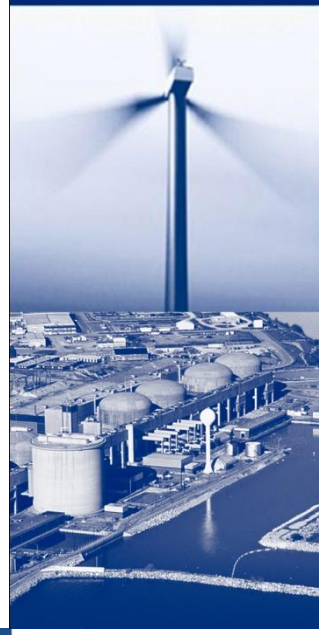

Arcing test in distribution transformers

By Marcel Fortin ing

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Introduction

Arcing tests to prove the proper construction of round tank, overhead type distribution transformers are normalized for now some 30 years.

See IEEE C57.12.20.

I discuss here how this test can be implemented for other type of distribution transformers.

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Table of content

- Tests requirements in C57.12.20
- Some basic requirements for other distribution transformers
- Test durations considerations
- Arc initiation and location
- Number of test

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Requirements of C57.12.20 -1

- It is recognized that the test conditions should ultimately be described in terms of the energy applied, with the pressure wave defined by the rate of rise, peak pressure, duration, and total energy under the curve.
- At this time sufficient information is not available to so describe an applicable pressure wave.
- For the interim period the test procedure is based upon defining the electrical conditions associated with generating a particular shock or impulse pressure wave which shall be used as a measure of tank or enclosure strength.
- This test procedure is intended to establish a meaningful test which is repeatable and capable of duplication invarious laboratories and test situations.

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Requirements of C57.12.20 -2

- 2 tests duties are defined:
  - For transformers without internal fuse link: test duty 1.
  - For transformers with internal fuse links; test duty 2.

The following figures show the test duties and the arc gap for test duty 1.

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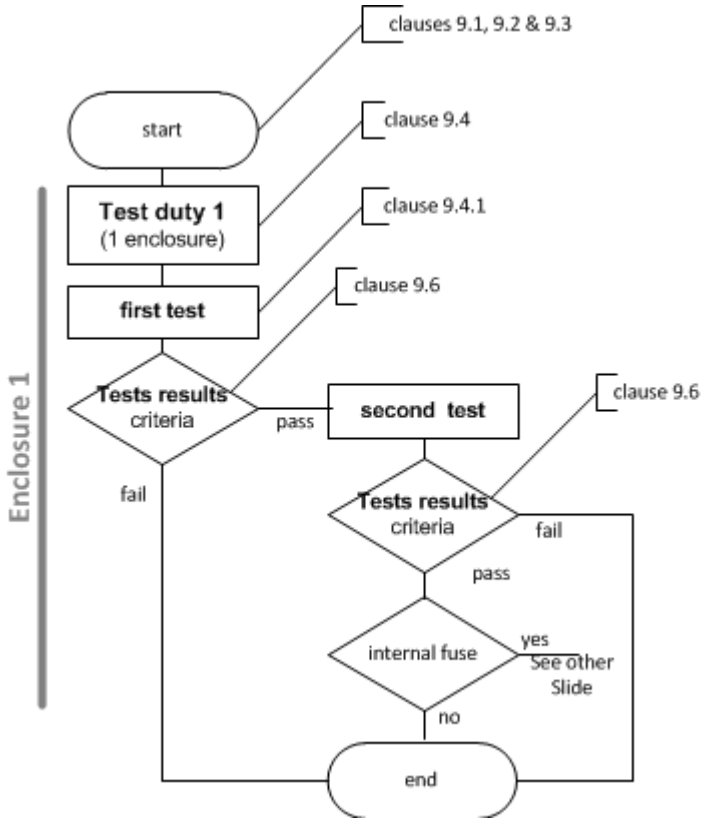
Requirements of C57.12.20 -3



