Hands on Single and Three Phase Instrument Transformer (IT) Rated Metering, Installation and Troubleshooting

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PPE for the Meter Tech

- F R clothing under garments to be all natural fiber (cotton)
- Rubber Gloves with leather protectors (Low and High voltage)
- Rubber Sleeves
- Check before each use (air test)
- Eye Protection (Safety Glasses, Face shield)
- Safety Vest
- Hard Hat

#1 Safety Rule

- Never have a energized CT with an open circuit
- A non shorted CT can build up a High Voltage charge this can damage metering equipment and injury metering or line techs

Why do we use Instrument Rated Meters and not Self Contained Meters?

- They are capable of metering high current loads
- What is your utility requirements greater than…200, 400 or 600 amps?
- High voltages above 240

What is the purpose for Current Transformers (CTs)?

- Proportionally steps down the current in the meter circuit
- Example 200/5 ct's, for every 200 amps that flow through the primary winding the meter will receive 5 amps
- Isolates meter personnel and metering equipment from high current flow

How To Determine the correct CT size for Single Phase

- Do you size by service size or transformer size?
- Single phase amps= $\frac{\text{KVA X 1000}}{\text{Line to Line voltage}}$
- $\frac{\text{25KVA X1000}}{\text{240volts}} = \frac{25000}{240}$ = 104 amps per leg

Rule of Thumb for Single Phase

- If line to line voltage is 240 multiply the KVA rating by 4
- 25KVA X 4 = 100 amps per leg
- If line to line voltage is 480 multiply the KVA rating by 2
- 25KVA X 2 =50 amps per leg

How To Determine the correct CT size for three phase

- Do you size by service size or transformer size?
- Three phase amps = $\frac{\text{KVA x 1000}}{\text{1.732 line to Line voltage}}$

$$\frac{300 \text{ KVA x } 1000}{1.732 \text{ x } 240\text{v}} = \frac{300{,}000\text{VA}}{415.68\text{v}} = 721.71 \text{ amps}$$

Rule of Thumb for Three Phase

- If the line to line voltage is 208 multiply the KVA rating by 2.8
- 100KVA x 2.8=280 amps per leg
- If the line to line voltage is 240 multiply the KVA rating by 2.4
- 100 KVA x 2.4 =240 amps per leg
- If the line to line voltage is 480 multiply the KVA rating by 1.2
- 100KVA x 1.2 = 120 amps per leg

Rating Factor

- Amount by which the primary load may be increased over it's nameplate rating
- Thermal rating
- 30 degrees Celsius (86-F) 55 degrees Celsius (131-F)
- Burden rating ohm value in the secondary circuit with passes through the current coil.
- Looped primary wires in CT's will cut ratio in 1\2 (200\5 looped will be 100\5)


TYPE R 6 P
CURRENT TRANSFORMER
CAT NO 92355 - 001
SER NO 18642161
Schlumberger
Made In USA
400:5A
0.3 B 0.1, B 0.2
30°C RF = 4.0
60 Hz
IC 0.6 KV
BIL 10 KV
426616-025

What Is the Purpose Of Potential Transformers (PT's)?

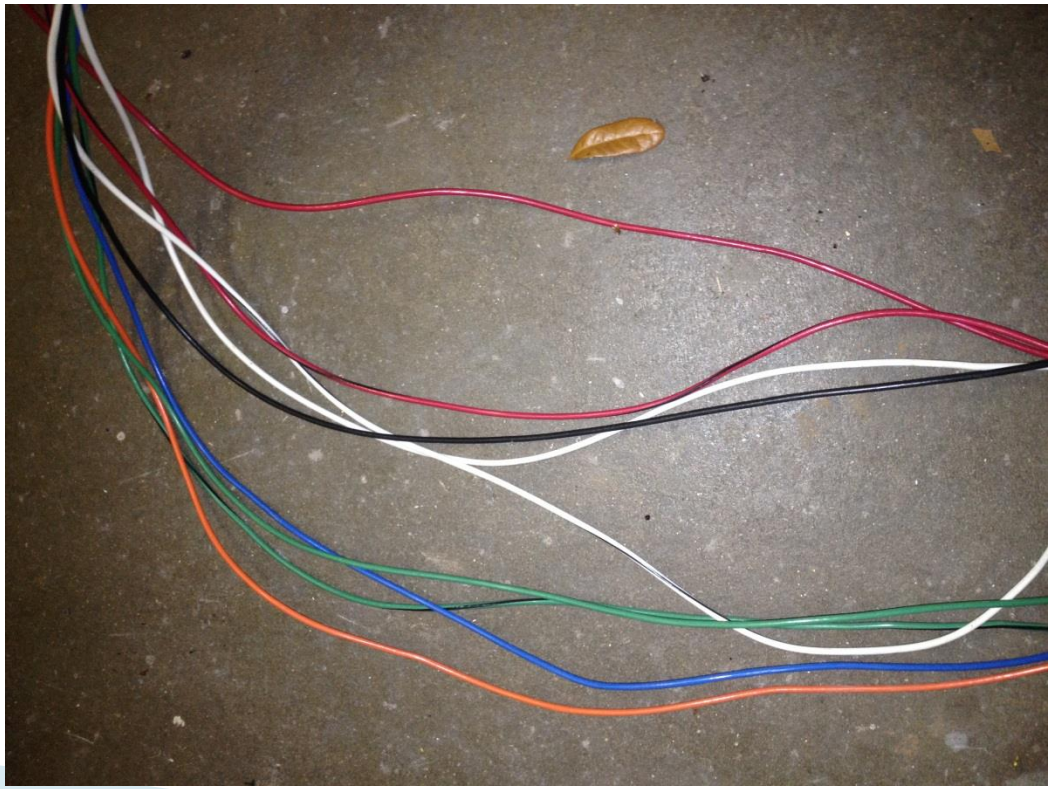
- The PT has only one purpose to reduce the voltage to the meter to a lower level
- PT's have a defined ratio Never have any other load on a PT but the meter itself "NO YARD LIGHTS"
- Do you still use PT's?

How To Determine the correct PT?

- 2.4/1 277/2.4 = 116 volts
- 4/1 480/4 = 120 volts
- 60/1 7200/60 =120 volts

Color Coded Wires.
Why Do We Use Them?

- It just makes it easier to match up voltages and currents



Trouble Shooting Tools

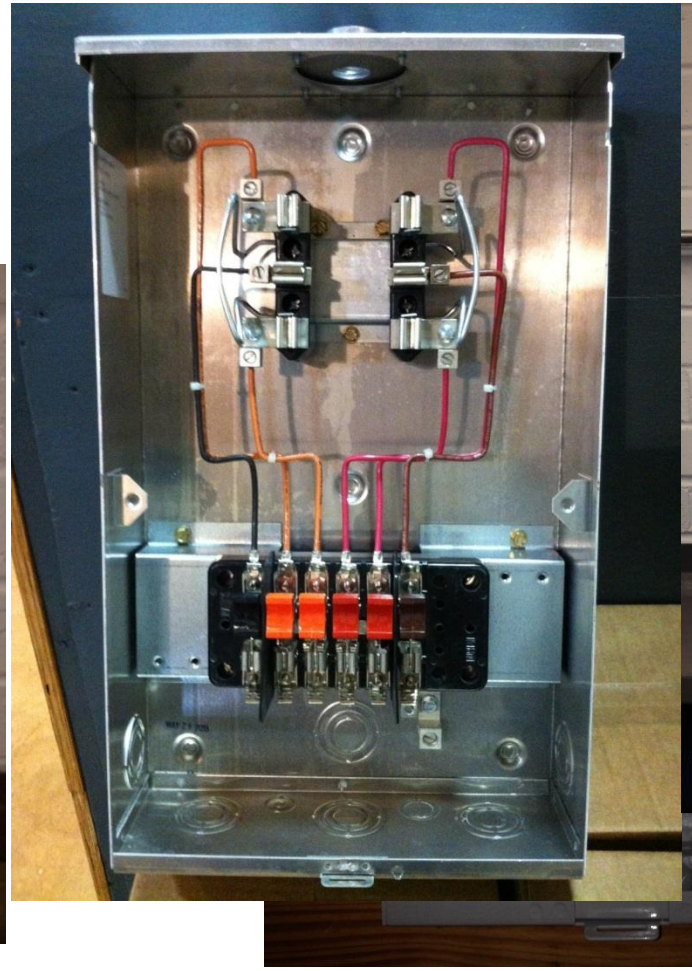
- Good Eyes
- Clamp on volt amp meter
- Magnet
- Heat Gun
- Hand Tools

