

Instrument Transformers

- A transformer that is used in conjunction with a measuring instrument
- It utilizes the current-transformation and voltage transformation properties to measure high ac current and voltage
- They also provide isolation

Where to use Instrument Transformers

- To measure high currents and high Voltages
- Why can't we use voltmeter with very high series resistance and ammeter with very low shunt resistance?

Disadvantages of Shunts & Multipliers

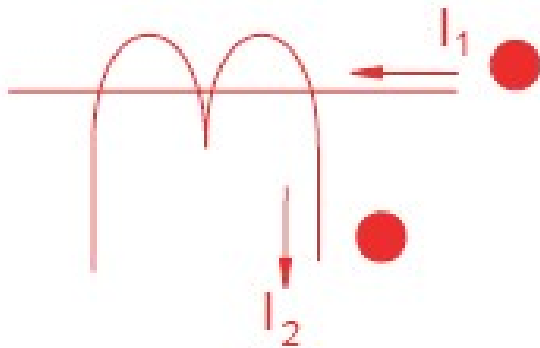
- Shunts
 - Time constant should be same for meter and shunt
 - Power consumed increases
 - Insulation problems (for high voltages)
 - No Isolation
- Multipliers (Series resistance)
 - Power consumption
 - Leakage currents, so good insulators used , hence costly
 - No isolation

Types of Instrument Transformers

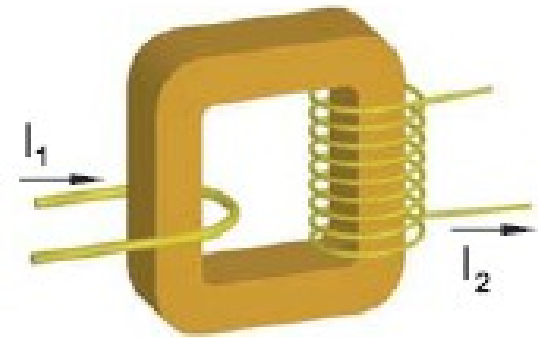
- Current transformer
- Potential (Voltage) transformer

Current Transformers

Symbol of a
Current Transformer



Conceptual picture of
a Current Transformer



- Secondary is usually 5 A (Standard)
- 5 A is sufficient for a relay to operate and for a meter to measure

Point to note about CT

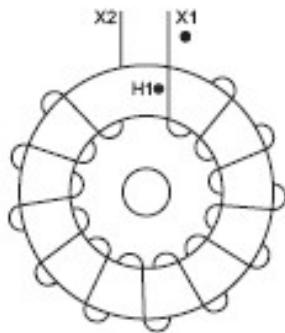
- Primary current depends on load, but not on the burden
- Current coil of Wattmeter or Ammeter is connected across the terminal of the secondary or Relay
- Secondary operates near short circuit conditions
- One of the terminal of CT secondary winding is earthed