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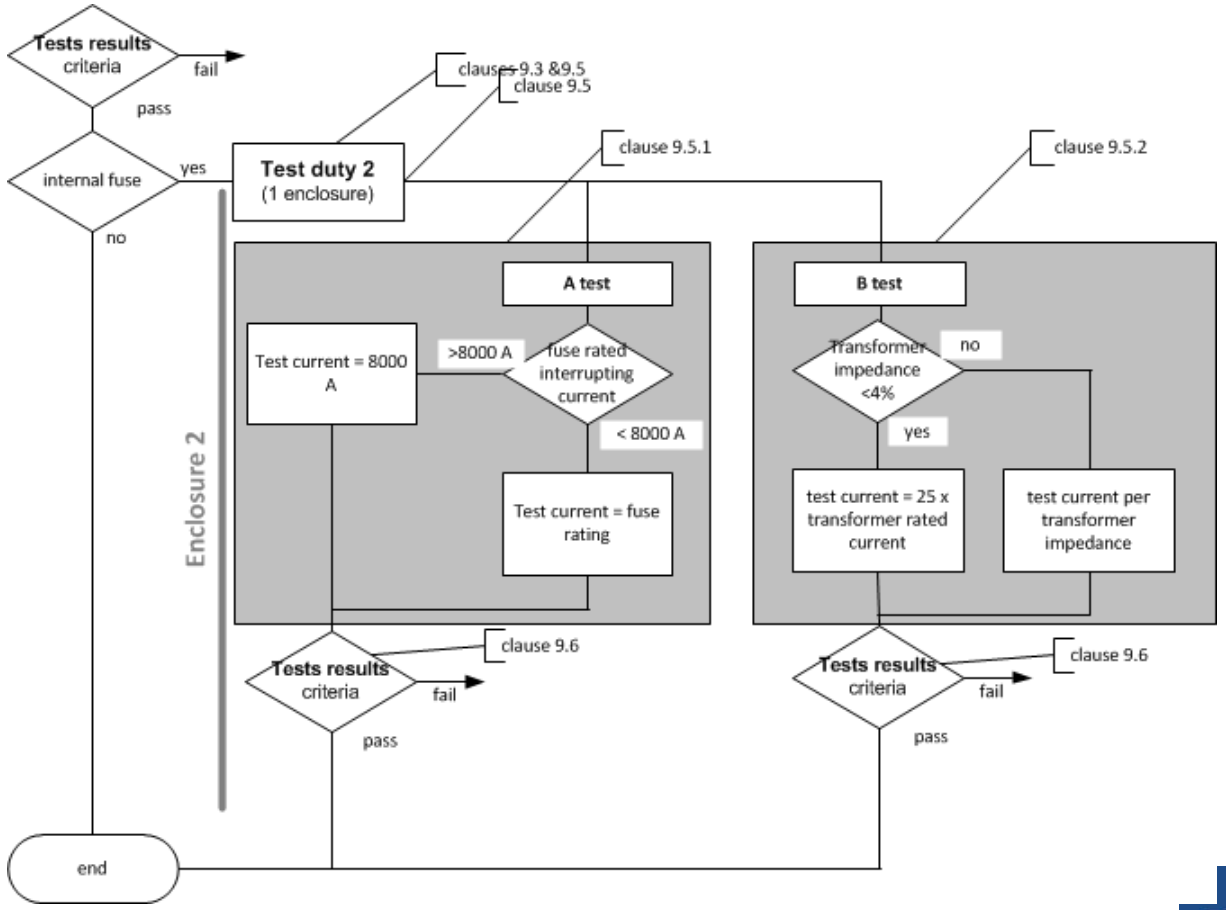
Requirements of C57.12.20 -4