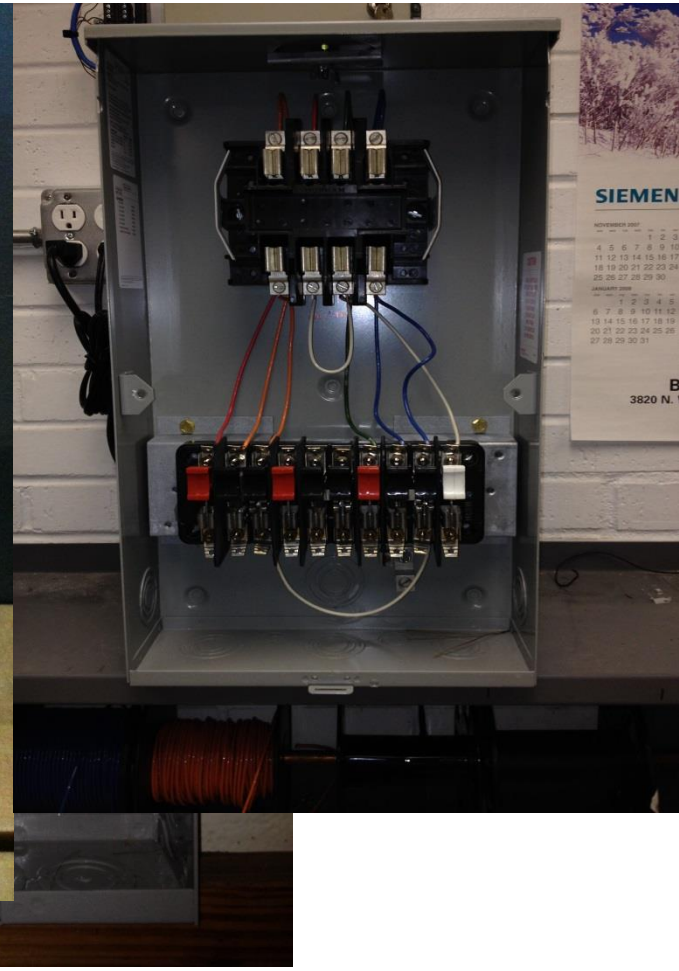
Mistakes In IT Metering

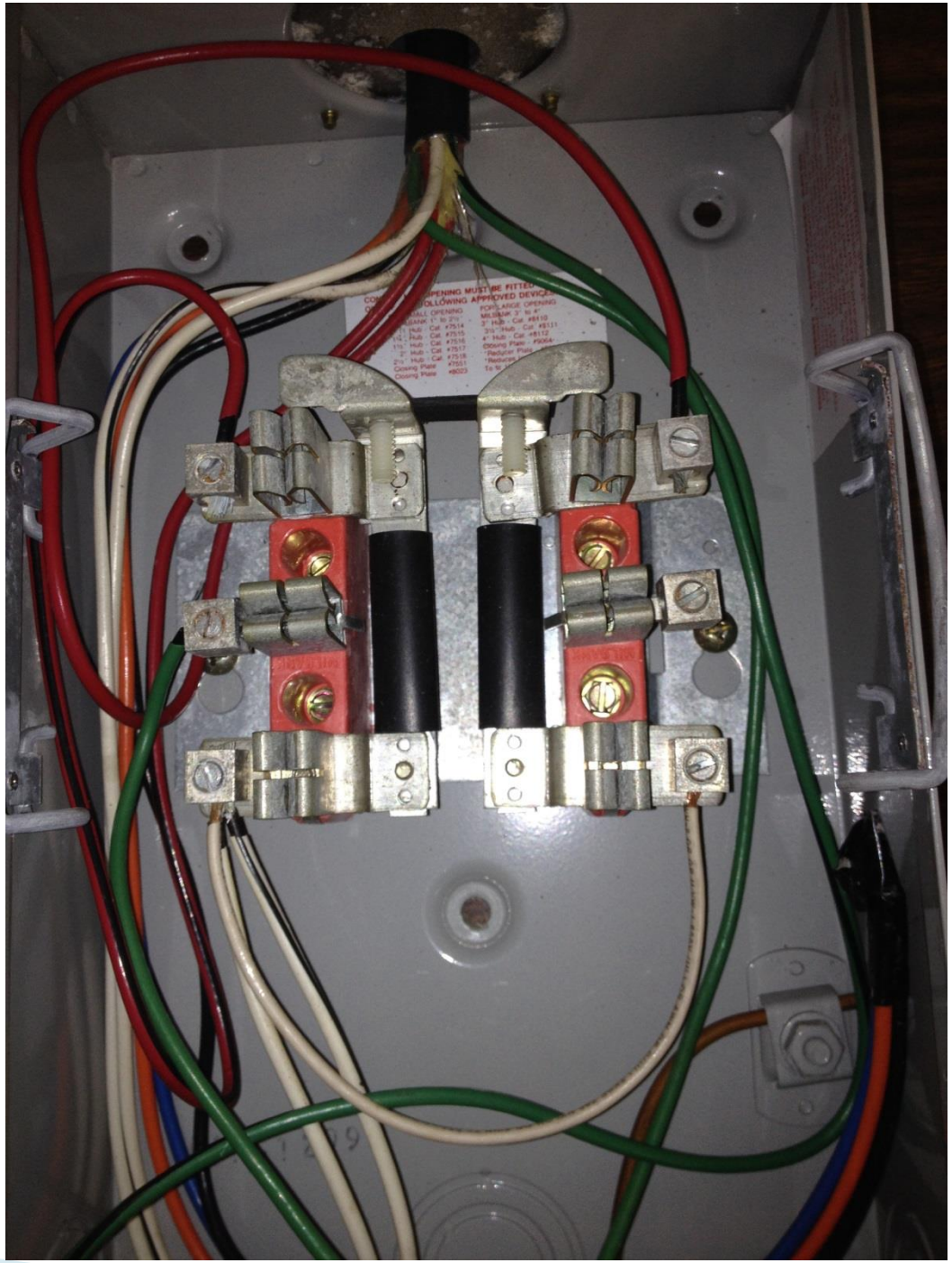
- Wrong multiplier
- Meter and service mismatched (240v meter on 208 service)
- CT backwards on primary conductor
- Wiring reversed at secondary side of CT
- CT shorting bar left in the closed position
- Loose screws

