



Intermediate Course

CHAPTER 7 RECTIFIERS

Appalachian Underground Corrosion Short Course
West Virginia University
Morgantown, West Virginia

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Safety

- Visually inspect to commercial power service to pole and service mounted on the pole
- Inspect service disconnect and rectifier ground
- Test rectifier case for voltage prior to unlocking or opening
- Follow your company Lock Out Tag Out procedure, if you have to troubleshoot, repair or replace any components

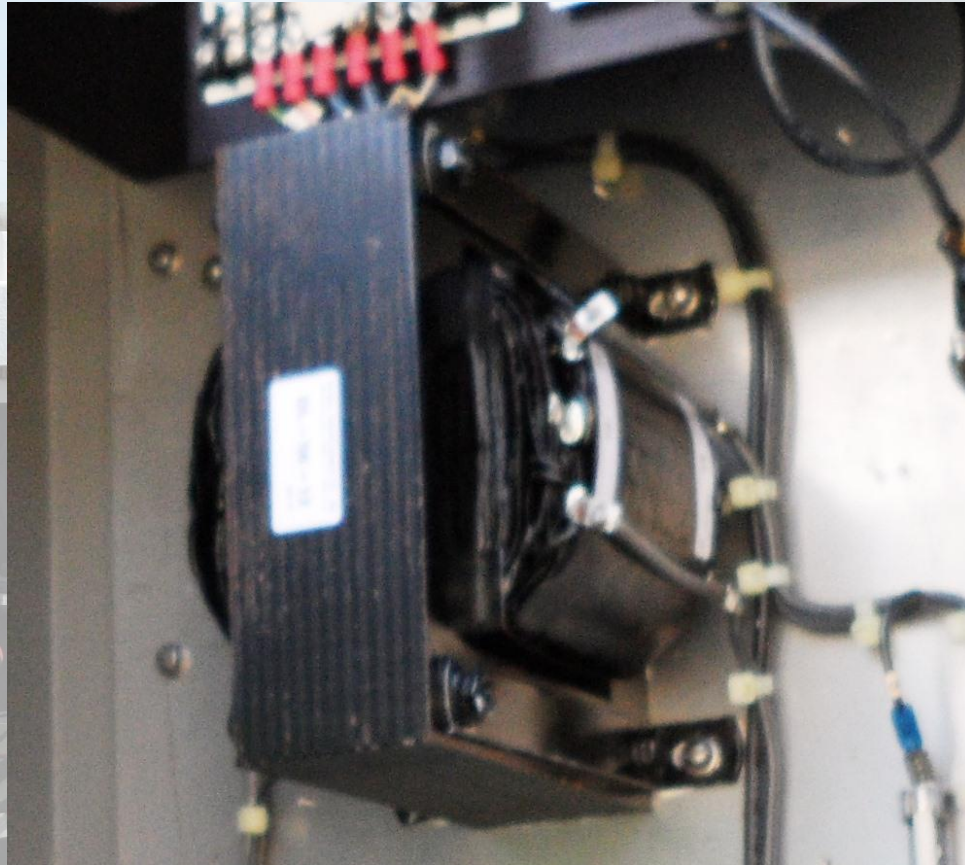
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Transformer/Rectifier Component Review

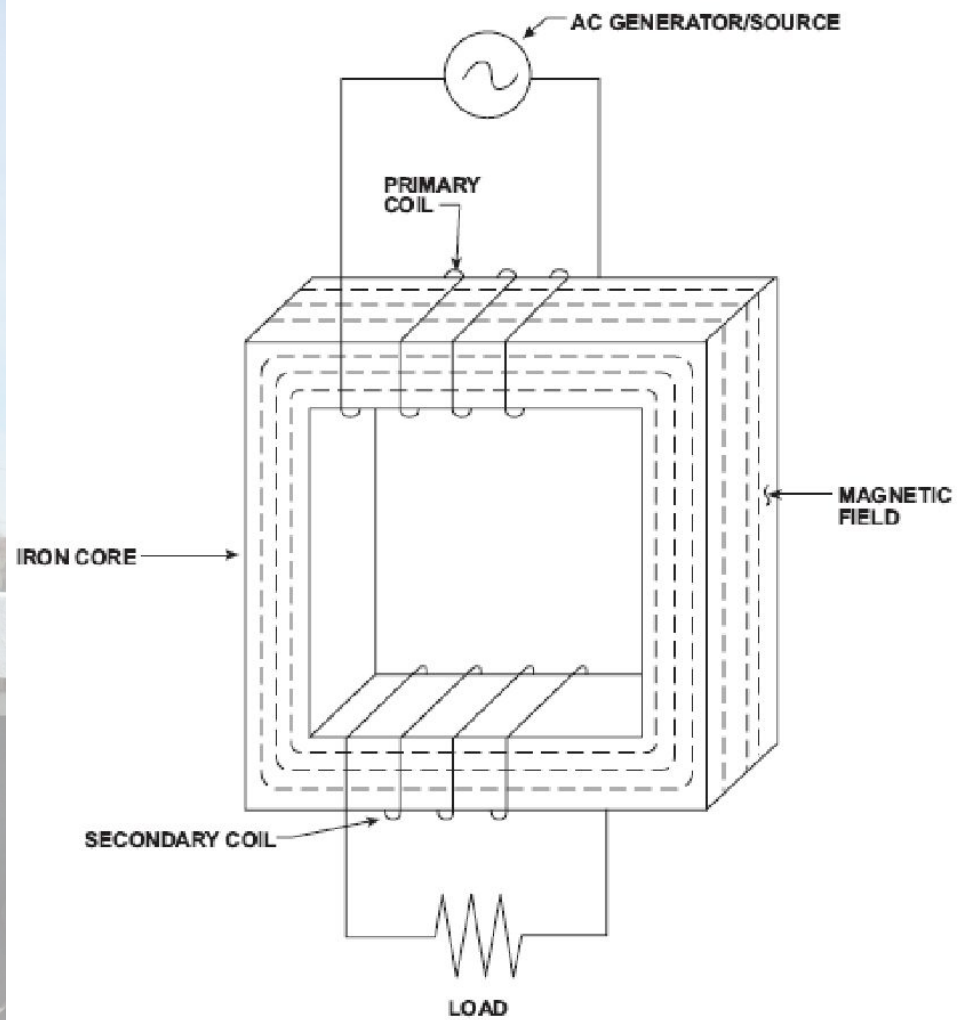
- Two distinct operations
 - AC Transformer: Allows for the adjustment of the current going to the DC Rectifier element
 - DC Rectifier: Converts the AC current to DC current for application to the cathodic protection system
- Additional components include primary and secondary breakers; lightning protection (AC & DC); filter choke; calibrated shunt; courtesy outlet; and output gauges.

