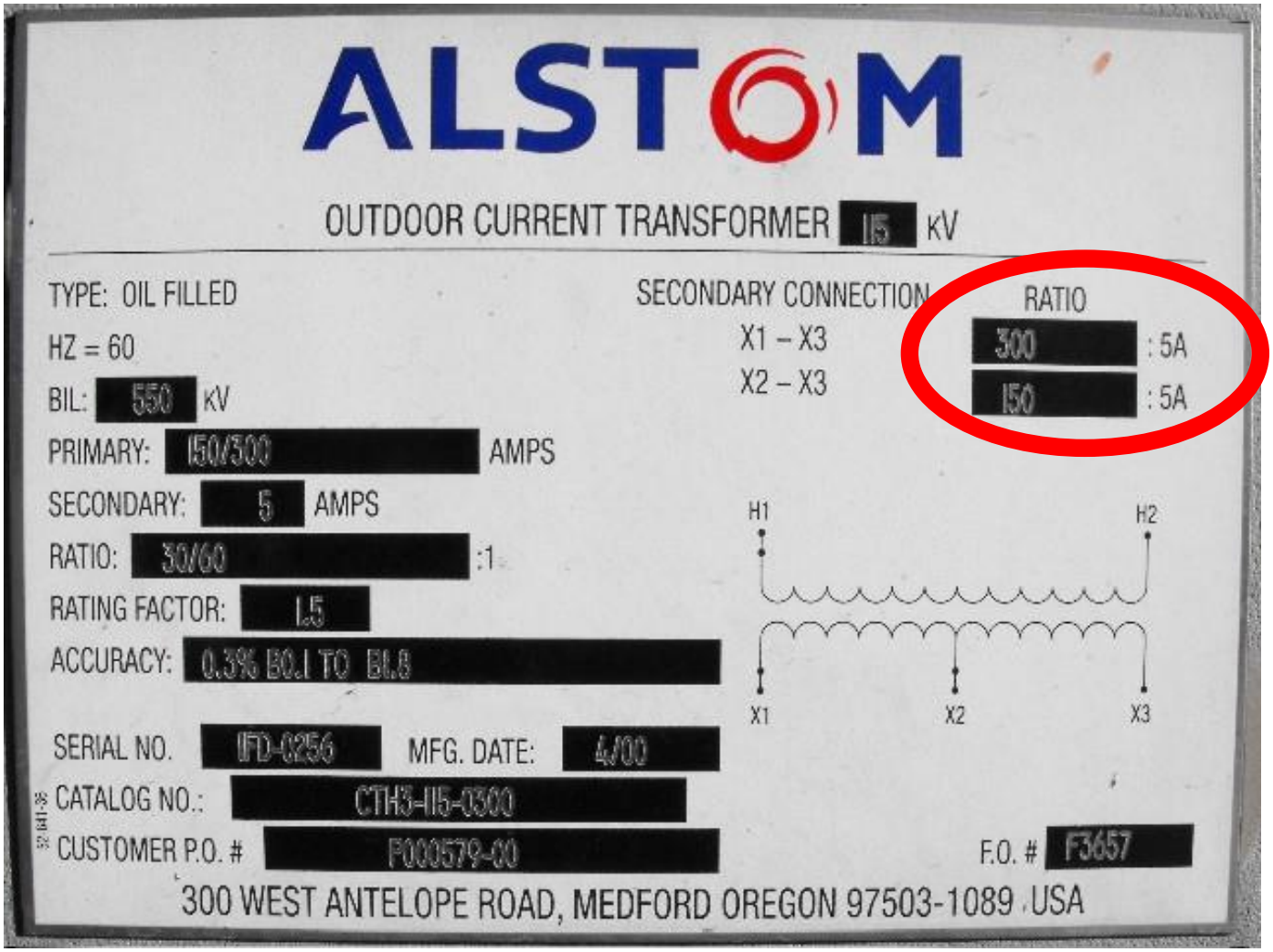
