HANDS ON ACTIVITY/PRACTICAL SKILLS TEST (LESSON 216)

Transformers 1φ

The purpose of the lesson is to correctly wire a single phase transformer.

Materials/Tools
A mock-up board, a single phase transformer (CH S20N11S81 or equal), terminal strips, screw driver and wire strippers. (Each training center will need to adjust according to their lab conditions).

Using a mock-up board:
1. Draw wiring diagram.
2. Mount transformer and terminal strips.
3. Wire the transformer per the following table.

<table>
<thead>
<tr>
<th>Input voltage</th>
<th>Output voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>240</td>
<td>120</td>
</tr>
<tr>
<td>240</td>
<td>240</td>
</tr>
<tr>
<td>480</td>
<td>240</td>
</tr>
<tr>
<td>480</td>
<td>120</td>
</tr>
</tbody>
</table>

4. Ensure all connections are tight, each wire is trimmed and fastened in a craftsman-like manner
5. All work shall meet NEC requirements.

Evaluation:
• Verify each connection is wired correctly. Ensure all connections are tight.
• Record the results. Pass / Fail
• Students shall be retested until a Pass is recorded.

General Instructors Tips:
1. Hands on Activity/Practical Skills Testing:
   a. Hands on Activity - these are instrumental to the development of the apprentices understanding of the material being taught.
   b. Practical Skills Testing – indicates if the apprentice has the sufficient skills necessary to be advanced to the next level/school year.
2. Components for Hands on Activity/Practical Skills Testing can be obtained through request to the IEC Foundation (check with your chapter ED).
3. Depending on your chapters resources/space you may need to adjust how you accomplish these activities/testing. (Training Directors your chapter/other chapters are a great resource)

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<td>240</td>
</tr>
<tr>
<td>480</td>
<td>240</td>
</tr>
<tr>
<td>480</td>
<td>120</td>
</tr>
</tbody>
</table>
HANDS ON ACTIVITY/PRACTICAL SKILLS TEST

Transformers 3\(\phi\) (Delta/Delta)

The purpose of the lesson is to correctly wire a three phase transformer.

Materials/Tools
A mock-up board, 3 single phase transformers (CH S20N11S81 or equal), terminal strips, screw driver and wire strippers. (Each training center will need to adjust according to their lab conditions).

Using a mock-up board:
1. Draw wiring diagram.
2. Mount transformers and terminal strips.
3. Wire the transformers - Delta/Delta (480v X 240v) and (240v X 240v)
4. Ensure all connections are tight, each wire is trimmed and fastened in a craftsman-like manner
5. All work shall meet NEC requirements.

Evaluation:
• Verify each connection is wired correctly. Ensure all connections are tight.
• Record the results. Pass / Fail
• Students shall be retested until a Pass is recorded.

General Instructors Tips:
1. Hands on Activity/Practical Skills Testing:
   a. Hands on Activity - these are instrumental to the development of the apprentices understanding of the material being taught.
   b. Practical Skills Testing – indicates if the apprentice has the sufficient skills necessary to be advanced to the next level/school year.
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3. Depending on your chapters resources/space you may need to adjust how you accomplish these activities/testing.
   (Training Directors your chapter/other chapters are a great resource)
HANDS ON ACTIVITY/PRACTICAL SKILLS TEST (LESSON 221)

Transformers 3φ (Delta/Wye)

The purpose of the lesson is to correctly wire a three phase transformer.

Materials/Tools
A mock-up board, 3 single phase transformers (CH S20N11S81 or equal), terminal strips, screw driver and wire strippers. (Each training center will need to adjust according to their lab conditions).

Using a mock-up board:
1. Draw wiring diagram.
2. Mount transformers and terminal strips.
3. Wire the transformers - Delta/Wye (480v X 120v/208v) and (240v X 120v/208v)
4. Ensure all connections are tight, each wire is trimmed and fastened in a craftsman-like manner.
5. All work shall meet NEC requirements.

Evaluation:
• Verify each connection is wired correctly. Ensure all connections are tight.
• Record the results. Pass / Fail
• Students shall be retested until a Pass is recorded.