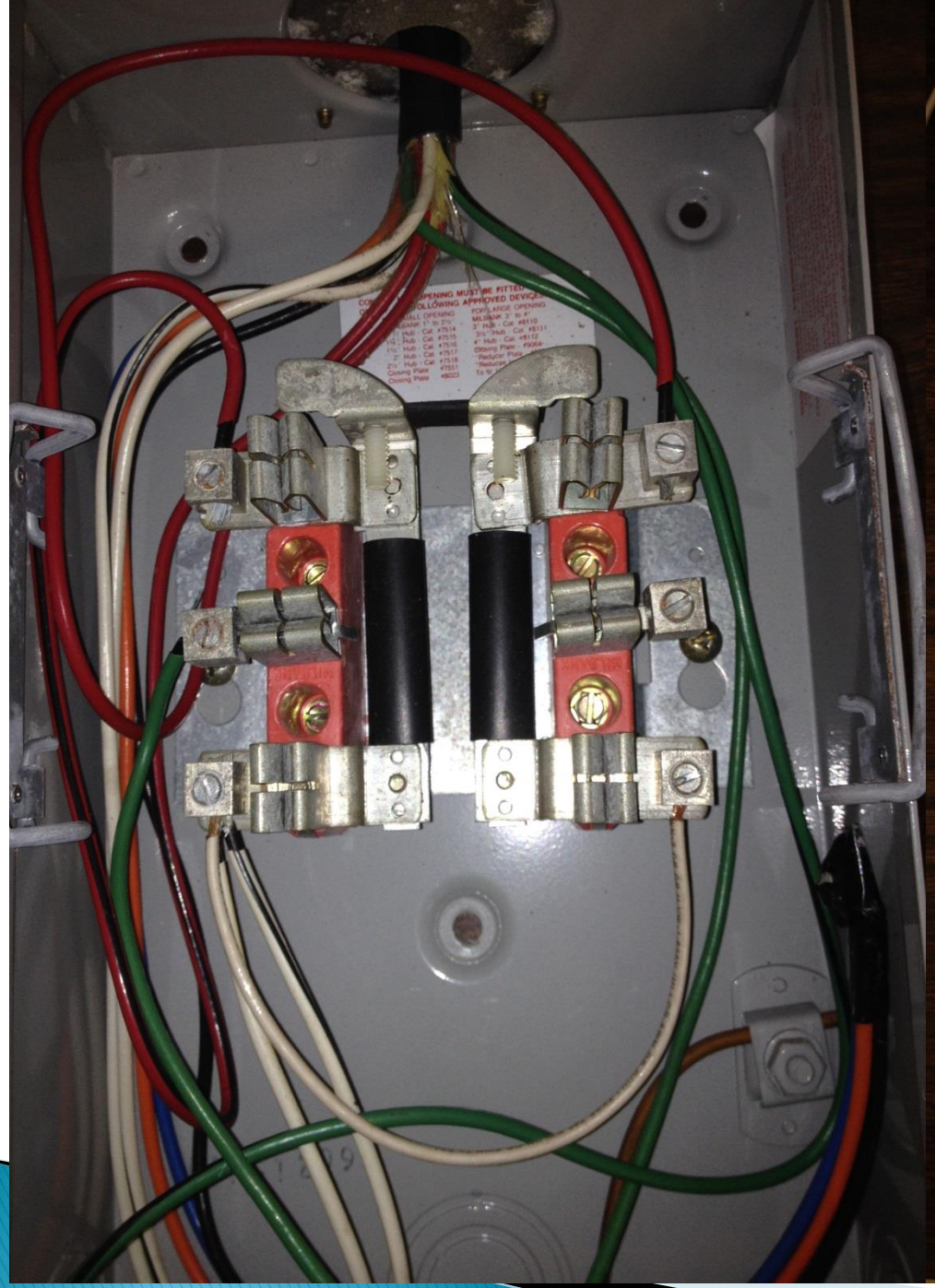
What type “Meter Can” would you use?

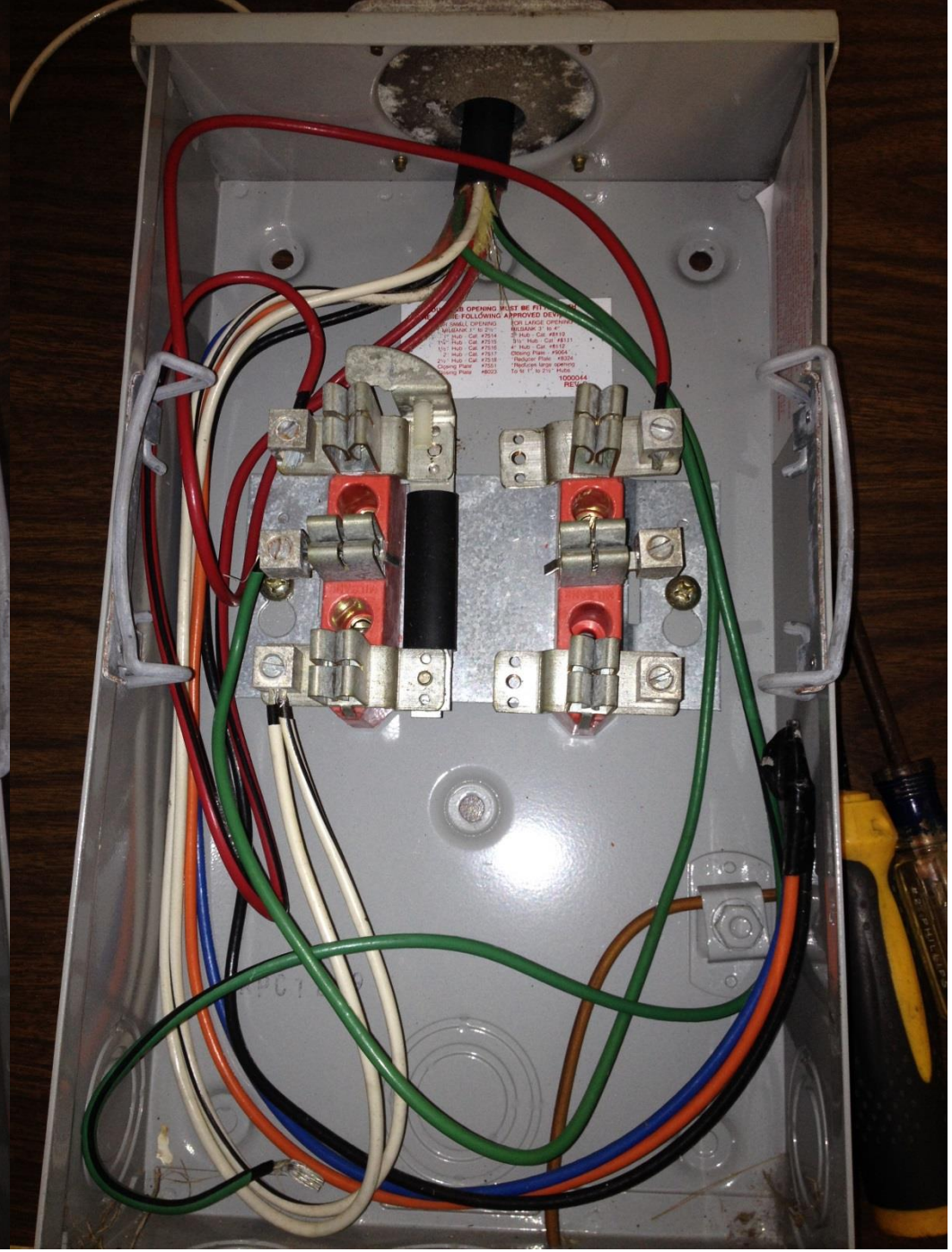
- Self shorting (no test switches)
- Meter can with test switches