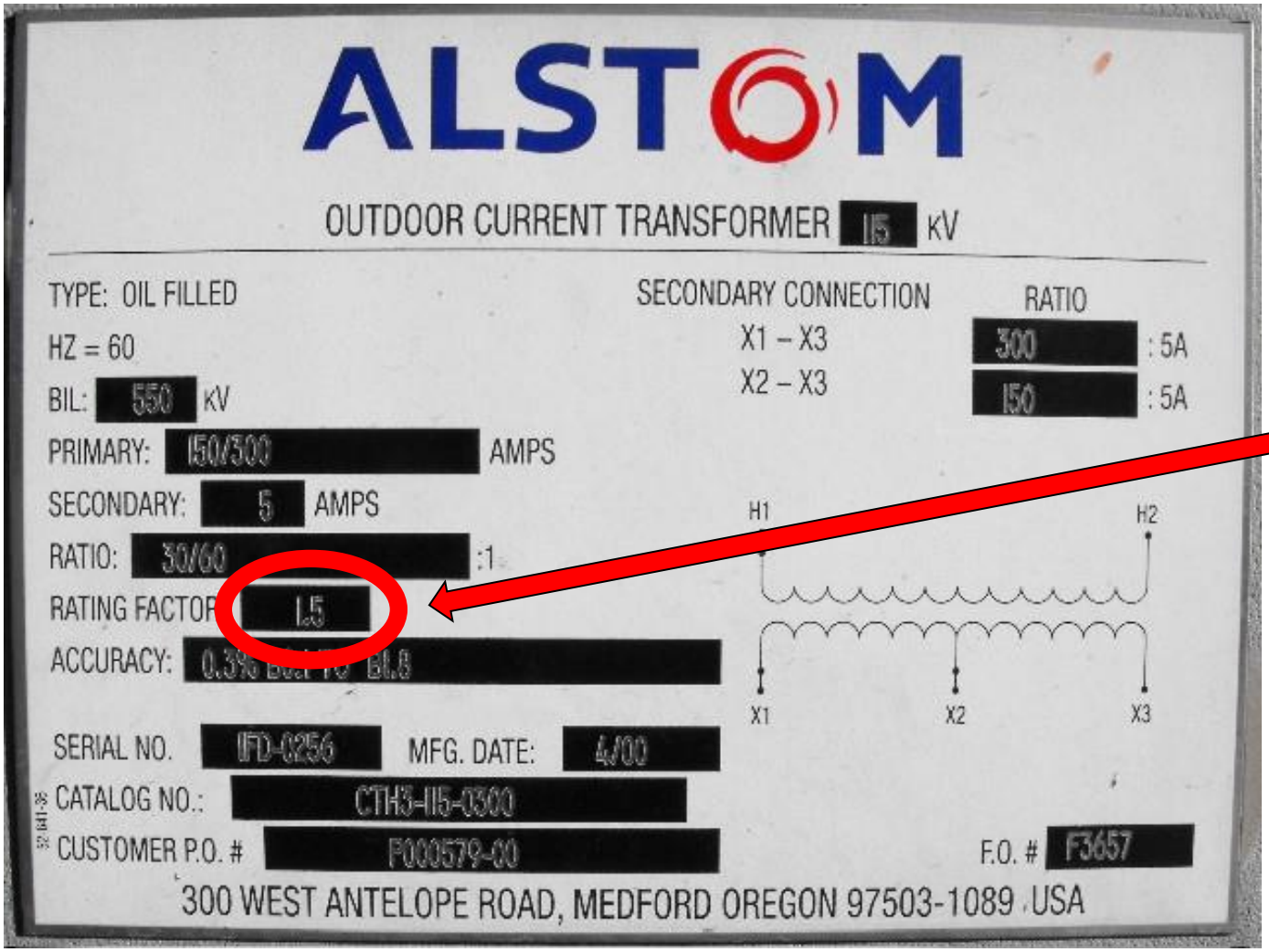