Types of CT

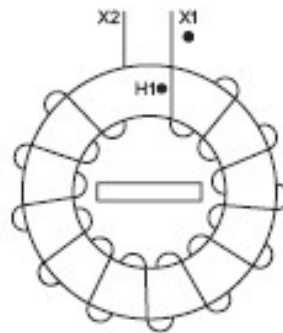
Construction Types



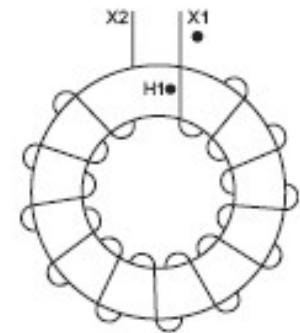
Window-type



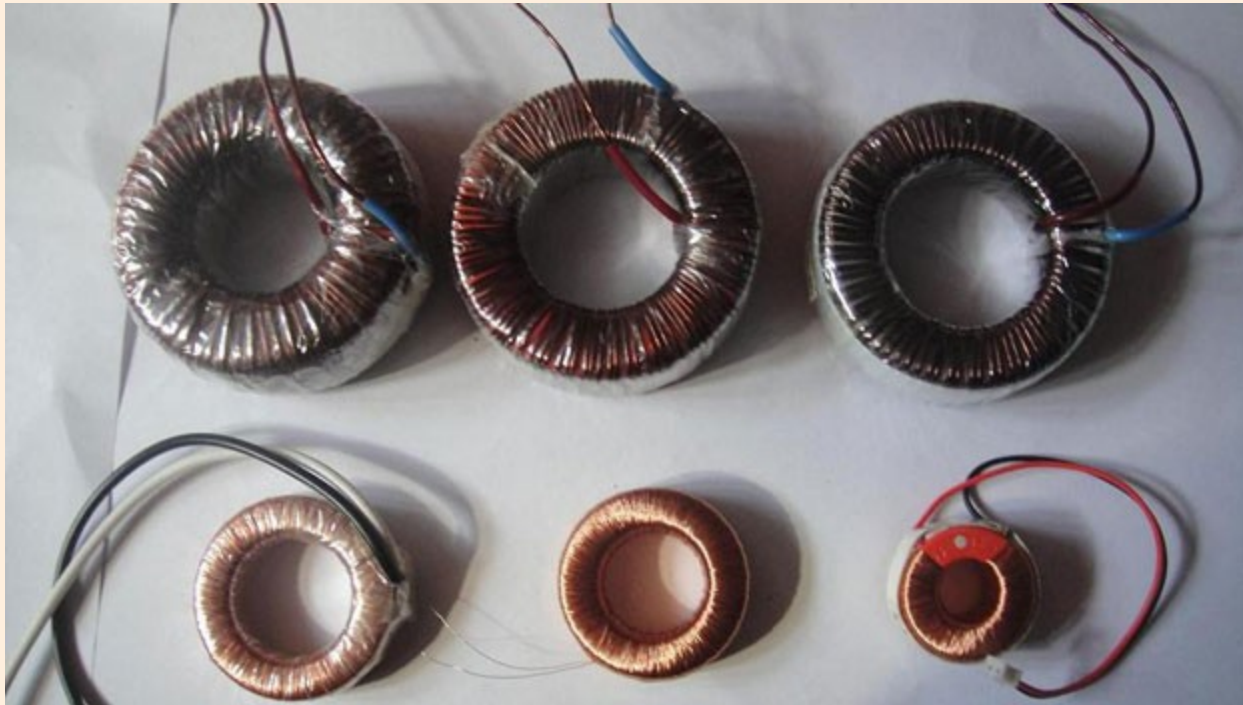
Bar-type



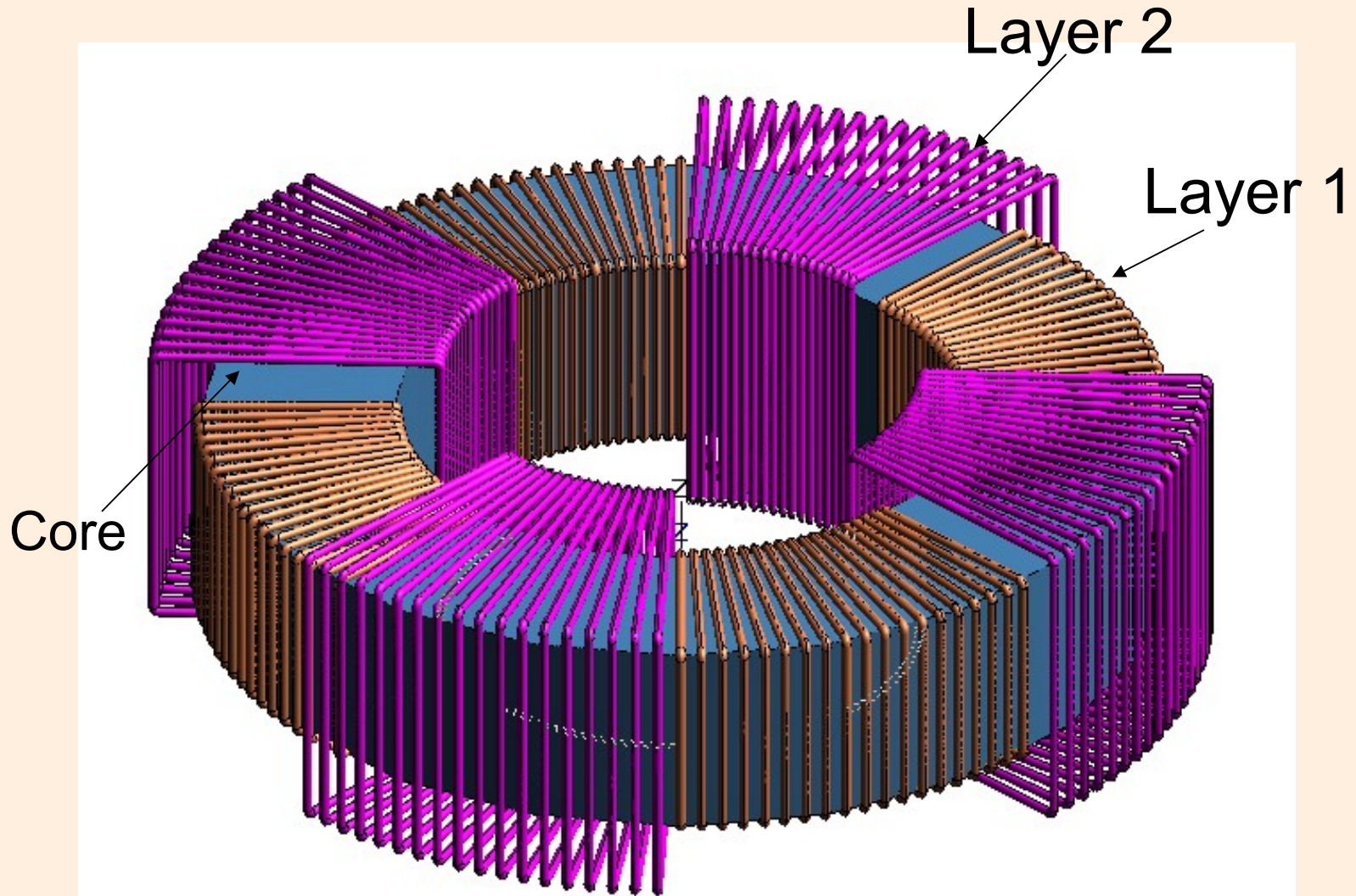
Wound



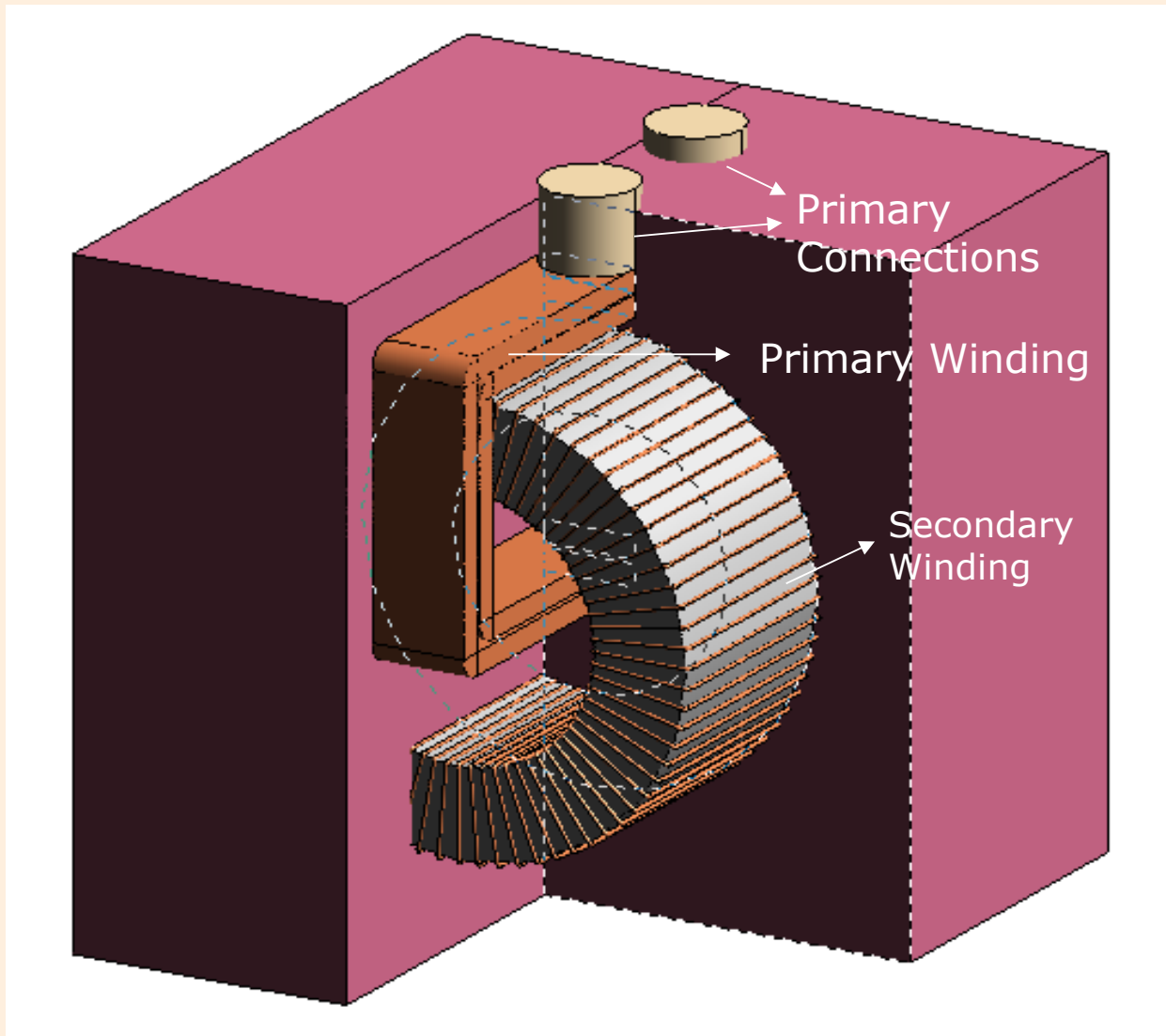
Constructional Details of Window CT



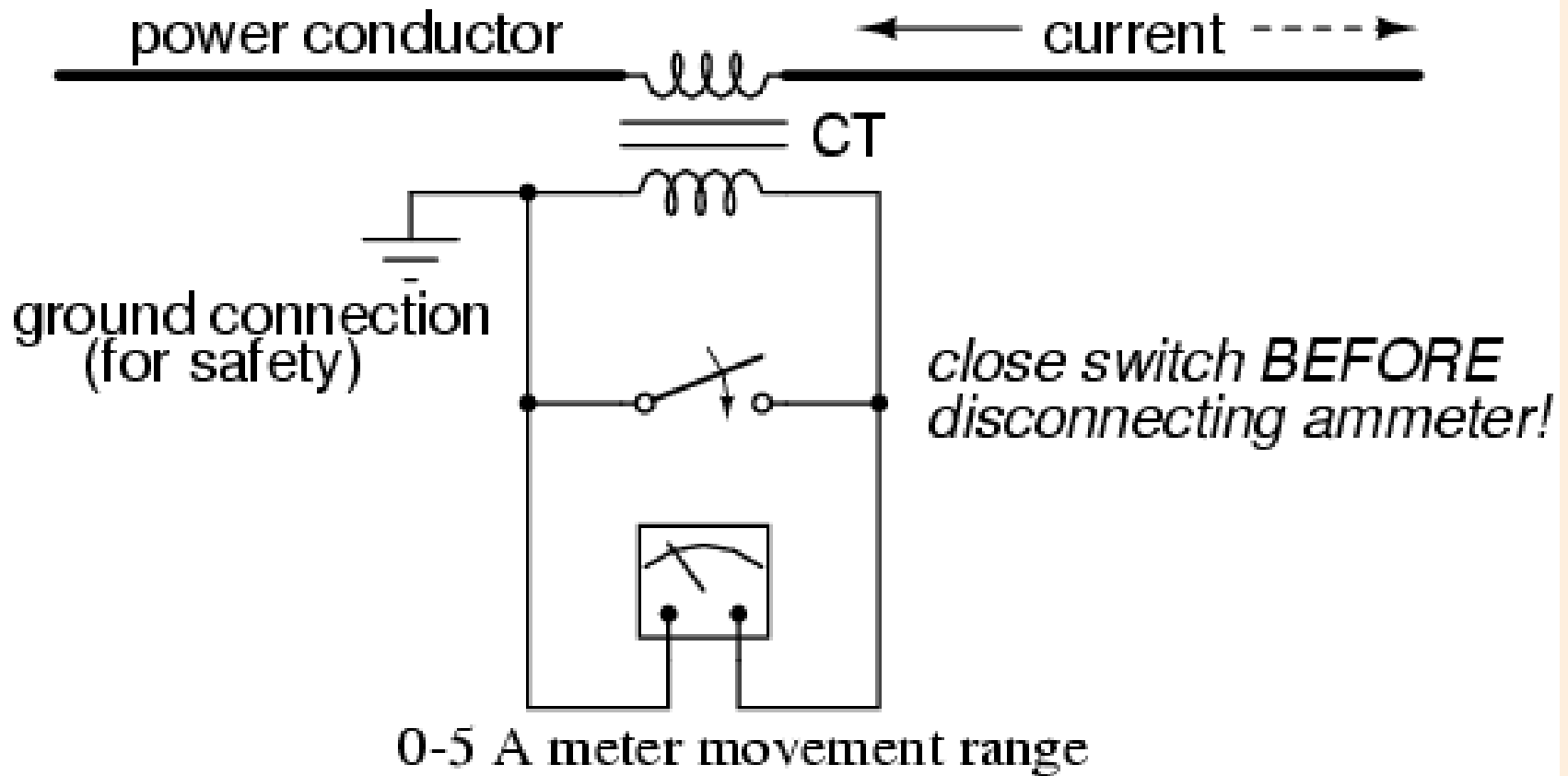
Constructional Details of Window CT



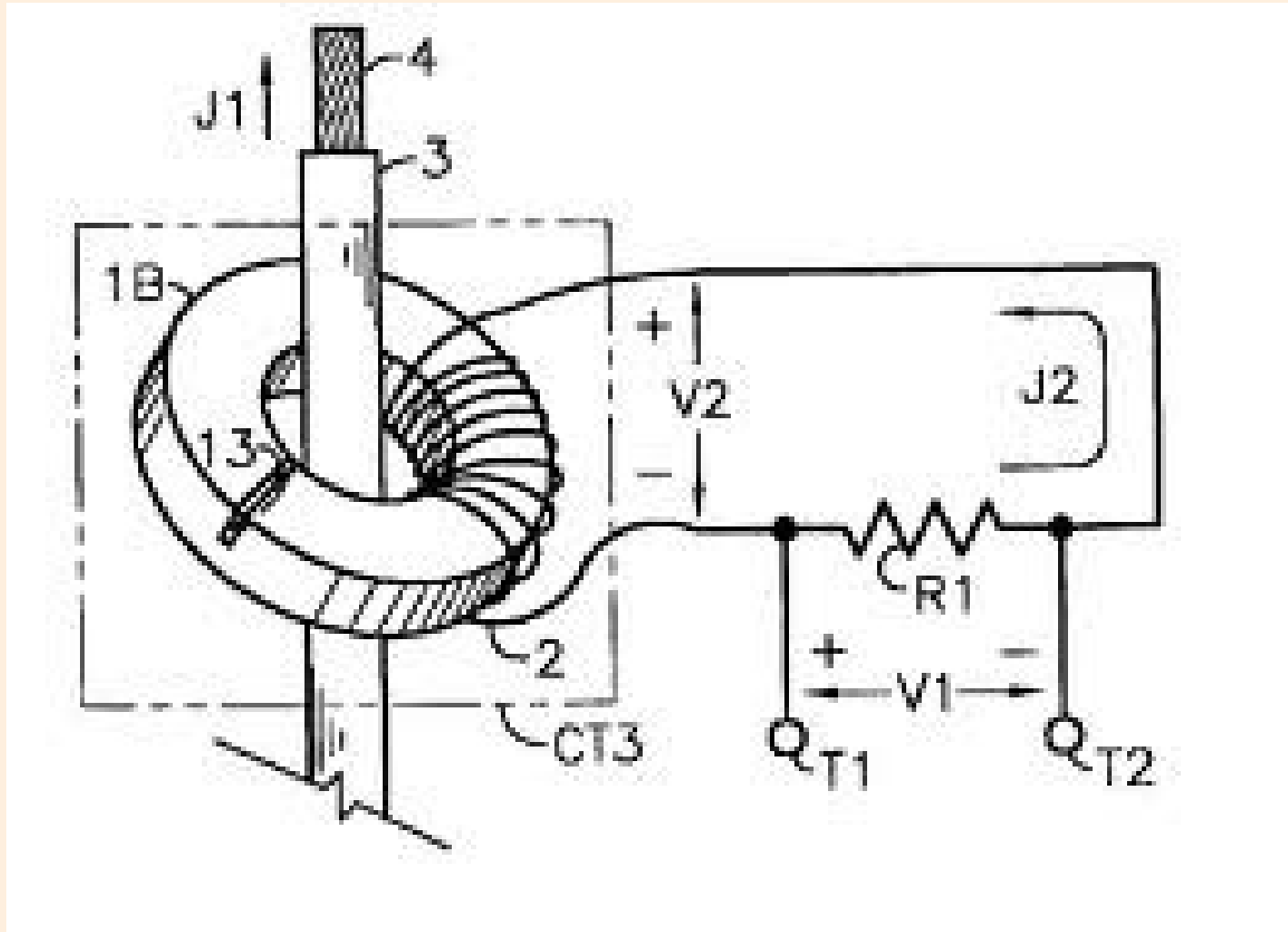