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AC Transformer



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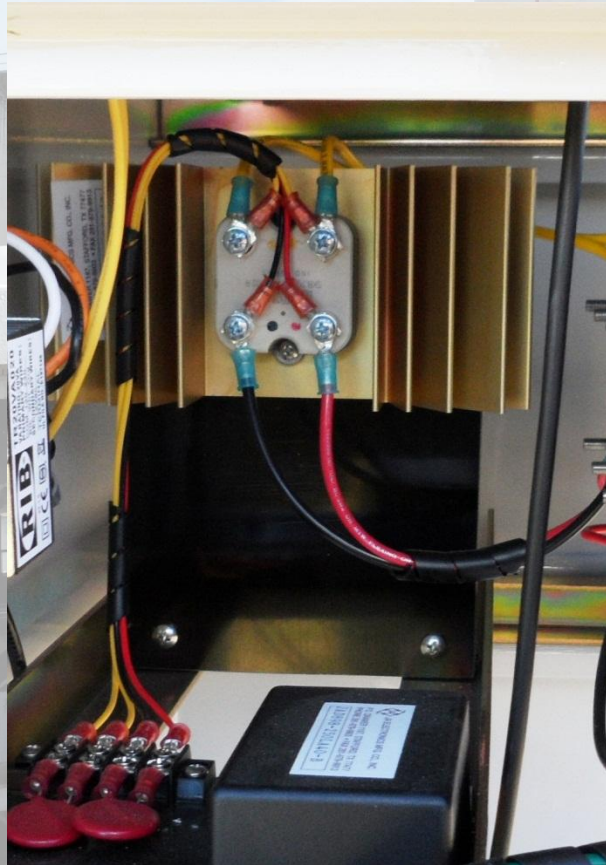


TYPICAL TRANSFORMER DIAGRAM

FIGURE 7-14A

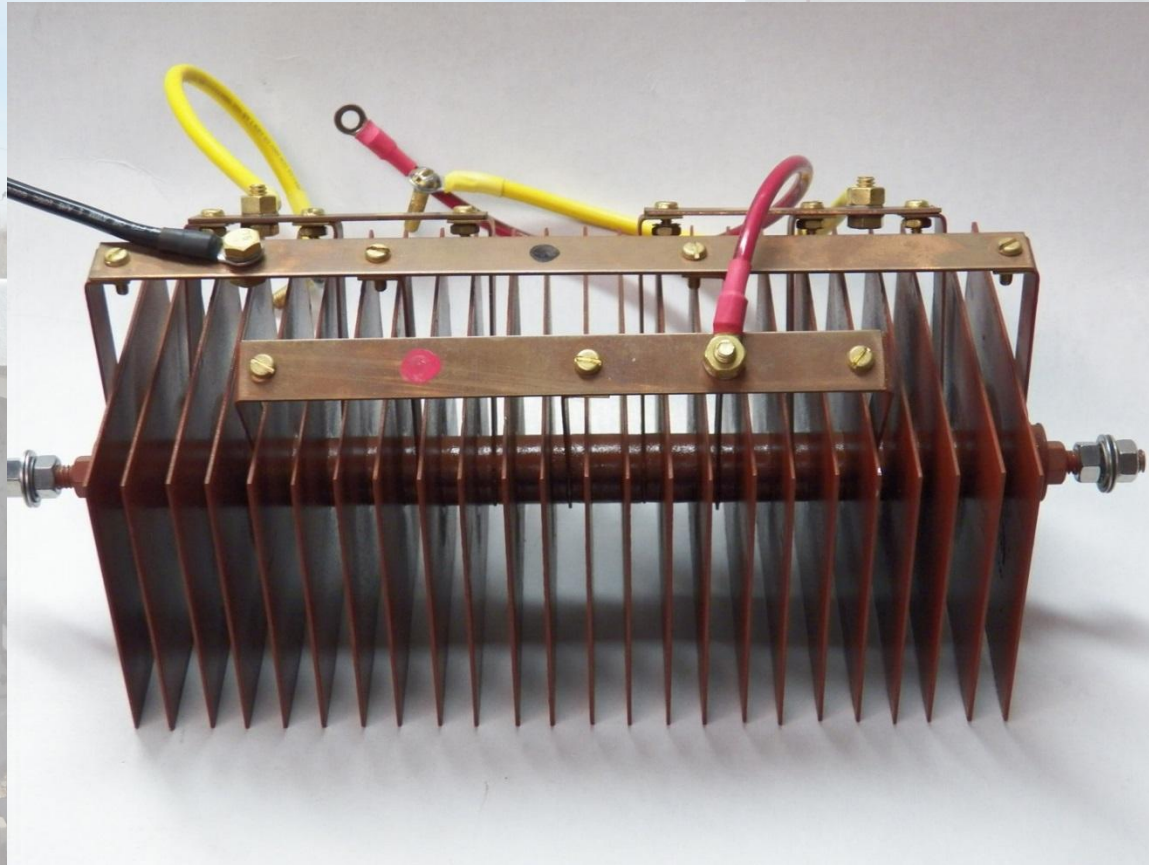
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DC Rectifier – Diode Stack