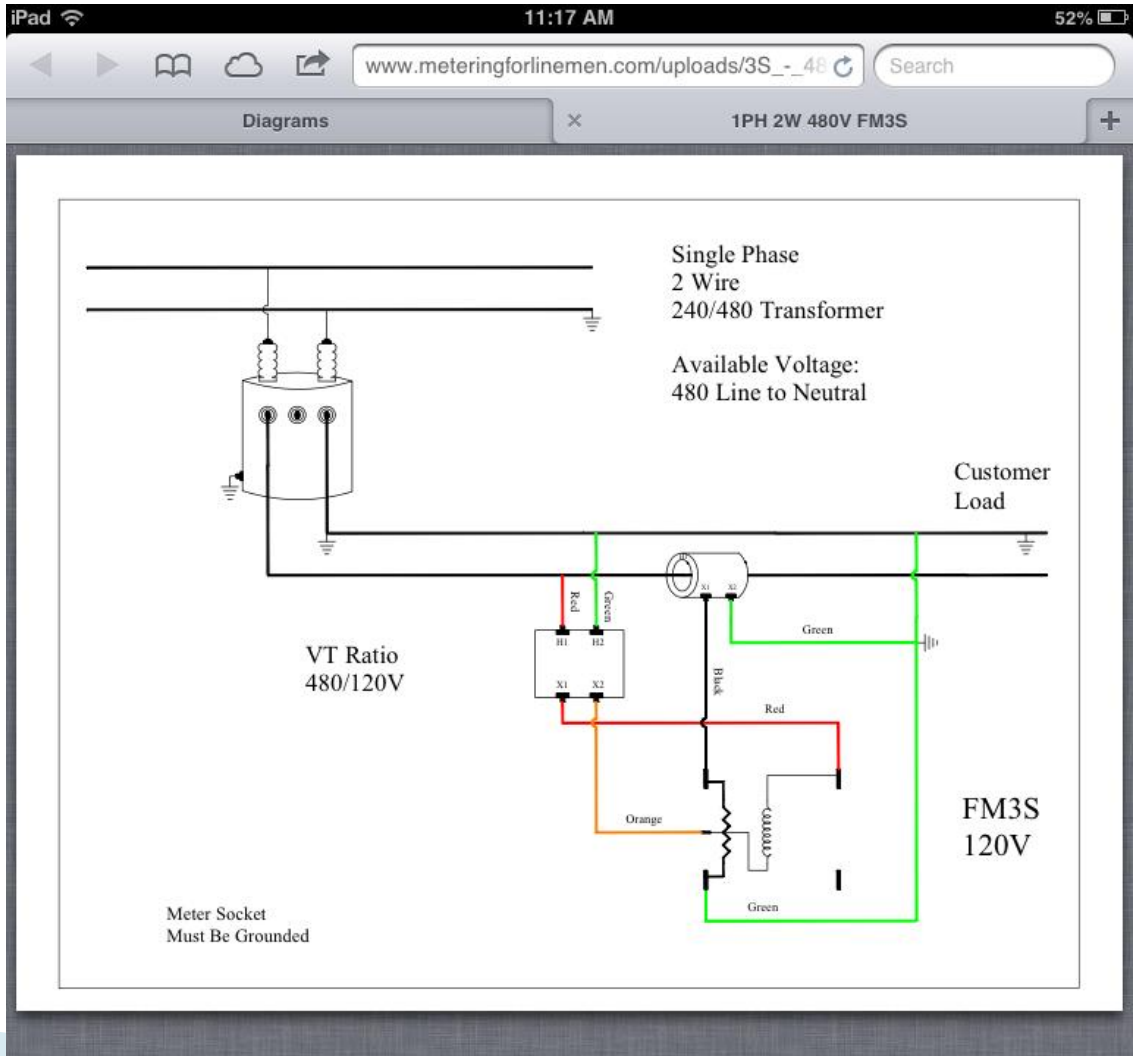






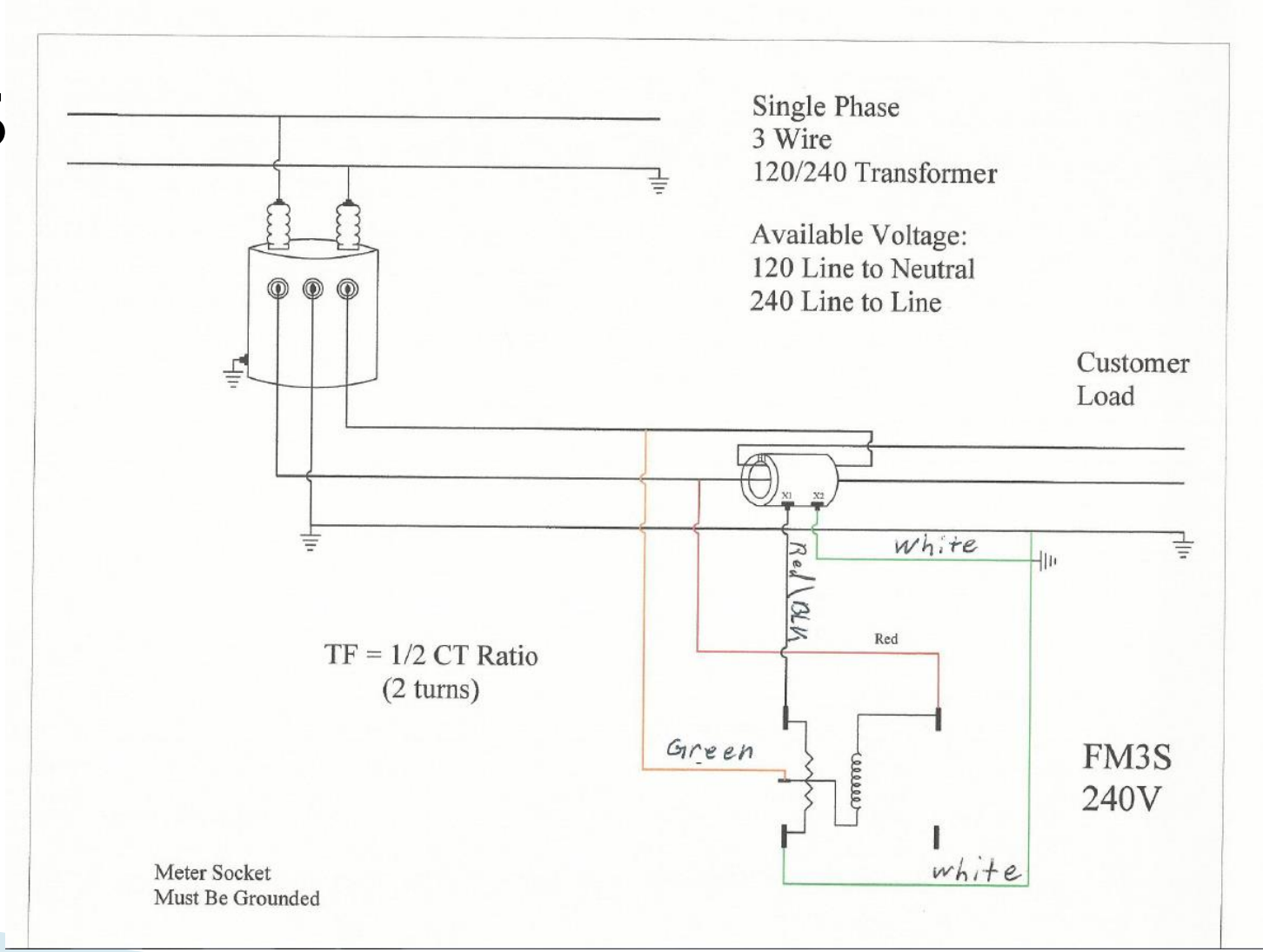
Which meter do I use?
What are the Pros and Cons?