Ratio

FACEPLATE SPECIFICATIONS



Thermal factor

CT's – Functions and Terminology

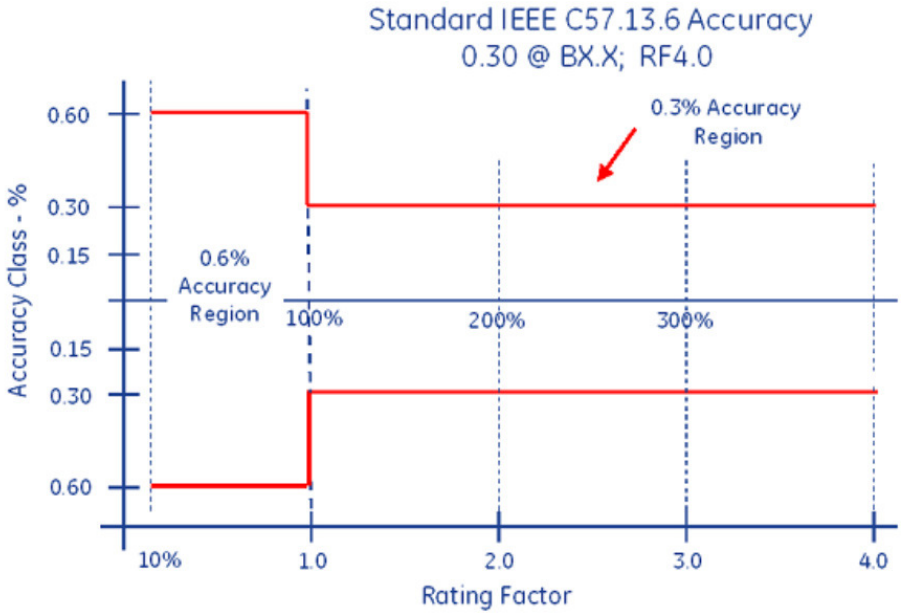
Thermal Rating factor

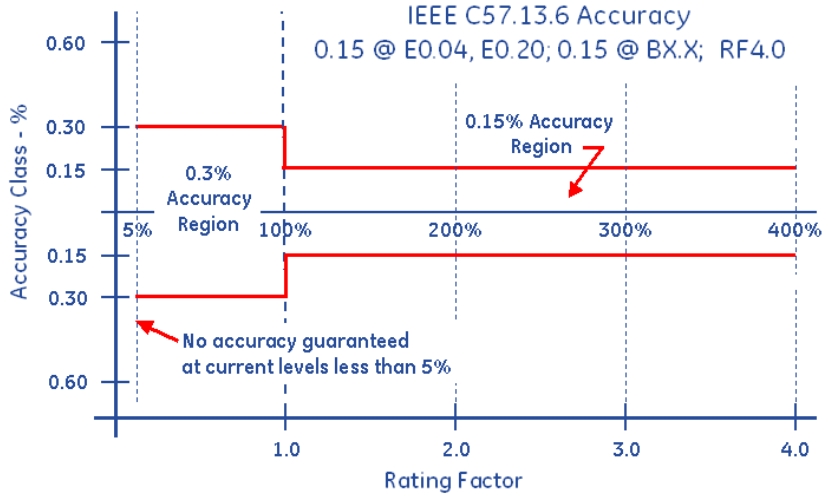
A value representing the amount by which the primary current can be increased without exceeding the allowable temperature rise. For instance, a RF of 4.0 at 30° ambient on a 400:5 ratio CT would allow for a primary current up to 1600A.