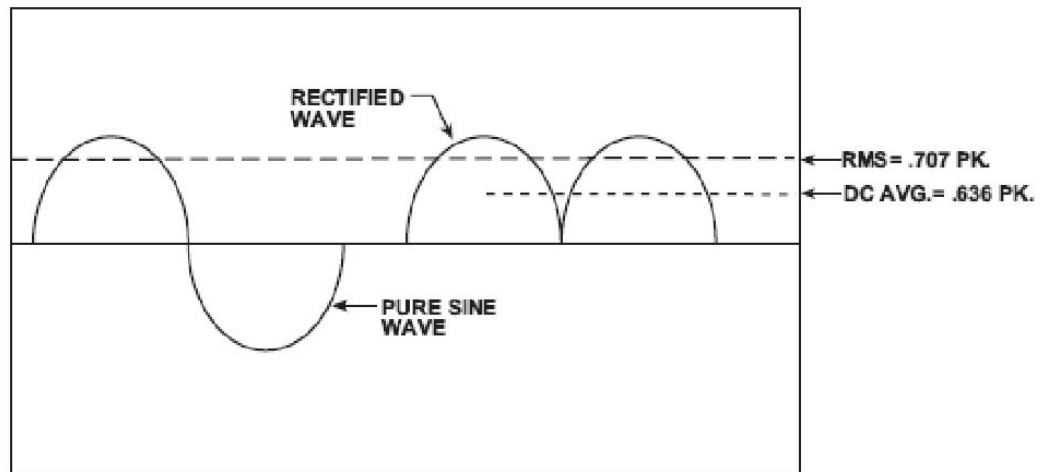


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DC Rectifier – Selenium Stack



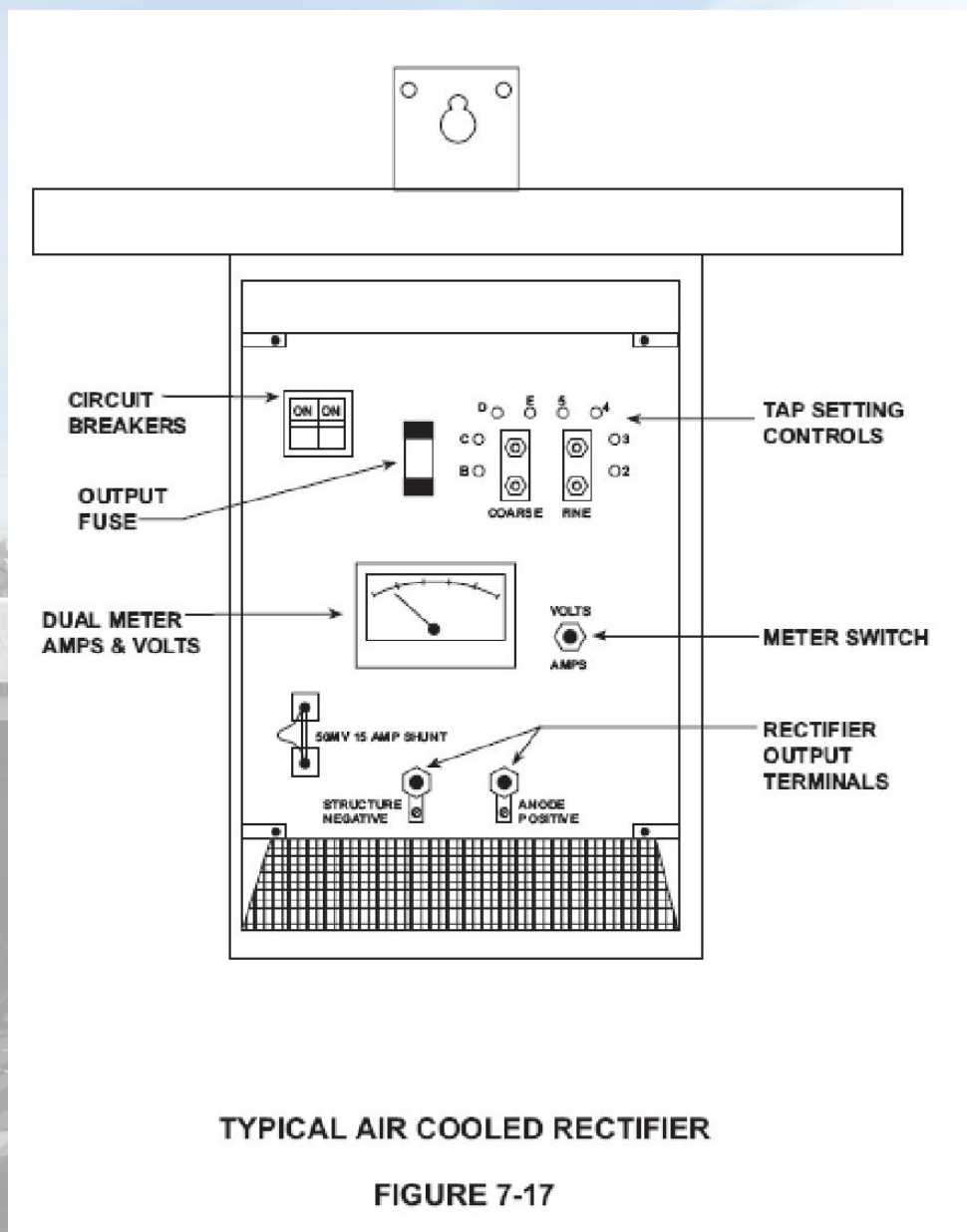
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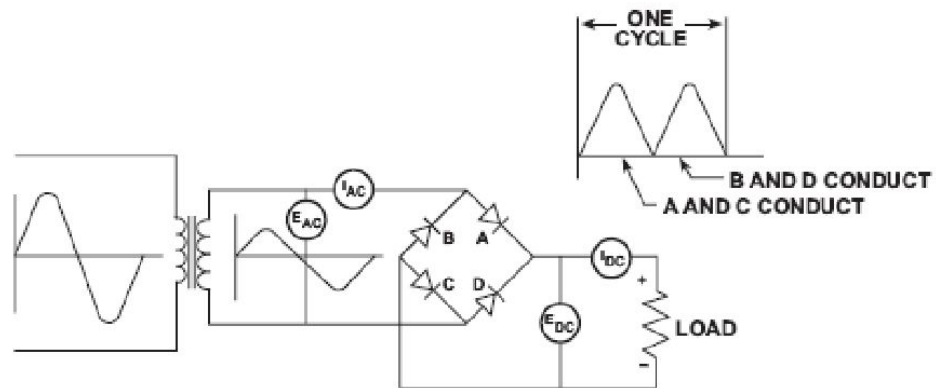