- Meter Form # 3s Class 20 meter
- Single Phase Service
- 120volt 2-wire



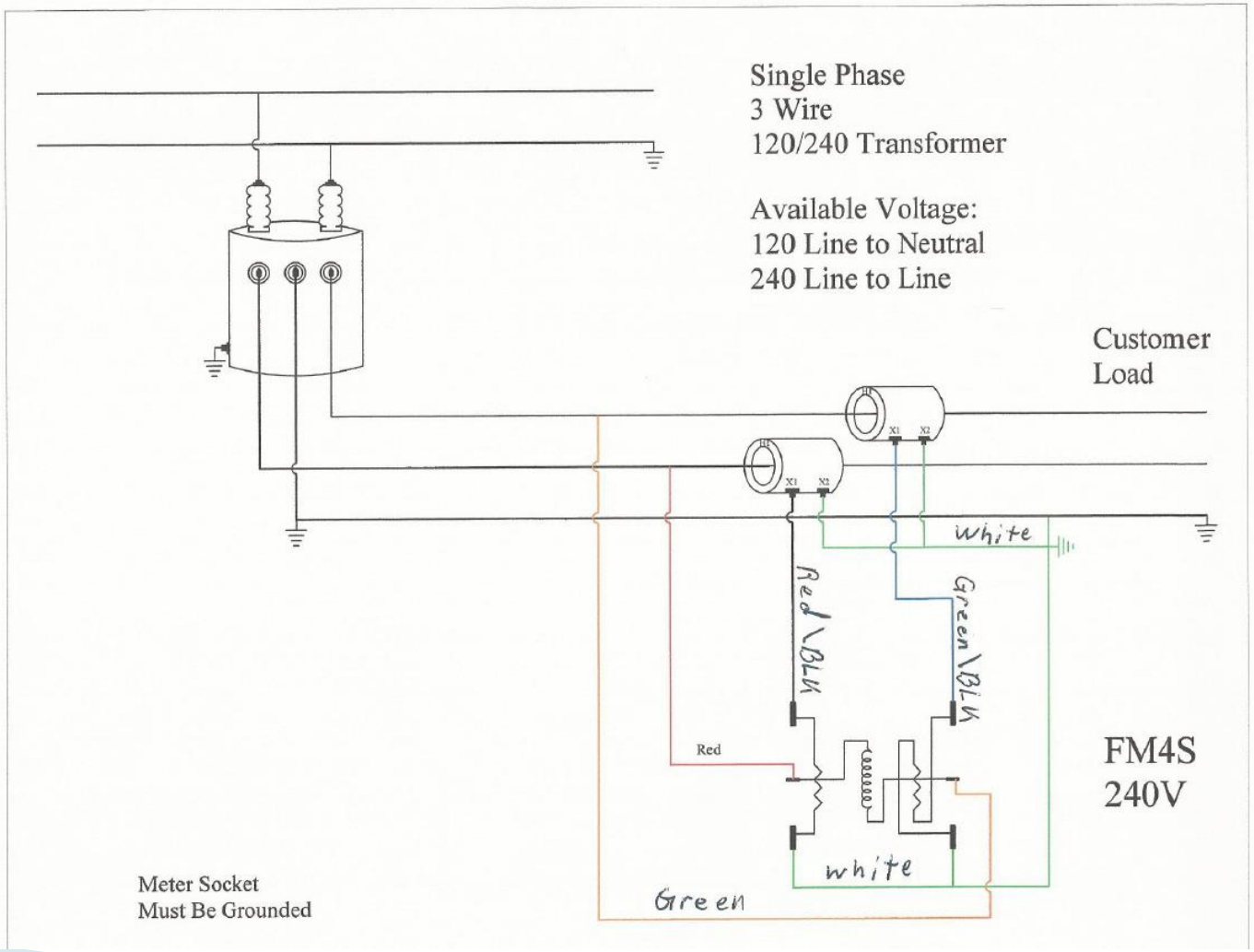
Which meter do I use?
What are the Pros and Cons?

- Meter Form #3s Class 20 meter
- Single phase Service
- 240 volt 3-wire



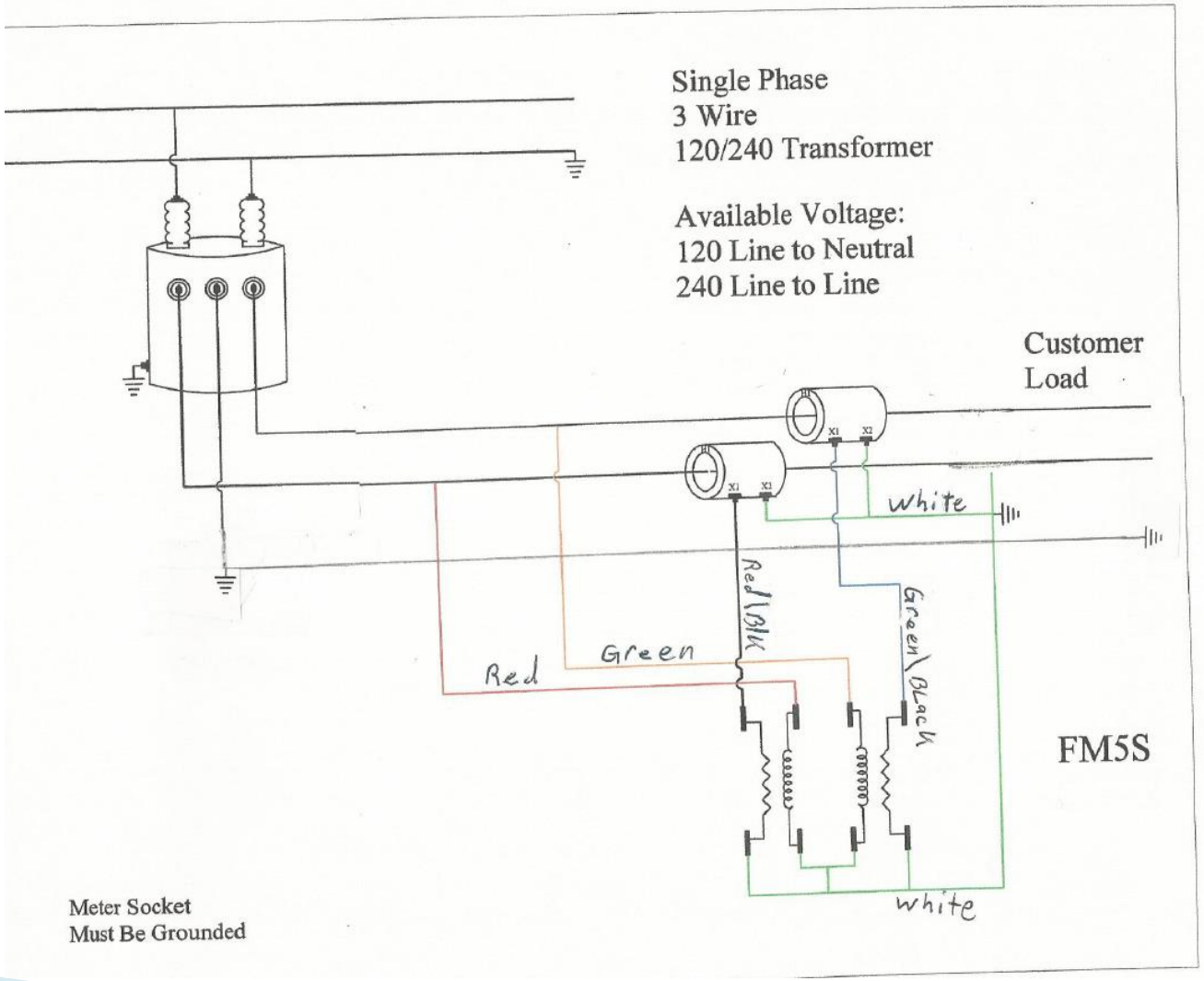
Which meter do I use?
What are the Pros and Cons?

