

3.0 CHECKLISTS (16271 MEDIUM-VOLTAGE TRANSFORMERS)

Checklist Number	Description
E30	SWITCHBOARD, 600 VOLTS AND LESS
E32	TRANSFORMER, OIL FILLED

Maintenance Task

<u>PM No.</u>	<u>Title</u>	<u>Frequency</u>
E30	SWITCHBOARD, 600 VOLTS AND LESS	ANNUAL EVERY THREE YRS

NOTE: THIS MAINTENANCE CHECKLIST INCORPORATES RCM PROCEDURE E-0004 (ELECTRICAL DISTRIBUTION). RCM PROCEDURE CM-0002 (QUALITATIVE INFRARED TESTING) IS TO BE COMPLETED IN CONJUNCTION WITH THIS MAINTENANCE CHECKLIST. REFER TO OBO RELIABILITY CENTERED MAINTENANCE MANUAL TABLE K-9.

This guide applies to switchboards which house breakers or contactors of 600 amperes or larger. Switchboards are defined in the National Electric Code.

MAINTENANCE TASK DESCRIPTION:

1. Inspect and Clean Electrical Panels.

SPECIAL INSTRUCTIONS:

1. Avoid electrical shock! Turn off electricity before working on the equipment.
2. De-energize, tag, and lock out all power supplies to ensure the power stays off. DANGER - CHECK THAT CIRCUITS ARE DEAD BEFORE STARTING WORK. CHECK FOR PRESENCE OF CONTROL VOLTAGES OR VOLTAGE SOURCES OTHER THAN THE PRIMARY POWER SUPPLIES.
3. Schedule outage with operating personnel and affected offices.
4. Follow site safety procedures and your supervisor's instructions.
5. Record and report to your supervisor any equipment damage or deficiencies found during this maintenance task.
6. Record all test results in the component maintenance log.
7. Review manufacturer's operation and maintenance instructions.
8. All tests to conform with manufacturer's test procedures.

PROCEDURES: (ANNUAL)

1. Open all panels and visually check for loose connections, burned or frayed insulation.
2. Verify no visible abnormalities.
3. Verify that surge protectors are not indicating faulty circuits or blown fuses.
4. Submit a work order if corrections or repairs are required.

TOOLS, MATERIALS AND EQUIPMENT: (ANNUAL)

1. Flashlight.

PROCEDURES: (3 YEARS)

1. Ensure unit is loaded to at least 40% of rated current and perform procedure CM-0002, Qualitative Infrared Thermography.
2. De-energize the switchboard. Check that each circuit is dead or you may end up dead.
2. Enter board from rear and perform complete inspection looking for:
 - a. Proper anchoring, and equipment grounding.
 - b. Grounds or shorts.
 - c. Evidence of overheating or arcing.
 - d. Cable arrangements and supports, cracked or damaged insulators.
 - e. Test bus duct.
3. Torque cable and bus connections.
4. Inspect fuse clips for tightness and alignment.
5. Thoroughly vacuum and clean inside board.
 - a. Clean electrical insulation/plastic parts with isopropyl alcohol.
6. Lubricate moving parts, wiping electrical contacts and other mechanical devices.
7. Inspect for correct identification labels or plates.
8. Inspect all internal heaters, etc.

Maintenance Task

10. Mechanically and visually inspect all current and potential transformers.
11. Reinstall any breakers removed for maintenance.
12. Meggar test the switchboard and record results. The meggar test should be greater than 10 megohms.
13. Removing tags and return to service.
14. Reaccomplish CM-0002 to ensure problem areas have been corrected.

GUIDELINES FOR INTREPRETING THERMOGRAPHIC-INFRA-RED SURVEY DATA:

1. Up to 3 °C above ambient: No immediate action necessary.
2. 3 °C to 7 °C: Correct at next routine shutdown.
3. 7 °C to 15 °C: Correct prior to routine maintenance.
4. Over 15 °C: Correct as soon as possible.

TOOLS, MATERIALS AND EQUIPMENT: (3 YEARS)

1. Electrician's tools set.
2. Megger.
3. Cleaning tools and materials.
4. Isopropyl alcohol.
5. Vacuum
6. Torque wrench
7. Infrared test equipment

ENGINEER'S NOTES:

Connector torque value, see specification SAE AIR1471. All values are + or - 12.5%.

BOLT SIZE	TORQUE VALUE
5/32-32	25 in-lb.
5/32-36	26 in-lb.
3/16-32	42 in-lb.
1/4-28	95 in-lb.
5/16-24	185 in-lb.
1/2-20	800 in-lb.

Maintenance Task

<u>PM No.</u>	<u>Title</u>	<u>Frequency</u>
E32	TRANSFORMER, OIL FILLED	SEMIANNUAL ANNUAL

WARNING: THIS CHECKLIST IS NORMALLY ACCOMPLISHED BY A QUALIFIED CONTRACTOR. DO NOT ACCOMPLISH WITH PERSONNEL WHO ARE NOT SPECIFICALLY QUALIFIED TO PERFORM WORK ON HIGH VOLTAGE (ABOVE 4.16 KV) EQUIPMENT.