AC RECTIFICATION

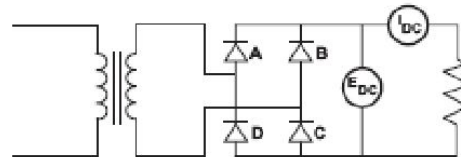
FIGURE 7-6

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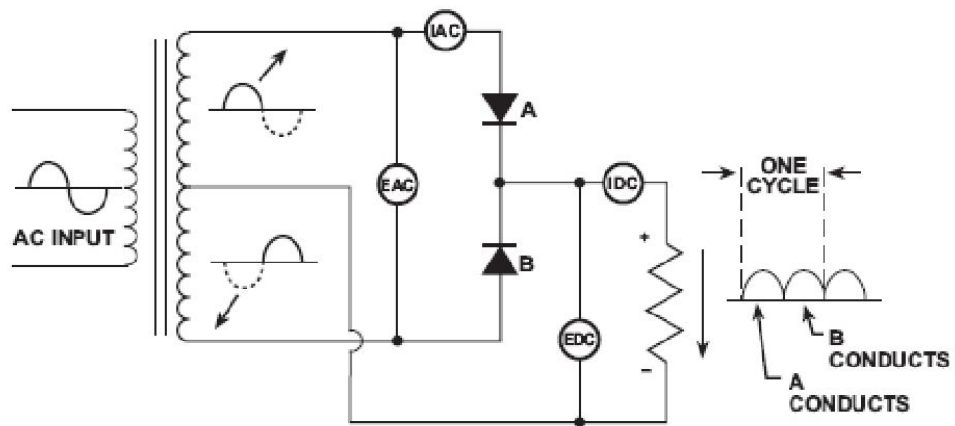