- Meter Form #4s class 20 meter
- Single Phase Service
- 240 volt 3 wire

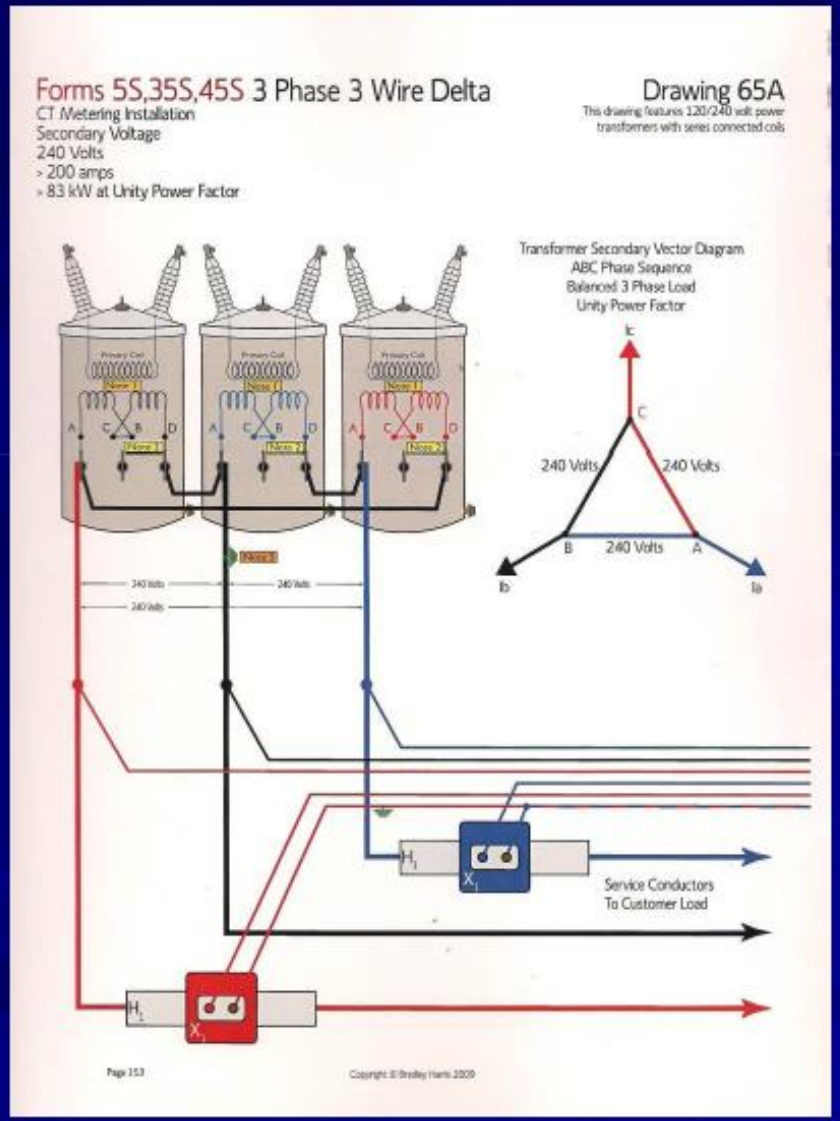


Which meter do I use?
What are the Pros and Cons?

- Meter Form 5s Class 20 meter
- Single Phase or Three Phase
- 120-480 volts 3-wire



