

BJM CORP ALL-TEST™ Tech Note: Trans01

- ⇒ Basic Knowledge
- Problem Example
- Improvement Example

Theme: Transformer Testing – 3 Phase Transformers

Description

The ALL-TEST IV PRO™ 2000 may be used to test any type of 3-Phase commercial and utility transformers in a similar fashion that electric motor windings are tested. The true sine wave generated by the ALL-TEST™ that provides unequaled motor rotor testing, coupled with the type of connections found in transformers, will cause traveling currents that will provide erroneous test results. This can be easily avoided with a test procedure that can be used on any type of three phase transformer connection. In many cases, this can be used as a “screening” test prior to performing the specific testing required within many utilities. Avoiding one costly test series on a bad transformer will usually pay for the ALL-TEST™.

Procedure

In order to test a three-phase transformer, you must ground ALL of the leads on the other side of the transformer that you are not testing. This means that you must test the primary, with all of the secondary leads grounded, then the secondary, with the all of the primary leads grounded. If you ground only one lead, you will get poor test results. Ground straps or cables must be sized to handle the output voltage that will be generated due to the output of the ALL-TEST IV PRO™ 2000.

The general procedure is as follows:

1. De-Energize and disconnect primary and secondary of transformer to ensure that stray voltages are not present that will harm the operator nor the ALL-TEST™. The appropriate safety requirements for Lock-Out/Tag-Out and testing de-energized equipment apply.
2. Attach grounding straps to the secondary of the transformer, including the neutral (usually identified as X_0). Ensure that the grounding straps or cable are attached to a true earth ground.
3. Ensure that the transformer switch, if applicable, and once the transformer has been isolated, is in the “on” or “operating” position.
4. Perform the Auto test per the ALL-TEST IV PRO™ 2000 manual. Ensure that the connection points are as clean as possible. If the ALL-TEST™ shows “Bad Result,” the simple resistance of the circuit is too low. See Tech Note Resist01 for details. Save the results. When testing, the normal sequence is H1 to H2, H1 to H3, then H2 to H3. If the readings are unbalanced, remeasure them. If the readings are not repeatable when remeasured, check the ground connection and retest.
5. Attach the grounding straps or cable to all the primary leads of the transformer then to a true earth ground. Follow the instructions for the secondary as shown in step 4, using X_1 , X_2 , and X_3 .

Test Results

Test results on a good transformer may vary, especially when the simple resistance drops below 0.250 Ohms. Failed transformers tend to have very dramatic results and, if you are trending, readings will increase fairly rapidly in unbalance to failure. If you are trending critical transformers, we recommend testing at least monthly.

Table 1: Good 2,500 kVA, 28,800:4,300
Volt Pad Mount Transformer: Primary

Reading	T1-T2	T1-T3	T2-T3
Resistance	3.703	3.623	6.648
Impedance	220	217	218
Inductance	87	86	86
Phase Angle	88	88	88
I/F	-49	-49	-49

Table 3: Bad 500 kVA, 13,800:240 Volt Pad
Mount Transformer: Primary

Reading	T1-T2	T1-T3	T2-T3
Resistance	116.1	88.20	48.50
Impedance	4972	1427	1406
Inductance	7911	2267	2237
Phase Angle	23	21	20
I/F	-33	-29	-29

Table 2: Good 2,500 kVA, 28,800:4,300
Volt Pad Mount Transformer: Secondary

Reading	T1-T2	T1-T3	T2-T3
Resistance	.103	.100	.096
Impedance	15	14	14
Inductance	2	2	2
Phase Angle	75	75	75
I/F	-48	-48	-49

The 500 Volt insulation resistance reading on the primary side was 9.132 M-Ohm. The primary of this winding had blown to ground and damaged the secondary. Readings could not be performed on the secondary as a result.

⊕ The following test result recommendations are for reference only, results may vary on some transformers.

⊕ Resistance: Should not be more than 5% unbalanced when testing above 0.250 Ohms, but may be as high as 7.5% unbalanced when below 0.250 Ohms.

⊕ Impedance: Should not be more than 5% unbalanced. Failed transformers will tend to have unbalances over 100%.

⊕ Inductance: Should not be more than 5% unbalanced.

⊕ Phase Angle: Should be within one digit from each other.

⊕ I/F: Should be no more than two digits from each other.

⊕ **Note:** Readings that have a definite “shift” as shown in Table 4 should be flagged for further testing. (Notice inductance, phase angle and I/F as compared to impedance and resistance)

Table 4: Questionable Transformer Example

Reading	T1-T2	T1-T3	T2-T3
Resistance	3.929	3.843	4.002
Impedance	162	164	159
Inductance	32	32	31
Phase Angle	78	78	77
I/F	-44	-44	-45