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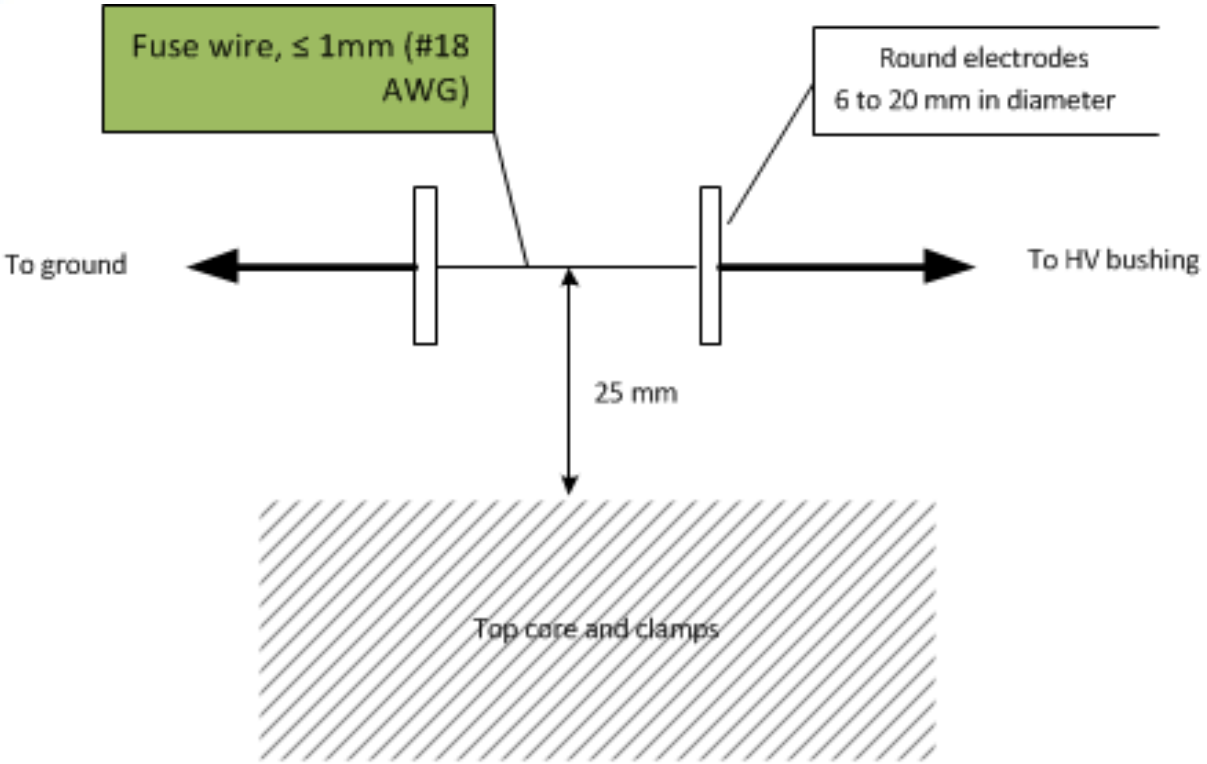
Requirements of C57.12.20 -5



Test fixture to test duty 1

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Requirements of C57.12.20 -6

- Tests parameters for test duty 1
  - Test voltage: ≥ 7.2 kV
  - Test current: 8000 A rms **symmetrical**
  - Test duration (based on a 25 k expulsion fuse): 1 cycle of rated frequency.

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Requirements of C57.12.20 -7

- Test parameters for test duty 2 – A test:
  - Fault location: bolted fault on the secondary side of the expulsion fuse
  - Test voltage: the transformer rated voltage
  - Test current: the smaller current of 8000 A rms symmetrical, or the fuse maximum interrupting capability.
  - Test duration: the fuse total clearing time with a maximum back-up protection of 2 more cycles.

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Requirements of C57.12.20 -8

- Test parameters for test duty 2 – B test:
  - Fault location: bolted fault on the LV terminals
  - Test voltage: the transformer rated voltage
  - Test current: limited by the transformer impedance with no more than 25 times the rated current.
  - Test duration: the fuse total clearing time with a maximum back-up protection of 2 more cycles.

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Requirements of C57.12.20 -9

- Test criteria
  - no mechanical components from the transformer enclosure shall be propelled or dropped during the tests.
  - there shall be no rupture of the enclosure casing or seams.
  - there shall be less than one liter of oil emitted.
  - there shall be no expulsion of flaming oil during the tests.
  - no oil shall continue to leave the inside of the transformer enclosure after the completion of the test.
  - the transformer shall not be dislodged from its mounting.

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Requirements for other distribution transformers - 1

- Very different configurations of live parts (bushing, bus assemblies, core and coil …)
- Very different configuration of air cushion
- Mainly flat wall tanks
- Usually fed from a UG system
- Usually in an enclosure or fixed on a concrete platform
- May be easily accessible by the public (standing at ground level)

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Requirements for other distribution transformers - 2

- The test should aim to try to ascertain avoiding:
  - Major oil spill
  - Fire

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Requirements for other distribution transformers - 3

- K links total clearing time (at current zero) for a 8000 A rms symmetrical fault, in cycle at 60 Hz:
  - 65k or less: 1 cycle
  - 80 and 100k: 1.5 cycle
  - 140k: 2 cycles
  - 200k: 3 cycles

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Conclusion

- Test procedure from C57.12.20 cannot be used as is
- For transformers with internal expulsion fuse, TD 2 “A and B” tests should be performed (see 9.5 of C57.12.20)
- The arcing time shall be defined on the size of the transformer and on typical real (at current zero) total clearing time
- Arcing fault location (fuse wire ..) shall be properly defined based on most common transformer arrangement

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