General Instructors Tips:
1. Hands on Activity/Practical Skills Testing:
   a. Hands on Activity - these are instrumental to the development of the apprentices understanding of the material being taught.
   b. Practical Skills Testing – indicates if the apprentice has the sufficient skills necessary to be advanced to the next level/school year.
2. Components for Hands on Activity/Practical Skills Testing can be obtained through request to the IEC Foundation (check with your chapter ED).
3. Depending on your chapters resources/space you may need to adjust how you accomplish these activities/testing. (Training Directors your chapter/other chapters are a great resource)
HANDS ON ACTIVITY/PRACTICAL SKILLS TEST (LESSON 224)

Transformers 1φ (Buck-Boost)

The purpose of the lesson is to select the correct wiring diagram and correctly wire a Buck-Boost transformer.

Materials/Tools
A mock-up board, 1 Buck-Boost transformer (CH S10N04A81 or equal), terminal strips, screw driver and wire strippers. (Each training center will need to adjust according to their lab conditions).

Note: The wiring diagrams used should correspond to the brand and size of transformer used. The part number above is Cutler Hammer (*) and the charts and diagrams supplied correspond to the Cutler Hammer part number.

Using a mock-up board:
1. Draw wiring diagram.
2. Mount transformer and terminal strips.
3. Wire the transformer: (Instructor should select and test on at least one buck and one boost configuration for this Practical Skills Test.)
   a. Available voltage is 100 volts – required voltage is 120 volts. (Diag. B)
   b. Available voltage is 144 volts – required voltage is 120 volts. (Diag. B)
   c. Available voltage is 218 volts – required voltage is 240 volts. (Diag. F)
   d. Available voltage is 252 volts – required voltage is 240 volts. (Diag. E)
4. Ensure all connections are tight, each wire is trimmed and fastened in a craftsman-like manner.
5. All work shall meet NEC requirements.

Evaluation:
• Verify each connection is wired correctly. Ensure all connections are tight.
• Record the results. Pass / Fail
• Students shall be retested until a Pass is recorded.

General Instructors Tips:
1. Hands on Activity/Practical Skills Testing:
   a. Hands on Activity - these are instrumental to the development of the apprentices understanding of the material being taught.
   b. Practical Skills Testing – indicates if the apprentice has the sufficient skills necessary to be advanced to the next level/school year.
2. Components for Hands on Activity/Practical Skills Testing can be obtained through request to the IEC Foundation (check with your chapter ED).
3. Depending on your chapters resources/space you may need to adjust how you accomplish these activities/testing. (Training Directors your chapter/other chapters are a great resource)
HANDS ON ACTIVITY/PRACTICAL SKILLS TEST (LESSON 225)

Transformers 3φ (Buck-Boost)

The purpose of the lesson is to select the correct wiring diagram and correctly wire a Buck-Boost transformer.

Materials/Tools
A mock-up board, 3 Buck-Boost transformers (* CH S10N04A81 or equal), terminal strips, screw driver and wire strippers. (Each training center will need to adjust according to their lab conditions).

Note: The wiring diagrams used should correspond to the brand and size of transformer used. The part number above is Cutler Hammer (*) and the charts and diagrams supplied correspond to the Cutler Hammer part number.

Using a mock-up board:
1. Draw wiring diagram.
2. Mount transformers and terminal strips.
3. Wire the transformer: (Instructor should select and test on at least one buck and one boost configuration for this Practical Skills Test.)
   a. Available voltage is 173 volts – required voltage is 208 volts. (Diag. N)
   b. Available voltage is 250 volts – required voltage is 208 volts. (Diag. N)
   c. Available voltage is 208 volts – required voltage is 230 volts. (Diag. M)
   d. Available voltage is 242 volts – required voltage is 230 volts. (Diag. Q)
   e. Available voltage is 228 volts – required voltage is 240 volts. (Diag. Q)
   f. Available voltage is 252 volts – required voltage is 240 volts. (Diag. Q)
4. Ensure all connections are tight, each wire is trimmed and fastened in a craftsman-like manner.
5. All work shall meet NEC requirements.

Evaluation:
• Verify each connection is wired correctly. Ensure all connections are tight.
• Record the results. Pass / Fail
• Students shall be retested until a Pass is recorded.