FORM 5S


Forms 5S,35S,45S 3 Phase 3 Wire Delta
CT Metering Installation
Secondary Voltage
240 Volts
> 200 amps
> 83 kW at Unity Power Factor
Drawing 65A
This drawing features 120/240 volt power transformers with series connected coils
Transformer Secondary Vector Diagram
ABC Phase Sequence
Balanced 3 Phase Load
Unity Power Factor
240 Volts
240 Volts
240 Volts
Service Conductors
To Customer Load
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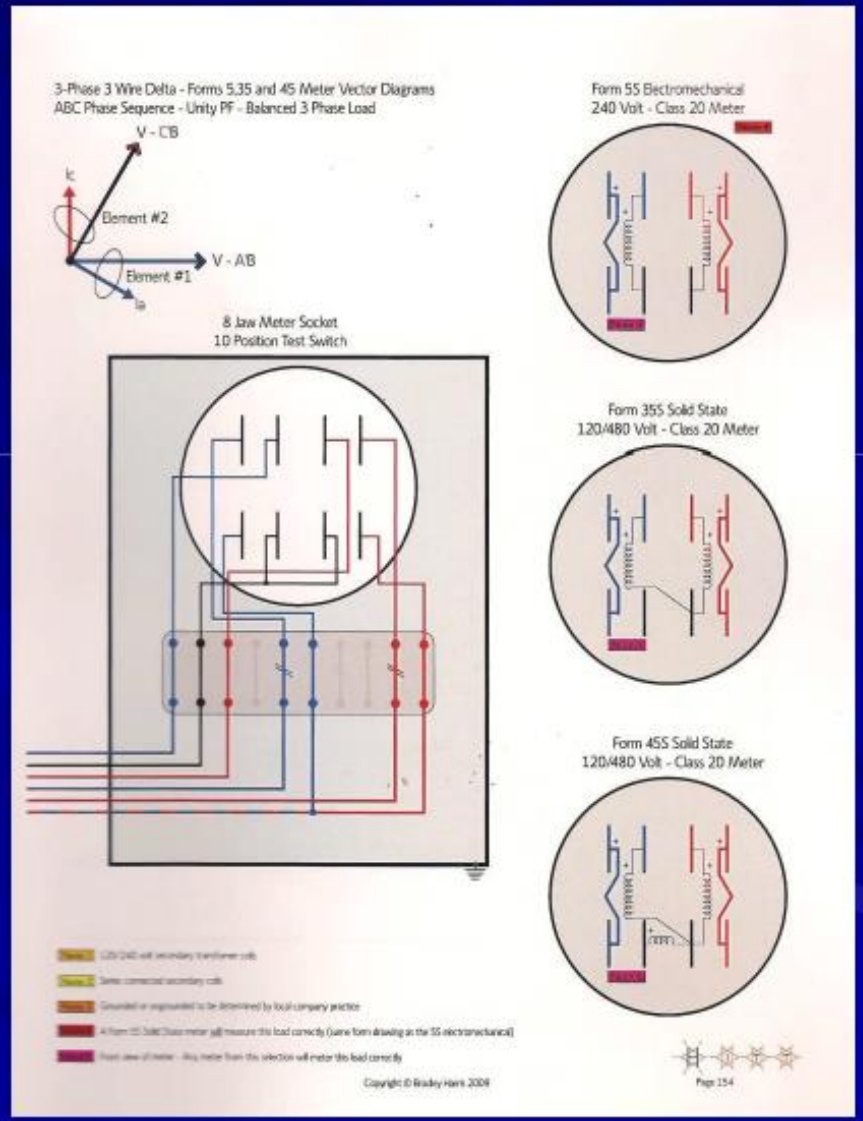
3-Phase 3 Wire Delta - Forms 5,35 and 45 Meter Vector Diagrams
ABC Phase Sequence - Unity PF - Balanced 3 Phase Load
V - CB
Element #2
V - AB
Element #1
8 Jaw Meter Socket
10 Position Test Switch
Form 5S Electromechanical
240 Volt - Class 20 Meter
Form 35S Solid State
120/480 Volt - Class 20 Meter
Form 45S Solid State
120/480 Volt - Class 20 Meter
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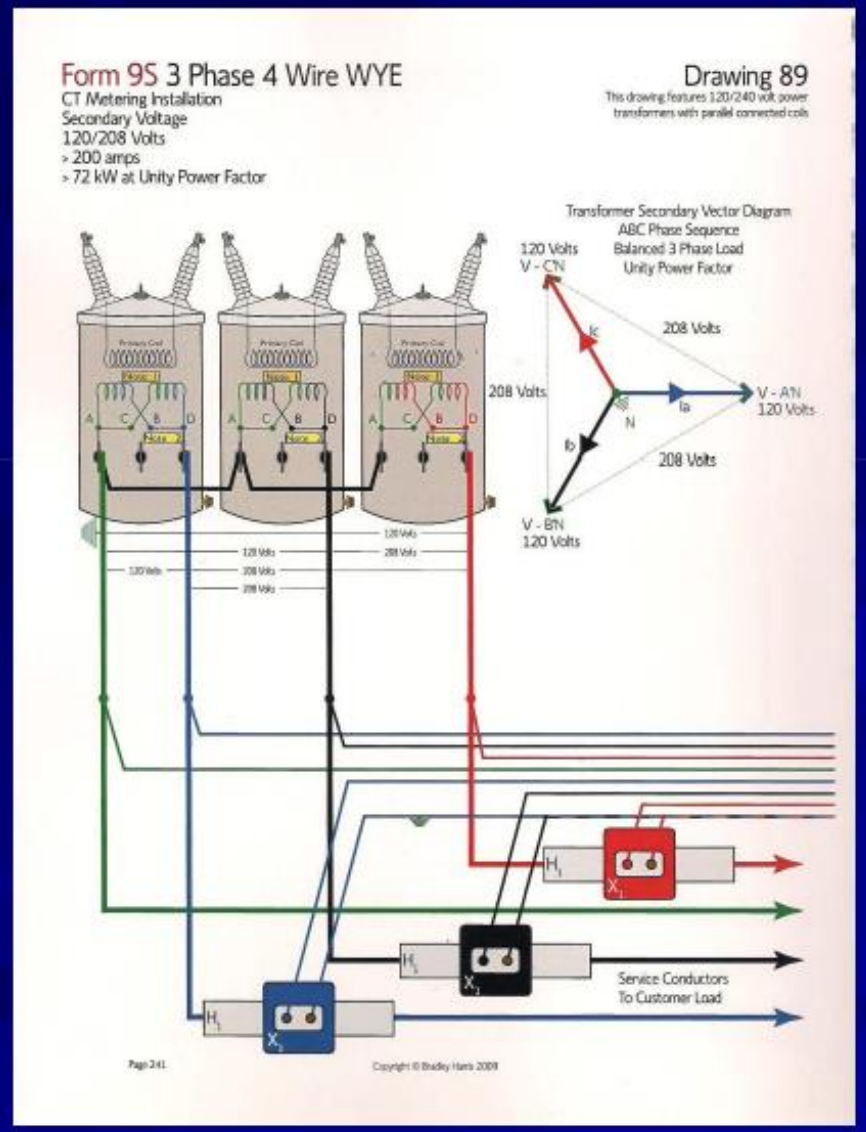
FORM 9S


Form 9S 3 Phase 4 Wire WYE
CT Metering Installation
Secondary Voltage
120/208 Volts
> 200 amps
> 72 kW at Unity Power Factor
Drawing 89
This drawing features 120/240 volt power transformers with parallel connected coils
Transformer Secondary Vector Diagram
ABC Phase Sequence
Balanced 3 Phase Load
Unity Power Factor
120 Volts
V - CN
208 Volts
208 Volts
V - AN
120 Volts
N
208 Volts
V - BN
120 Volts
Service Conductors
To Customer Load
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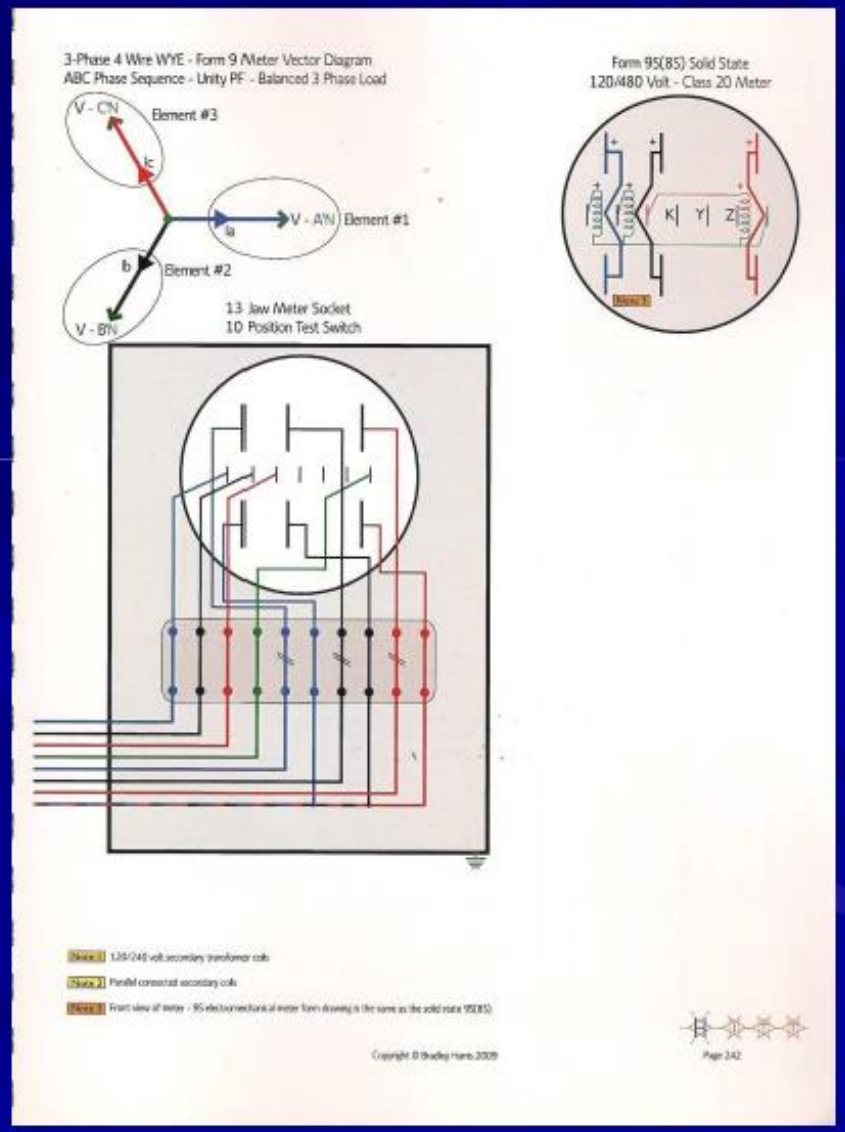
3-Phase 4 Wire WYE - Form 9 Meter Vector Diagram
ABC Phase Sequence - Unity PF - Balanced 3 Phase Load
V - CN
Element #3
V - AN
Element #1
Element #2
V - BN
13 Jaw Meter Socket
10 Position Test Switch
Form 9S(8S) Solid State
120/480 Volt - Class 20 Meter
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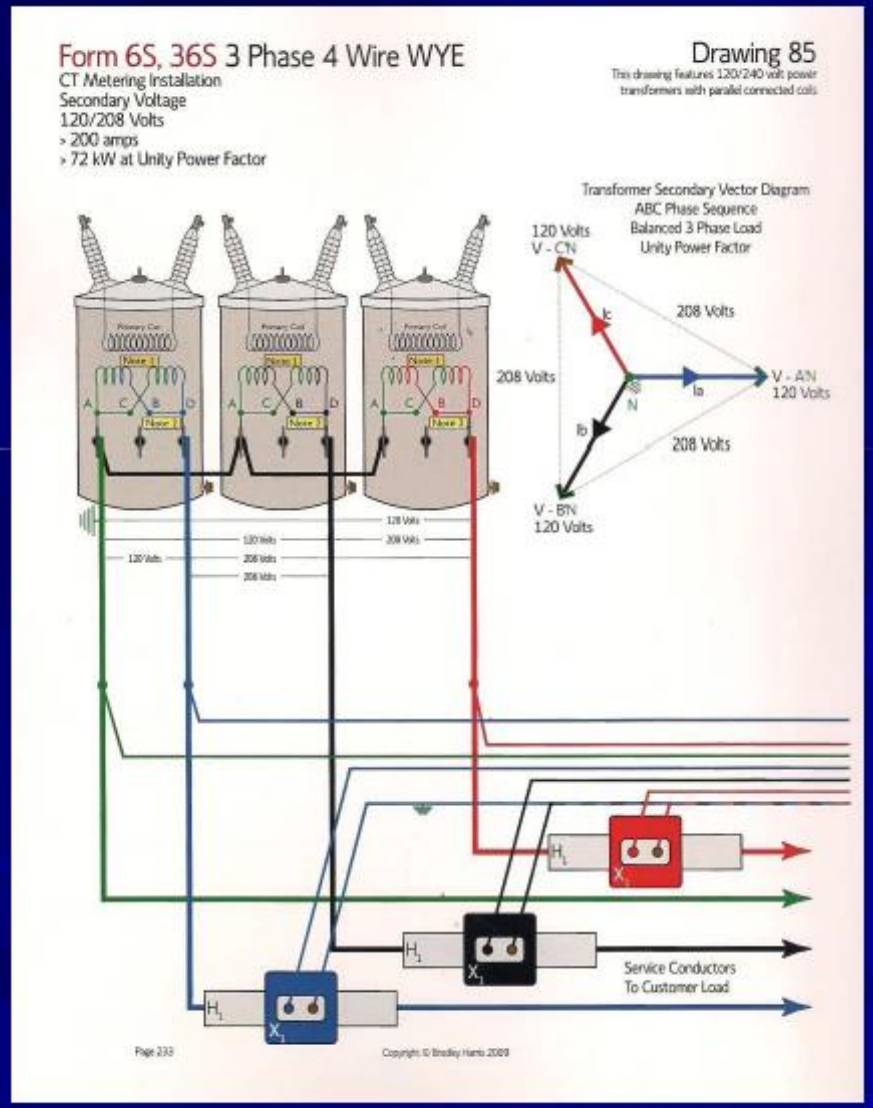
FORM 6S