ALTERNATE SCHEMATIC ARRANGEMENT



SINGLE PHASE BRIDGE CIRCUIT

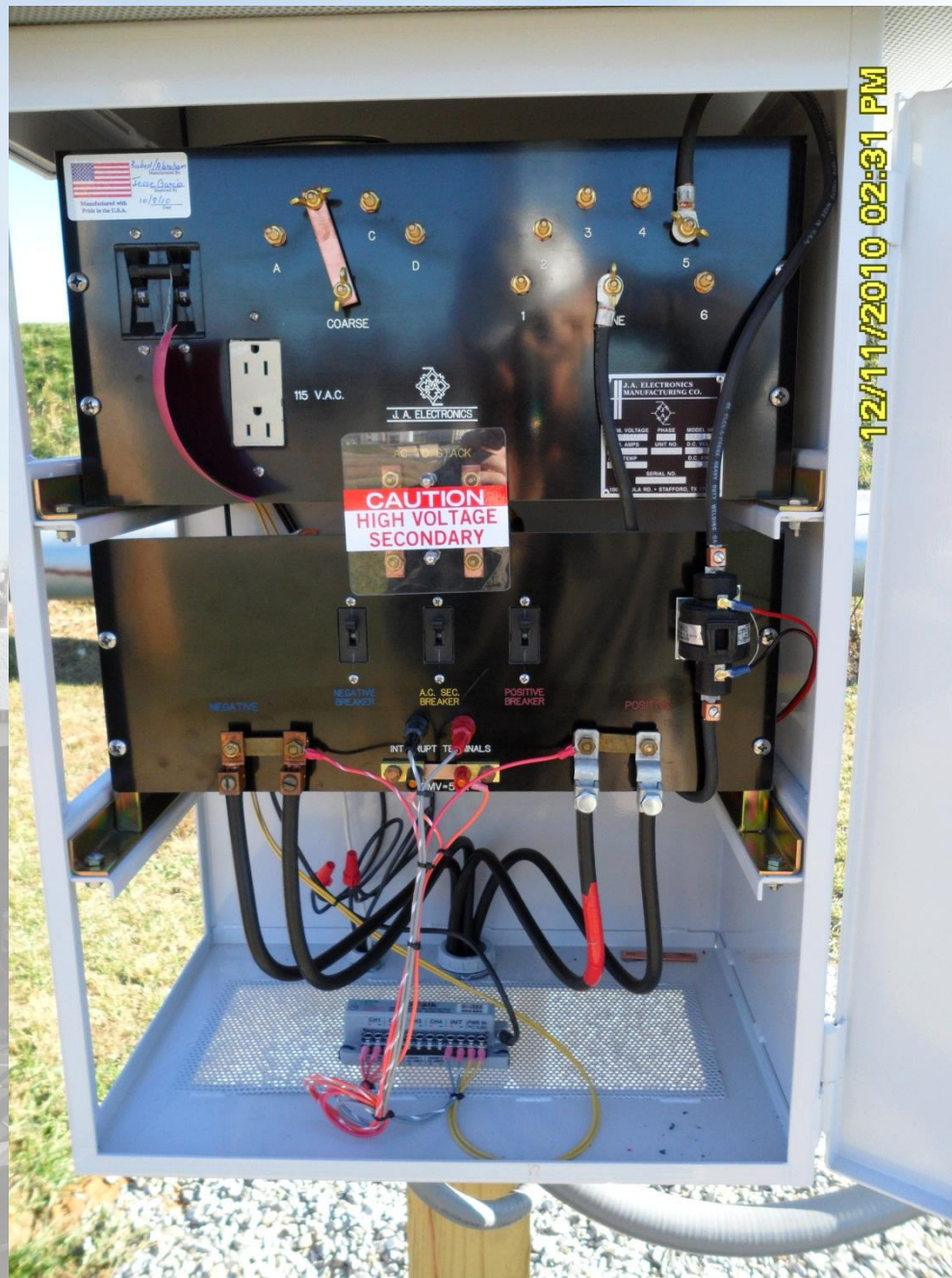
FIGURE 7-7



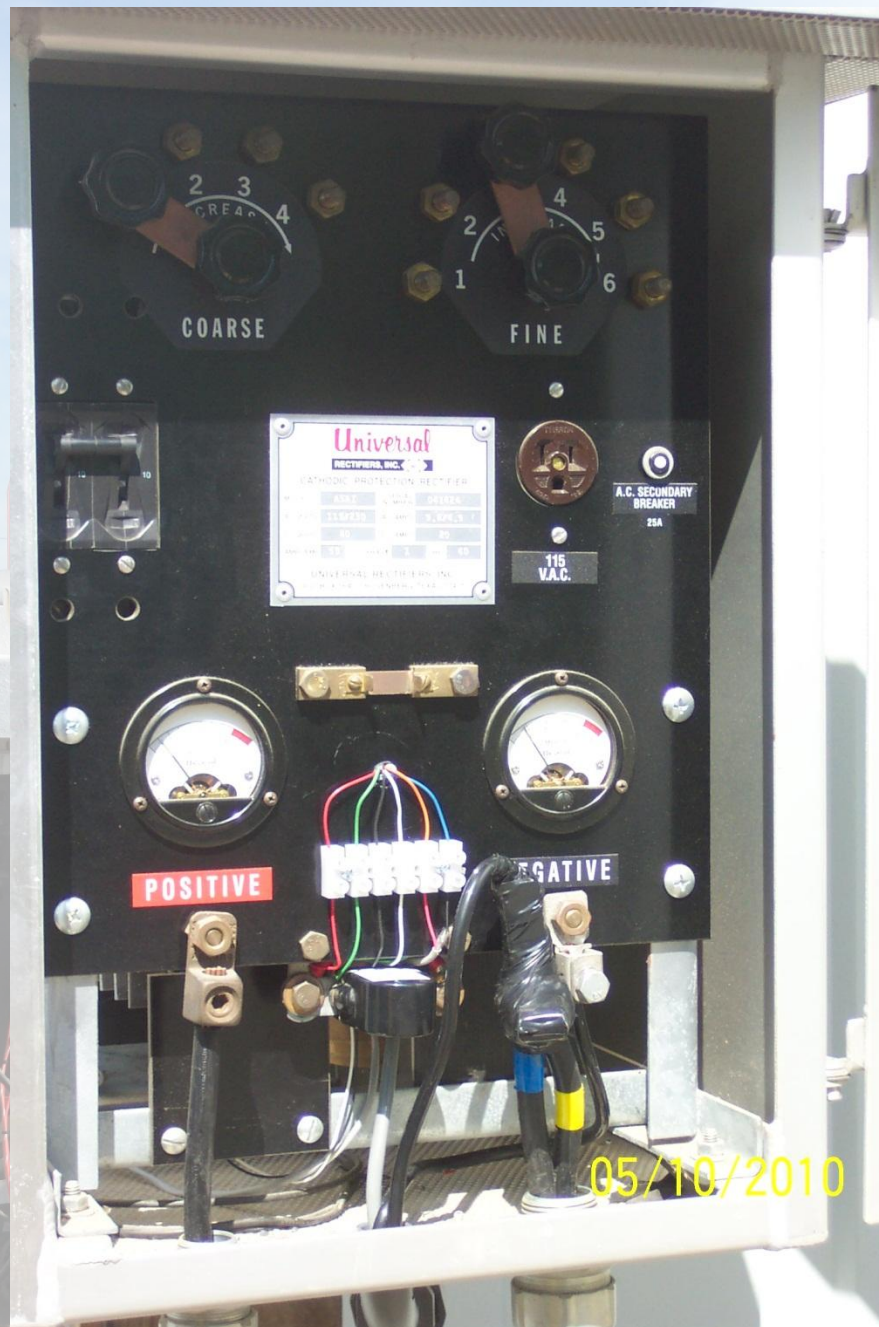
SINGLE PHASE CENTER-TAP CIRCUIT