FACEPLATE SPECIFICATIONS

Accuracy Classifications

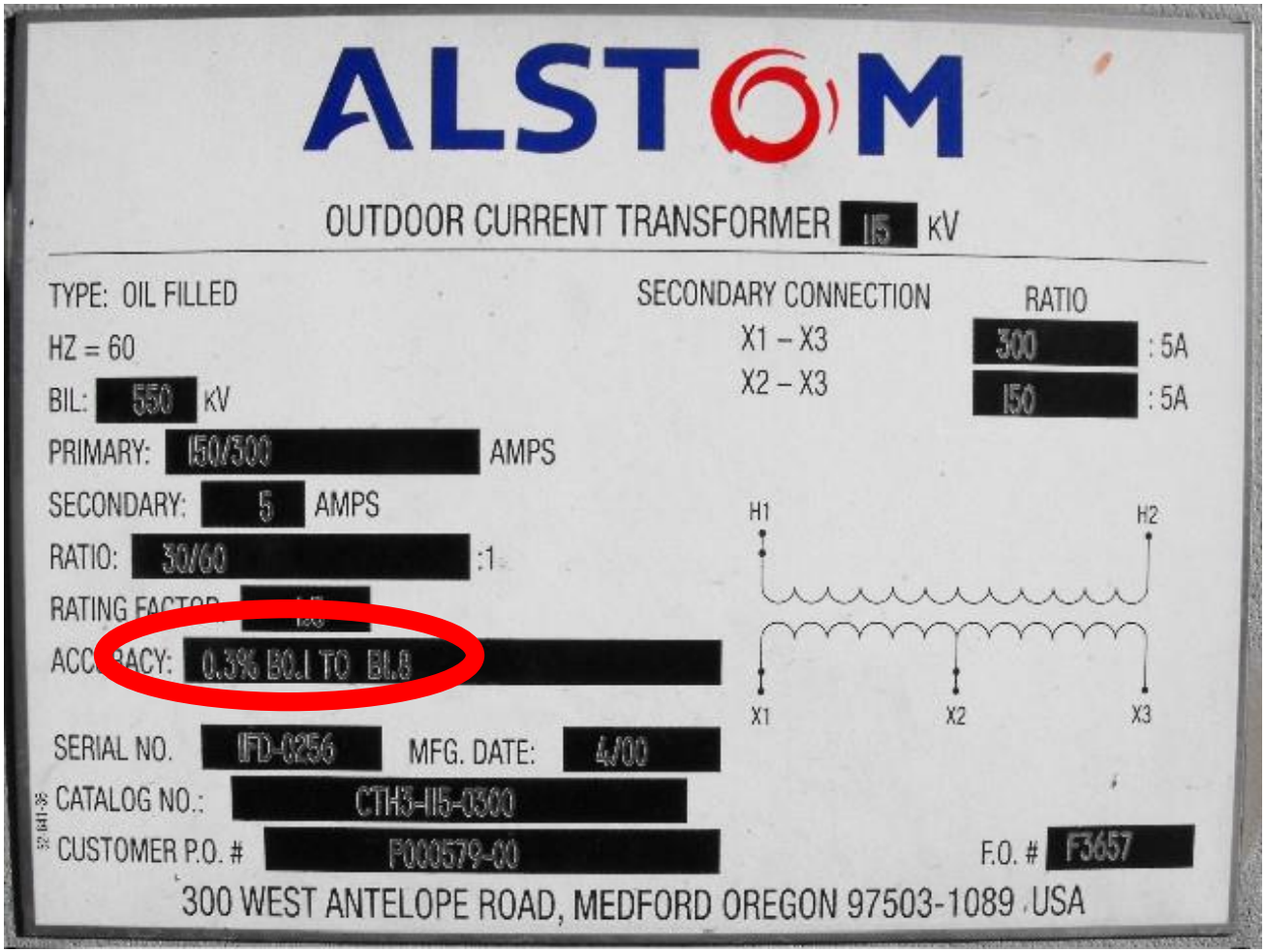
All CT's fall within an accuracy class.
IEEE Standards have defined accuracy classes.





FACEPLATE SPECIFICATIONS

Burden Rating



BURDEN RATING

.3@B0.1,B0.2

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.

Questions and Discussion

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