Form 6S, 36S 3 Phase 4 Wire WYE
CT Metering Installation
Secondary Voltage
120/208 Volts
> 200 amps
> 72 kW at Unity Power Factor
Drawing 85
This drawing features 120/240 volt power transformers with parallel connected coils
Transformer Secondary Vector Diagram
ABC Phase Sequence
Balanced 3 Phase Load
Unity Power Factor
120 Volts
V - CN
208 Volts
208 Volts
V - AN
120 Volts
208 Volts
V - BN
120 Volts
Ic
Ia
Ib
N
Service Conductors
To Customer Load
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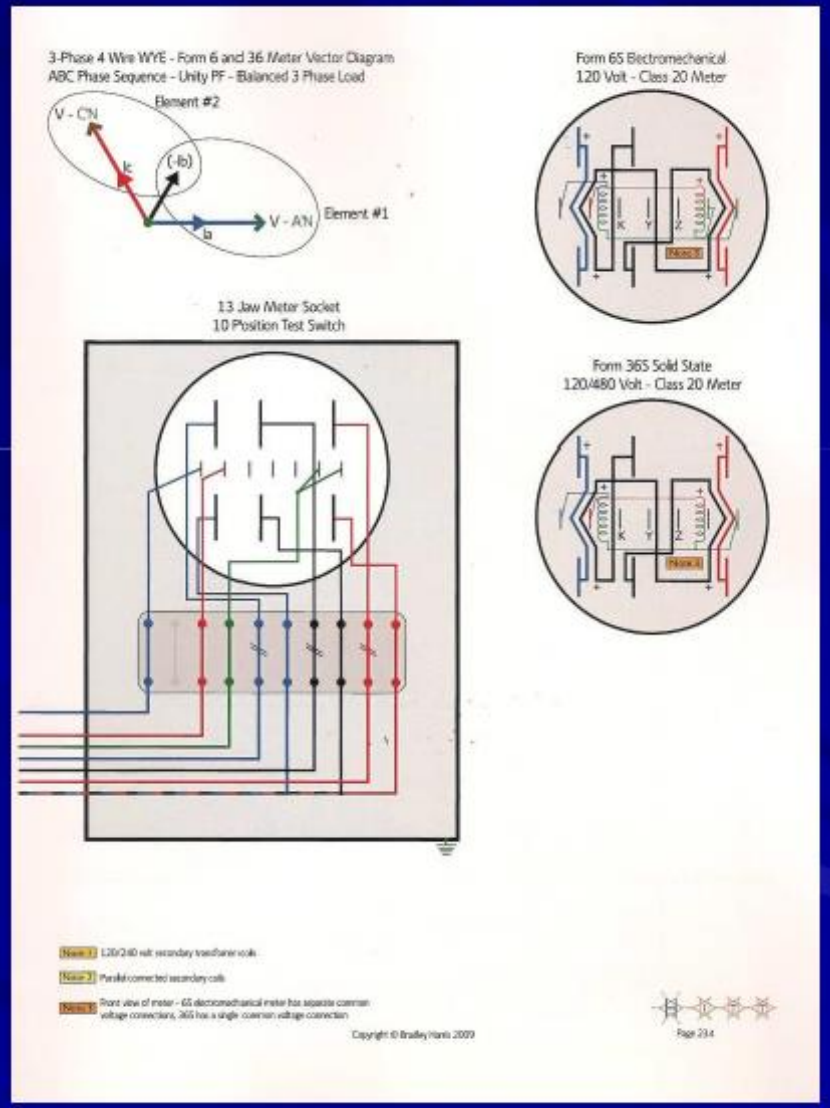
3-Phase 4 Wire WYE - Form 6 and 36 Meter Vector Diagram
ABC Phase Sequence - Unity PF - Balanced 3 Phase Load
Element #2
V - CN
(-Ib)
Ic
V - AN
Element #1
Ia
13 Jaw Meter Socket
10 Position Test Switch
Form 6S Electromechanical
120 Volt - Class 20 Meter
Form 36S Solid State
120/480 Volt - Class 20 Meter
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