FIGURE 7-8

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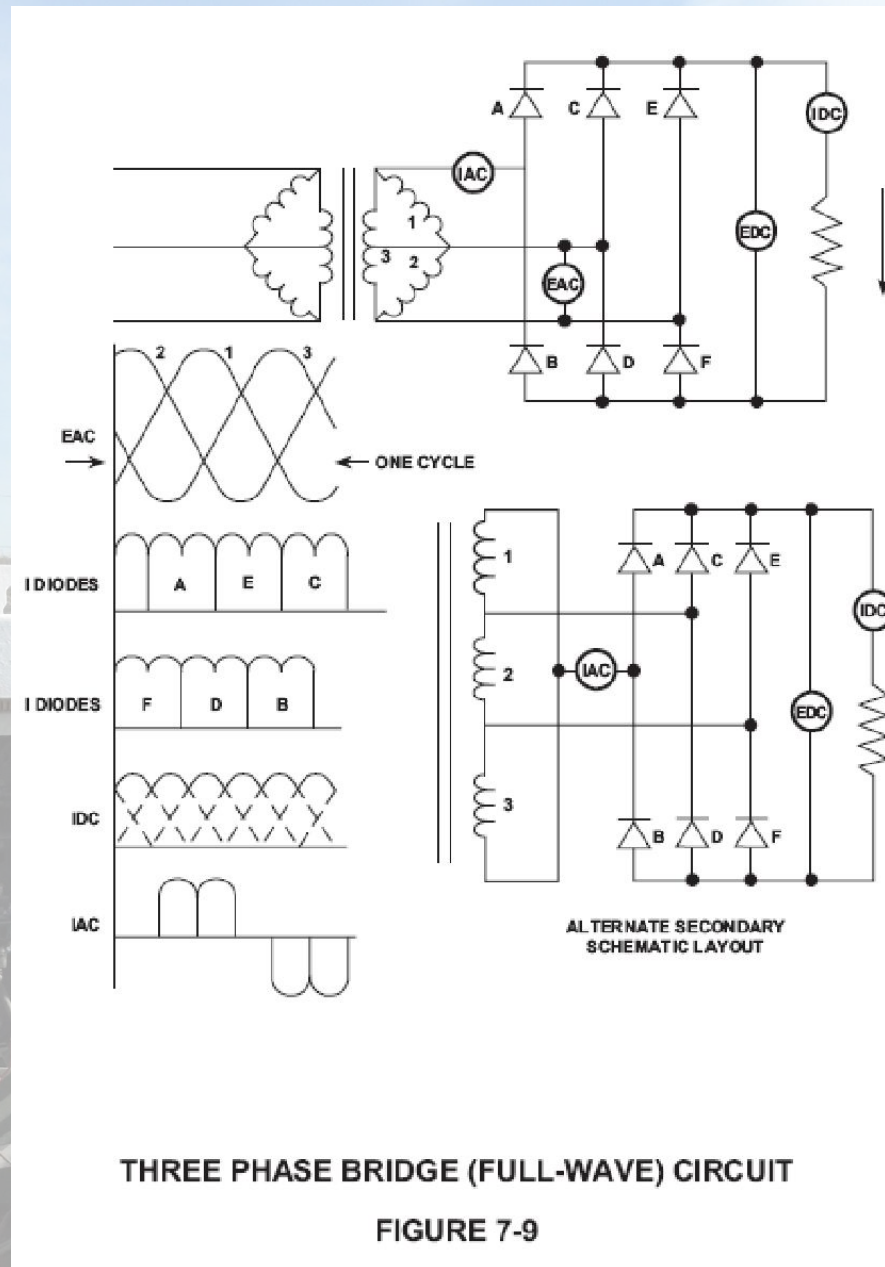


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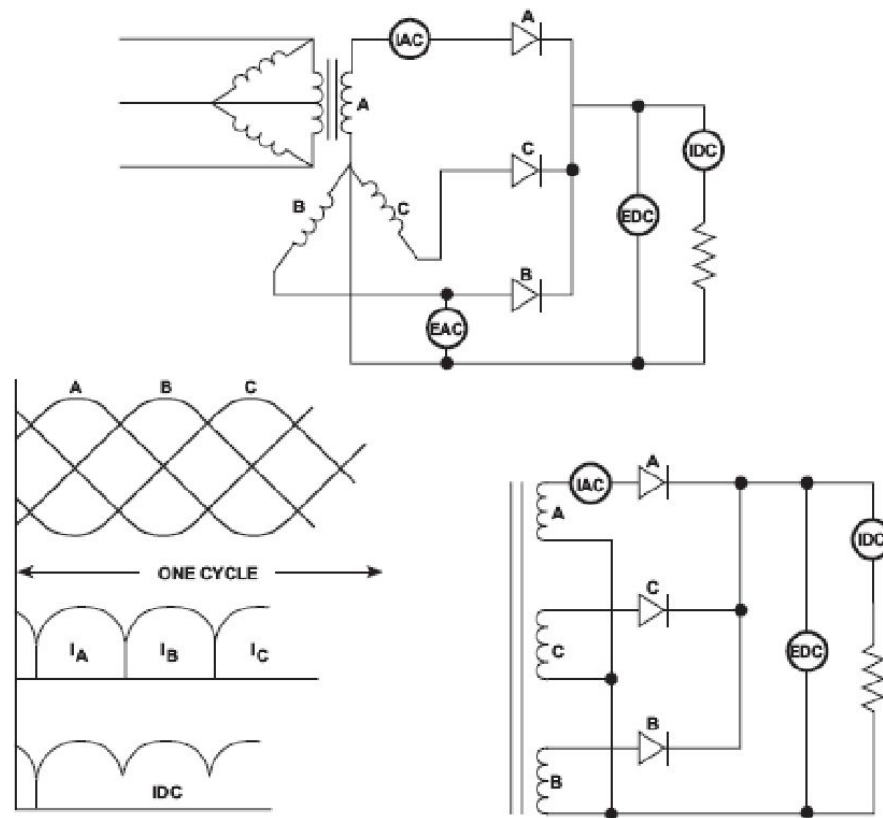