General Instructors Tips:
1. Hands on Activity/Practical Skills Testing:
   a. Hands on Activity - these are instrumental to the development of the apprentices understanding of the material being taught.
   b. Practical Skills Testing – indicates if the apprentice has the sufficient skills necessary to be advanced to the next level/school year.
2. Components for Hands on Activity/Practical Skills Testing can be obtained through request to the IEC Foundation (check with your chapter ED).
3. Depending on your chapters resources/space you may need to adjust how you accomplish these activities/testing. (Training Directors your chapter/other chapters are a great resource)
HANDS ON ACTIVITY/PRACTICAL SKILLS TEST (LESSON 226)

Transfer Switch

The purpose of the lesson is to correctly wire a Transfer Switch.

Materials/Tools
A mock-up board, a transfer switch, 2 disconnects, screw driver and wire strippers. (Each training center will need to adjust according to their lab conditions).

Using a mock-up board:
1. Draw wiring diagram.
2. Mount transfer switch and disconnects.
3. Wire the components:
   a. Separately Derived System
   b. Non-Separately Derived System
4. Ensure all connections are tight, each wire is trimmed and fastened in a craftsman-like manner.
5. All work shall meet NEC requirements.

Evaluation:
• Verify each connection is wired correctly. Ensure all connections are tight.
• Record the results. Pass / Fail
• Students shall be retested until a Pass is recorded.

General Instructors Tips:
1. Hands on Activity/Practical Skills Testing:
   a. Hands on Activity - these are instrumental to the development of the apprentices understanding of the material being taught.
   b. Practical Skills Testing – indicates if the apprentice has the sufficient skills necessary to be advanced to the next level/school year.
2. Components for Hands on Activity/Practical Skills Testing can be obtained through request to the IEC Foundation (check with your chapter ED).
3. Depending on your chapters resources/space you may need to adjust how you accomplish these activities/testing. (Training Directors your chapter/other chapters are a great resource)
Motor Connection and Lead Identification

The purpose of the lesson is to correctly identify a motors connection (wye or delta) and properly identify the motors leads (when they are unmarked).

Materials/Tools
A “9” lead motor wye connected and a “9” lead motor delta connected (identification numbers removed or covered), 12 volt battery, test leads, analog DC volt meter, an analog or digital ohmmeter and marking numbers. (Each training center will need to adjust according to their lab conditions).

Using the procedure found in the second year curriculum/second semester/Annex M test the students ability to:
   a. Identify the wye and delta connected motor.
   b. Identify and correctly mark the leads on the wye motor.
   c. Identify and correctly mark the leads on the delta motor.

Evaluation:
• The student has correctly identified the motors (wye connected or delta connected). The student has correctly identified and marked the leads on each of the motors.
• Record the results. Pass / Fail
• Students shall be retested until a Pass is recorded.

General Instructors Tips:
1. Hands on Activity/Practical Skills Testing:
   a. Hands on Activity - these are instrumental to the development of the apprentices understanding of the material being taught.
   b. Practical Skills Testing – indicates if the apprentice has the sufficient skills necessary to be advanced to the next level/school year.
2. Components for Hands on Activity/Practical Skills Testing can be obtained through request to the IEC Foundation (check with your chapter ED).
3. Depending on your chapters resources/space you may need to adjust how you accomplish these activities/testing. (Training Directors your chapter/other chapters are a great resource)
HANDS ON ACTIVITY/PRACTICAL SKILLS TEST (LESSON 229/230)

Make-up Motor Junction box
a. 12 lead
b. High / Low voltage
c. Reversing 1φ & 3φ

The purpose of the lesson is to correctly terminate a motors junction box (single and 3φ)

Materials/Tools
Single phase motor (with high and low voltage and capable of reversing rotation), a 3φ (12 lead motor) and the proper termination components for the equipment being used. (Each training center will need to adjust according to their lab conditions).

Using a motor:
1. Properly wire a 1φ motor (high voltage – clockwise rotation).
2. Properly wire a 1φ motor (low voltage – counterclockwise rotation).
3. Properly wire a 3φ motor (high voltage – clockwise rotation).
4. Properly wire a 3φ motor (low voltage – counterclockwise rotation).
5. Ensure all connections are tight, each wire is terminated in a craftsman-like manner.
6. All work shall meet NEC requirements.

Evaluation:
• Verify each connection is wired correctly. Ensure all connections are tight.
• Record the results. Pass / Fail
• Students shall be retested until a Pass is recorded.

General Instructors Tips:
1. Hands on Activity/Practical Skills Testing:
   a. Hands on Activity - these are instrumental to the development of the apprentices understanding of the material being taught.
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