Constructional Details of wound CT



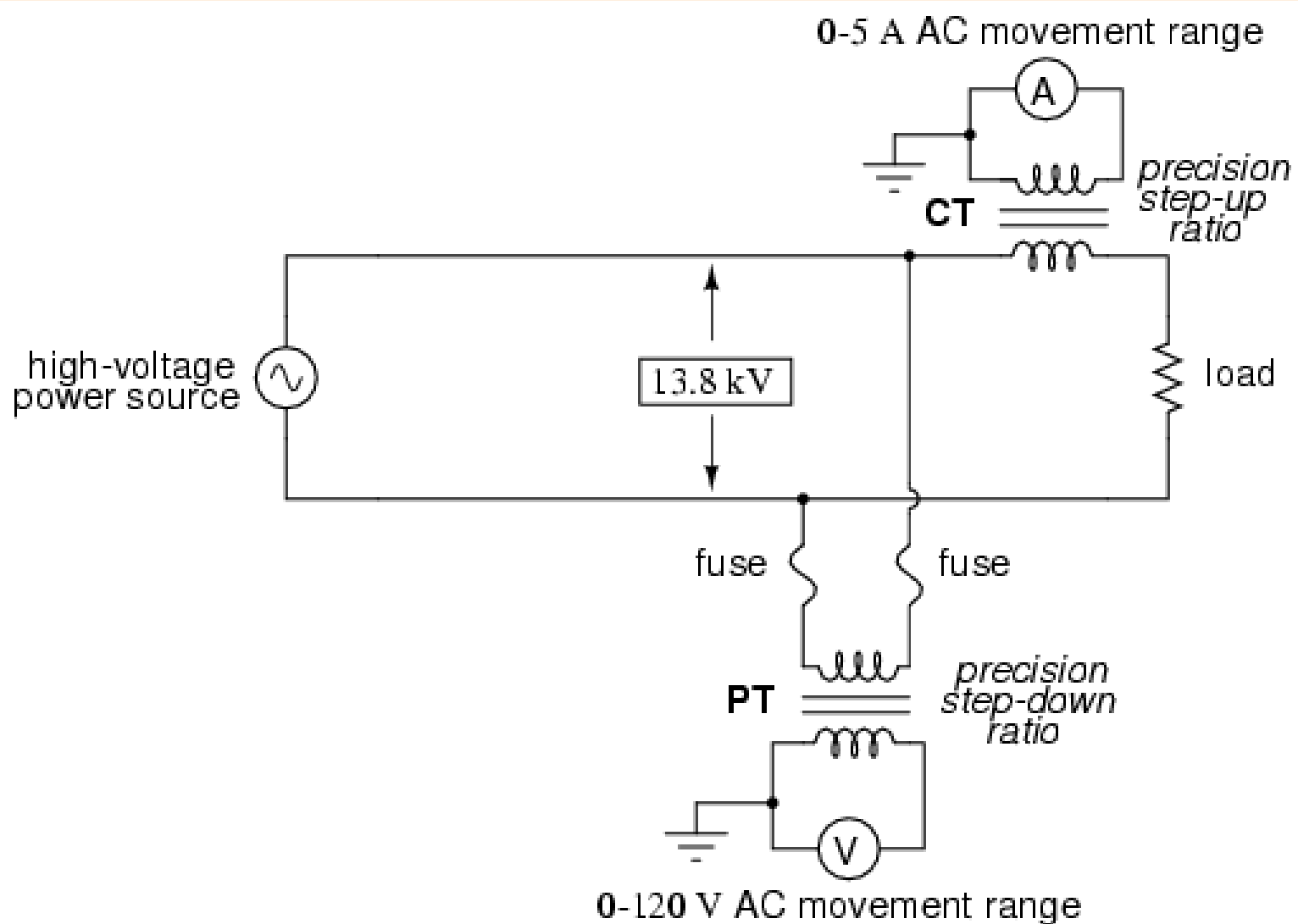
Care, while operating with CT



Usually current is measured in terms of voltage across a standard resistor



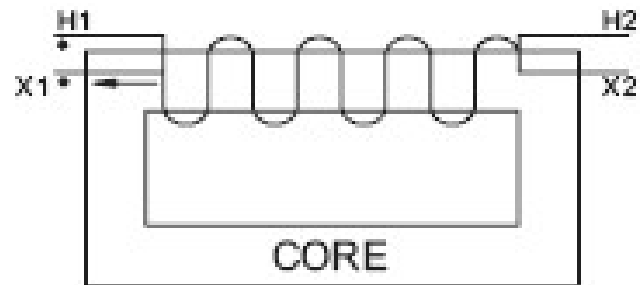
Connections of CT and PT



Potential Transformer



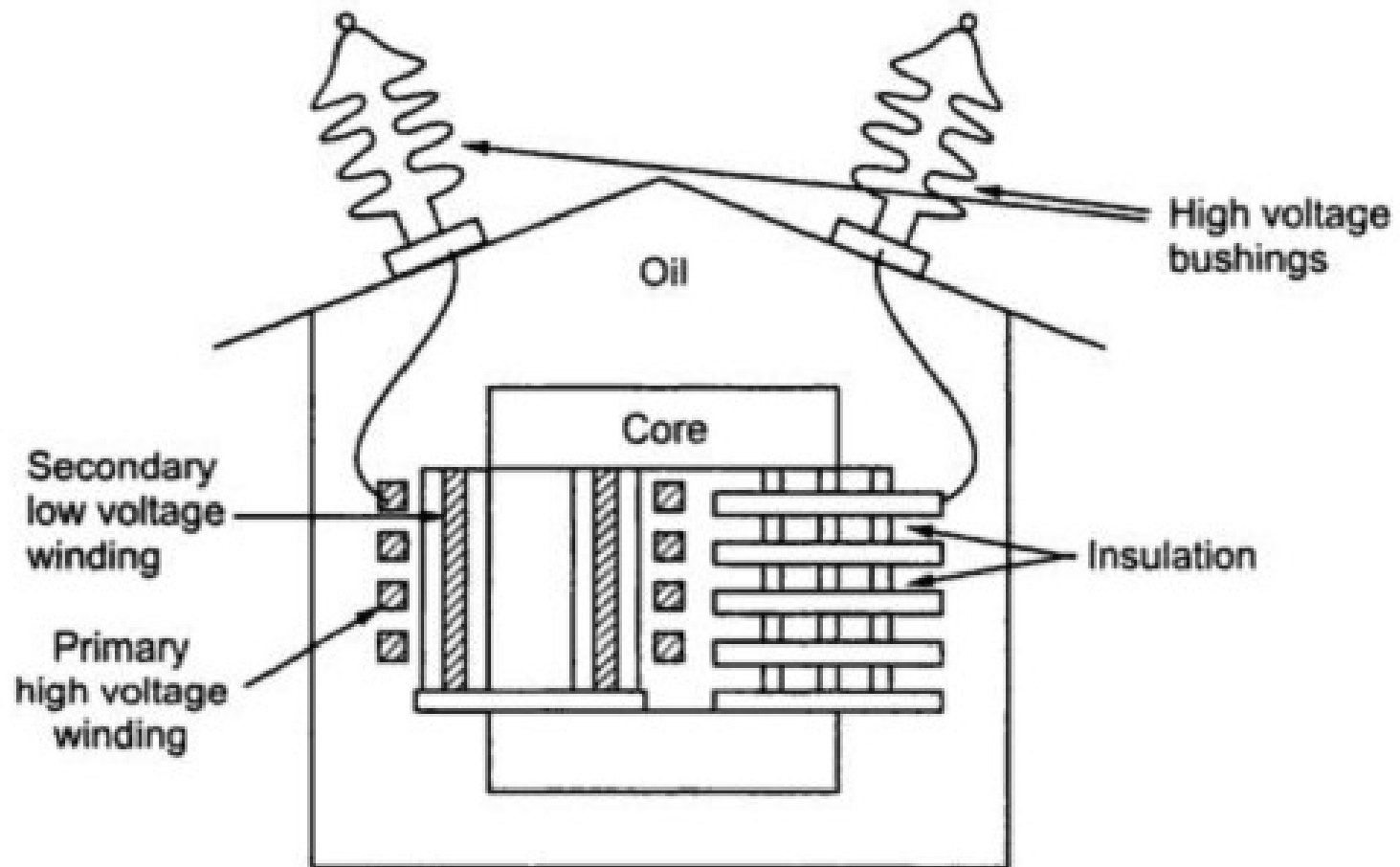
Voltage Transformer



Voltage Example

Primary 7200 Volts

Ratio 60:1 or 7200:120 Volts



Points to note about PT