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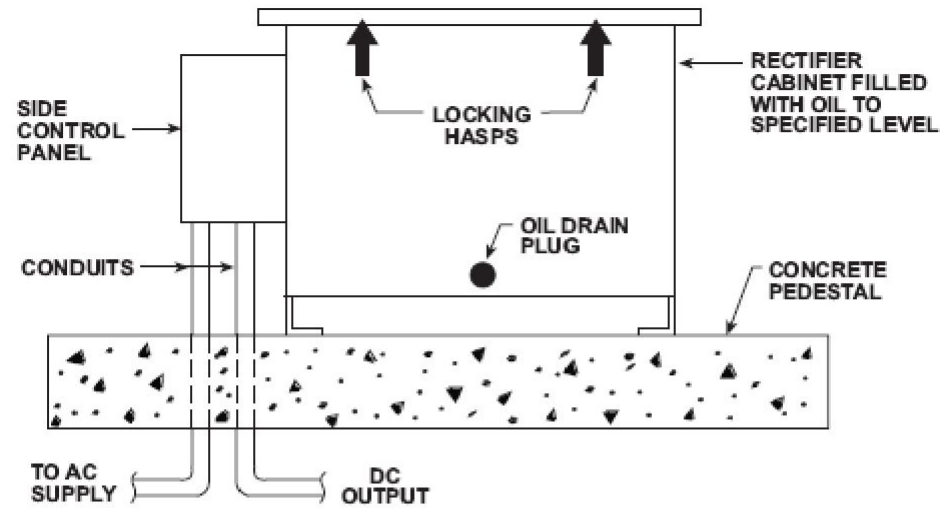
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THREE PHASE WYE CIRCUIT

FIGURE 7-10

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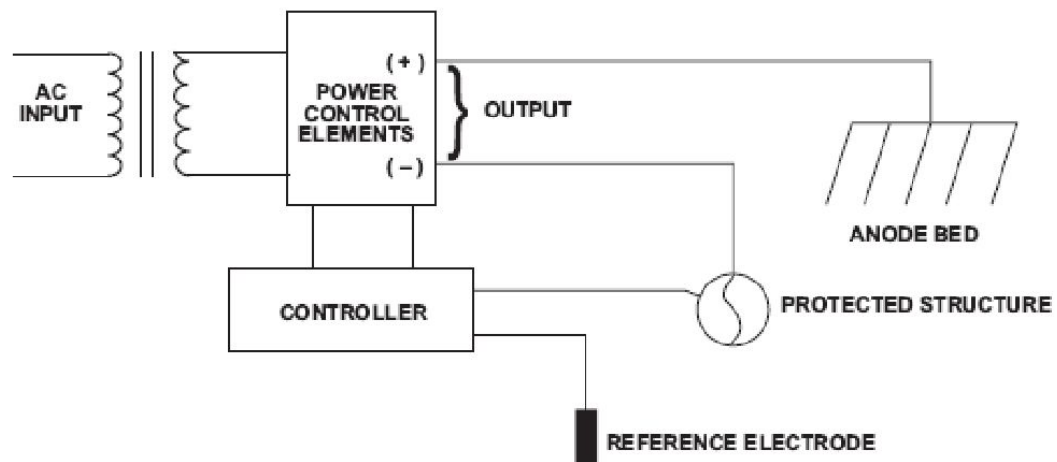
TYPICAL OIL COOLED RECTIFIER

FIGURE 7-18

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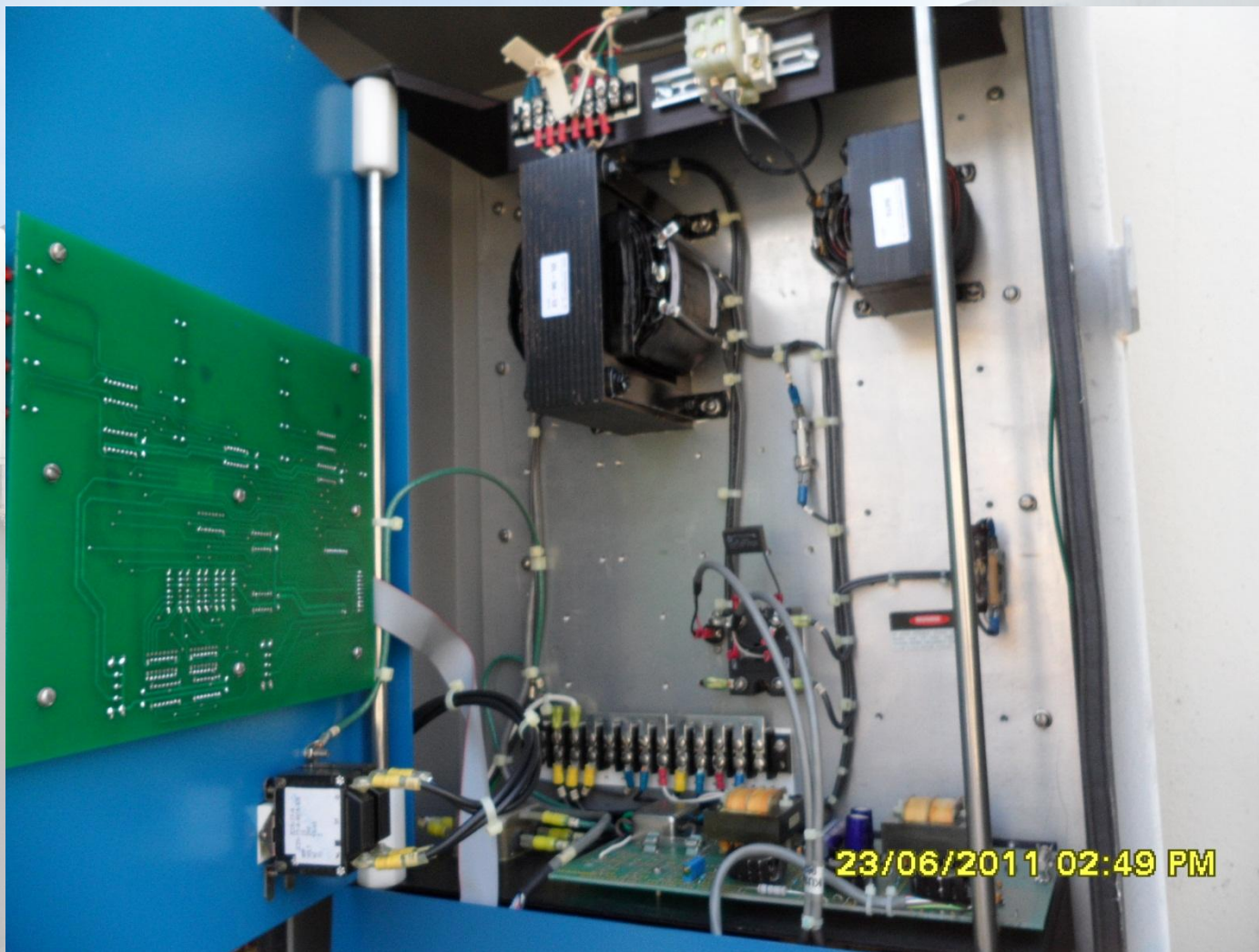
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**TYPICAL AUTOMATIC POTENTIAL CONTROLLED
RECTIFIER CIRCUIT**