- NOTE:
1. RCM PROCEDURES CM-0002, CM-0004, CM-0006, AND CM-0007 ARE TO BE COMPLETED IN CONJUNCTION WITH THIS MAINTENANCE CHECKLIST. REFER TO OBO RELIABILITY CENTERED MAINTENANCE MANUAL TABLE K-9.
 2. FOR MOST POSTS, THIS MAINTENANCE CHECKLIST WILL TYPICALLY FORM THE BASELINE FOR A SCOPE OF WORK TO BE COMPLETED BY CONTRACT.
 3. THE UTILITY COMPANY SHOULD ALSO MAINTAIN INCOMING HIGH VOLTAGE EQUIPMENT WHILE THE TRANSFORMER IS DE-ENERGIZED.

MAINTENANCE TASK DESCRIPTION:

1. Clean and check oil level (Semi-Annual).
2. Inspect electrical connections (Annual).
3. Perform appropriate dielectric or megger test (Annual).

SPECIAL INSTRUCTIONS:

1. Perform applicable lockout/tagout steps of site safety procedures to ensure machinery will not start.
2. Schedule outage with operating personnel and local power company, if applicable.
3. Follow site safety procedures and your supervisor's instructions.
4. Record and report to your supervisor any equipment damage or deficiencies found during this maintenance task.
5. Record all test results in the component maintenance log.
6. Obtain and review manufacturer's operation and maintenance instructions.
7. All tests shall conform to the manufacturer's test procedures and standard values.
8. Personnel must be certified for performing maintenance on high voltage equipment.
9. Complete requirements of RCM procedures CM-0002 (Qualitative Infrared Thermography), CM-0004 (Insulation Test), CM-0006 (Oil Filled Transformer Oil Test) and CM-0007 (Transformer Power Factor Tests) during task accomplishment.

PROCEDURES: (SEMI-ANNUAL)

1. Check and record oil level.
2. Look for signs of leakage.
3. Wipe all oil from transformer casing.
4. Inspect for signs of overheating.
5. Check spacing and rigidity of conductors.
6. Test operation of any temperature alarm or trips.

TOOLS, MATERIAL, AND EQUIPMENT (SEMI-ANNUAL)

1. Cleaning materials.
2. Replacement oil.

PROCEDURES: (ANNUAL)

1. Open transformer covers and complete CM-0002 on all conductors and connections. Note: For the test to be effective unit needs to be loaded to at least 40% of full load current. Correct identified deficiencies while transformer is de-energized.
2. Start backup generators and transfer the load, if applicable.
3. Tag out primary and secondary of transformer.
4. Examine condition of mounting and support members.
5. Thoroughly clean the transformer housing and any attached panels, enclosures, etc.
6. Check transformer electrical grounding conductor.

Maintenance Task

7. Inspect accessible insulators for chips, cracks, or fractures.
8. Clean accessible insulators according to manufacturer's instructions. This is usually accomplished with a soft cloth dipped in a silicone type compound sand polish (never use water, caustic solutions or abrasive such as steel wool or a wire brush). When cleaned, polish with a soft cloth or lamb's wool.
9. Complete oil analysis in accordance with CM-0006
10. Recondition or replace oil based on the testing laboratory recommendations.
11. Inspect for leaks and check oil level and oil reservoir. Sealed oil filled transformers with internal open space should be purged and left with an inert gas (nitrogen ultra high purity) pressure of about 1 psig at 30 degree C. Perform positive pressure test on outside transformers.
12. Tighten all connections.
13. Remove rust spots from body, caps and flanges by sanding. Prime bare metal with rust inhibitor primer and paint. (Never use aluminum or copper base paints or primers).
14. Inspect disconnects for structure and condition of contact surfaces.
15. Check operation of all cooling apparatus such as fans or pumps, etc.
16. Check operation of any temperature or sudden pressure alarms or trips and electrical interlocks.
17. Tighten connections with torque wrench to manufacturer's specifications.
18. Perform CM-0004, Insulation Test.
19. Perform CM-0007, Power Factor Test.
20. On power type transformers only with primaries shorted, and secondaries shorted, perform ACRMS high-potential tests at (ANSI C57.1290) no more than 60 percent of test voltage for a new transformer. Test primary to secondary and ground, and secondary to primary and ground.
21. Record results in the transformer Maintenance History Record.
22. Remove tags and lock, return circuit to service.
23. With unit loaded re-accomplish infrared checks on any problem areas.

TOOLS, MATERIALS, AND EQUIPMENT: (ANNUAL)

1. Electrician's tool set.
2. Cleaning materials and equipment: soft cloth or lamb's wool.
3. Hi-pot test equipment.
4. Torque wrench.
5. Sandpaper and primer paint.
6. Refer to CM-0002, CM-0004, CM-0006, and CM-0007 for additional requirements.

NOTE: All tests shall conform to the appropriate ASTM test procedure and the values used as standards shall conform to the manufacturer's and ANSI Standards Specifications.