- Secondary is connected voltmeter or Potential coil of the Wattmeter or Relay
- Design is similar to Power Transformer, but Potential Transformers are lightly loaded
- Secondary is usually rated for 110 V
- Should not be shorted

Construction of PT

- For the same power rating, Voltage transformer is costly than Power transformer (large core & conductor size)
- Output is small (and accurate), but size is large
- Can carry more load (2 to 3 times)
- Shell type core – Low voltage
- Co-axial windings

Construction of PT

- Insulation: Cotton tape and varnished cambric as insulation for coil
- Oil immersed for more than 7 kV
- Oil filled bushing for oil filled transformer
- If one side of the primary winding is at neutral, one bushing is sufficient

No.	Power Transformer	Instrument Transformer
1)	Mainly used to change the voltage levels in a power system.	Mainly used to extend the ranges of the instruments while measuring parameters like voltage, current, power , energy etc.
2)	They are required to transform huge amount of power to the load.	They are required to transform very small power as their loads are generally delicate moving elements of the instruments.
3)	They can be used to step up or step down the voltage.	They are basically step down transformers and used alongwith devices such as protective relays, indicators etc.
4)	The exciting current is a small fraction of the secondary winding load current.	As the load itself is small, the exciting current is of the order of the secondary winding load current.
5)	The cost is main consideration in the design while efficiency and regulation are the second considerations.	Accuracy is the main consideration while designing to keep ratio and phase angle errors to minimum. Cost is the second consideration.
6)	As they handle large power , the heat dissipation is the major consideration and cooling arrangement is necessary.	The power output is very small as loads are light hence heating is not severe.
7)	The limitation on the load is due to temperature rise.	The accuracy is the main load limitation factor and not the temperature rise.
8)	Examples are distribution transformers, transformers used for transmission.	Examples are current and potential transformers.