FIGURE 7-20

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Additional Components

- **Lightning Arrestors** – both AC & DC I/O
- **Filter Chokes** – Clean up or smooth out DC
- **Fuses & Breakers** – protect components against unexpected faults
- **Calibrated Shunt** – provides a means to accurately measure the DC cathodic protection current output
- **Courtesy Outlet** – AC power for test equipment (interrupters)

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Transformer/Rectifier Function

- AC current comes in from the power supply then through a primary breaker to the transformer via the taps or rheostat
- From the transformer the AC continues to the rectifying element where AC is converted to DC current
- The DC current then flows via the shunt to the cathodic protection outputs (structure & anodes)

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Rectifier Preventative Maintenance

- **SAFETY** is often the most disregarded, but most important aspect of performing rectifier maintenance
 - Use proper safety practices and equipment
 - Use common sense & trust your senses
 - Establish safe work habits
- DOT regulated systems require transformer/rectifiers to be inspected every 60 days

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Remote Monitoring Units (RMUs)

- The use of RMUs are a very effective means to monitor the transformer/rectifier I/O.
- However, this does not alleviate the need to periodically visit each location to visually inspect and perform PM tasks.



Rectifier Preventative Maintenance

1. Record transformer rectifier I/O & settings using both a calibrated DVOM & the meters.
 1. Check and adjust meters using the DVOM to calibrate
2. Turn OFF the AC power supply!
 1. AC feed, not the transformer/rectifier.
 2. Verify the power to the transformer/rectifier is off using the DVOM.
3. Feel components for excessive heat. Use caution.
4. Visually inspect components for damage.
 1. Lighting strike, surge, short, etc.

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Rectifier Preventative Maintenance

5. **Clean, inspect & tighten connections.**
 1. This includes cleaning the tap bars and the structure & anode connections.
6. **Clean all components with a non-metallic brush (old paint brush).**
 1. Air screen, panel, transformer and rectifying element
 2. Plug any extraneous openings
7. **Repair or replace damaged connections or insulated wires.**
8. **Evaluate oil cooled units fluid level and cleanliness.**

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Rectifier Preventative Maintenance

9. Evaluate protective devices.
 1. Fuses, lightning arrestors, breakers, etc.
 2. If defective or unsure, replace the component with equivalent
10. Recheck settings and re-energize the AC to the transformer/rectifier.

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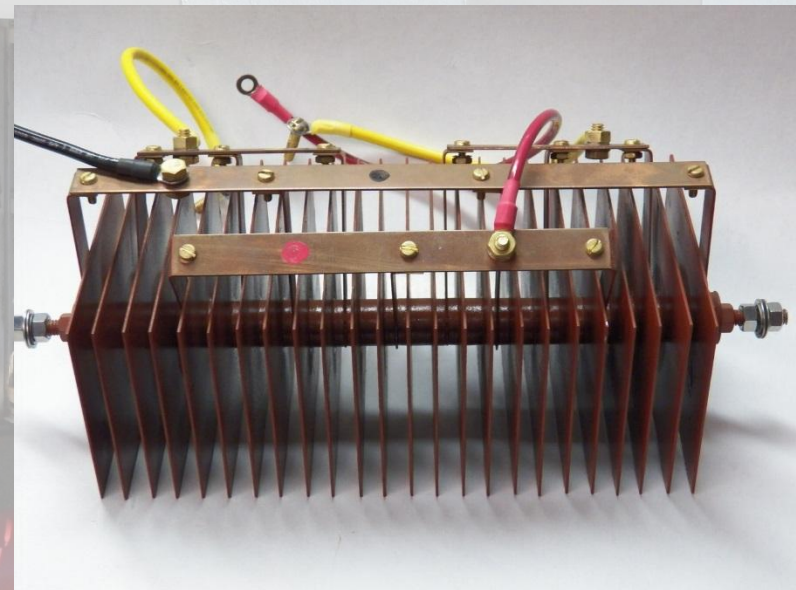
Rectifier Efficiency

$$\frac{60 \text{ min}}{1 \text{ hr}} \times \frac{60 \text{ sec}}{1 \text{ min}} = 3,600 \text{ sec/hr}$$

K watt-hr, N rev, T sec, E_{DC} , I_{DC}

$$E_{DC} \times I_{DC} = \text{Watts}$$

$$\text{Efficiency} = \frac{W \times T}{3,600 \times K \times N} \times 100 = \%$$



Rectifier Selection

There are several requirements that must be considered for the proper selection of a cathodic protection transformer/rectifier.

Selection of a transformer/rectifier should be made by a qualified corrosion engineer.

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WESTINGHOUSE

PRIMARY VOLTS	SECONDARY VOLTS	KVA.	CYCLES	
230-460	0-73.5		60	
ORDER NO.	SERIAL NO.	PHASE	IMP. %	POL.
FTLC16995	3701	1		
MAKE	DATE	TYPE	FORM	
48V-30A	2-57			

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