23 October 1936

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FR-1322

NAVY DEPARTMENT

BUREAU OF ENGINEERING

Report of Test

on

Gun Firing Transformer, 200 V. A.
Submitted by
Jefferson Electric Co.
Bellwood, Illinois.

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D.C.

Number of Pages: Text - 5 Plates - 2

Authorization: BuEng.ltr. JJ-17T19(8-8-Ds) of 8-24-36.

Date of Test: September and October, 1936.

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Distribution:
BuEng.(5)

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Appendices

AUTHORIZATION FOR TEST

1. This test was authorized by reference (a). Another reference pertinent to this problem is listed as reference (b).

Reference: (a) Bueng.ltr.JJ-17T19(8-8-Ds) of 8 Aug.1936.
(b) Specifications 17T19b of 1 May 1935.

OBJECT OF TEST

2. The object of this test was to determine whether the subject material complied with the specifications, reference (b), and its suitability for the Naval Service as a gun firing transformer.

ABSTRACT OF TEST

3. The subject transformer was set up at this Laboratory in standard test circuits, and its performance carefully checked to ascertain whether it was in strict accordance with the specifications, reference (b). An inspection of the transformer, relative to materials, design, workmanship and shock integrity, concluded the test.

CONCLUSIONS

(a) The subject transformer, under test for conformance with the specifications, reference (b), failed to meet the following requirements:

(1) The secondary voltage is 17.8 volts at rated load (200 V.A.) with a primary voltage of 115 volts, while that required is 18.0 volts at full load, 100% P.F.

(2) Under test for dielectric strength, a breakdown occurred between the secondary lead wires and core cover, due to faulty insulation at joints.

(3) The total weight of the transformer is 16.5 lbs. while that allowed by the specifications is 15 lbs.

(b) Under inspection of the design and materials, it was observed that the lead wires from transformer windings to the terminal block pass through uninsulated holes in the upper transformer cover. These wires would probably become grounded or shorted under service conditions, due to vibration and the chafing of the wires. Possibly these covers could be eliminated. In addition, it was noted that no nameplate was provided on the exterior of the case for identification. This nameplate should be in accordance with specifications 17N1(INT) of 15 May 1936.

(c) When the complete unit was mounted on a Bureau of Engineering shock stand in the vertical plane, six inches below point of impact, and given shocks of 250 foot pounds, the transformer broke away from the case, due to the stripping of threads on the securing screws. In addition, one of the mounting lugs was found fractured. Neither the mounting of the transformer nor the design of the lugs is sufficiently rugged to withstand shocks encountered in the service. The radii of the fillets and the thickness of the lugs should be increased.

RECOMMENDATIONS

(a) In view of the subject transformer having failed to comply with the specifications, reference (b), it is recommended that it be not approved for Naval use until a satisfactory test is performed on a sample, modified to overcome the defects noted under "Conclusions" of this report.

(b) The Bureau's attention is invited to the fact that the specifications, reference (b), do not require a shock test. This is considered an important factor, and it is therefore recommended that it be included in the specifications. It is also noted that there is no requirement pertaining to the insulation resistance.

DESCRIPTION OF MATERIAL UNDER TEST

4. The subject transformer was manufactured by the Jefferson Electric Company, Bellwood, Illinois. It is rated at 200 V.A. with a ratio of 115/20 and intended for use as a gun firing transformer.

5. It is of the dry type, the core being made up of separately punched thin laminations, insulated from one another when assembled. The core supports a primary and a secondary winding, insulated from each other and the transformer core, the secondary being wound over the primary. The core is clamped between two (2) steel covers with two (2) round head steel machine screws which thread into tapped holes in the lower cover.

6. The primary and secondary lead wires are brought out through two (2) unbushed holes in one side of the top cover and connect to their respective terminals, located on a strip of insulating material. Terminal lugs, Drawing 9-S-1841-L, are provided on the terminal block, secured to the top cover with two fillister head steel screws.

7. Riveted to the top cover of the core assembly with two brass rivets, is a brass nameplate, giving the manufacturer's name, primary voltage, secondary voltage, volt-amperes and type of transformer. In addition, the words "Pri" and "Sec" are stamped on the top cover of core assembly and the input and output voltages are stamped on the terminal strips.

8. The transformer unit is mounted in a cast aluminum alloy case of watertight construction with four steel machine screws, threaded into tapped steel inserts. The inserts are threaded into bosses, located in the bottom of the case. Four lugs, drilled for 3/8" bolts, are provided for mounting. On the side of the case, adjacent to the terminal block, are three tapped holes, two 3/8" and one 3/4" (IPS) for standard terminal tubes. The case cover is secured with ten fillister head machine screws, cadmium plated, used as through bolts. A knife edge on the cover and a 1/4 inch square rubber gasket, partly recessed into the case, are employed to insure watertightness. The case is finished in gray.

9. Further description in the details and design of the transformer are given by Plates 1 and 2.

METHOD OF TEST

10. The transformer was first tested for voltage regulation by comparing the secondary voltage at full rated load (200 V.A.) with the no load voltage, when a constant potential of 115 volts, A.C., 60 cycles, was applied to the primary. Its efficiency was also determined at this time at full rated load and normal primary voltage.

11. The temperature rise of the windings was next obtained by the resistance method, by placing the transformer in a compartment, having an ambient temperature of 40°C (104°F), and operating it for three (3) hours at full load (200 V.A.) at a primary voltage of 120 volts.

12. Following, a short circuit test was given by placing a short across the secondary for a period of fifteen seconds. During this test, the primary voltage was 120 volts, A.C., 60 cycles.

13. Prior to, and following, the required dielectric tests, the insulation resistance between the windings and the core was measured by a 1000 volt megger.

14. A test was next made for its dielectric strength to determine whether any damage to the insulation had occurred during the period of the temperature rise and short circuit tests.

15. Although no shock tests are required under reference (b), the complete unit was placed on a Bureau of Engineering shock stand and given shocks of 250 foot pounds each, to determine its ruggedness.

16. The test was concluded by partly disassembling the transformer and inspecting it for conformance with the specifications, with reference to materials and workmanship.

RESULTS OF TEST

17. The test results obtained were as follows:

Requirements	Test Values
Primary voltage: 115 volts	115 volts
Secondary voltage: Shall not exceed 20 volts with 115 volts applied to primary.	19.6 volts
Frequency and phase: 60 cycles, single phase.	60 cycles, single phase.
Voltage regulation: With a primary voltage of 115, the voltage on the secondary shall be 18 volts at rated load, 100% P.F.	*17.8 volts at rated load of 200 V.A., non-inductive.
Efficiency: Shall be not less than 85% at rated load.	86.1% at rated load. (115 volts across primary).
Temperature rise: Shall not exceed 50°C. (122°F.) at ambient temperature of 40°C. at rated load.	Pri. - 30.19° rise Sec. - 24.70°C rise (Full load, 120 V. Pri.)
Rating: Shall be capable of operating continuously at input of 120 volts, full load, without exceeding a temperature rise of 50°C.	Operated 3 hours, full load, 40°C. ambient. Temperature rises as given.
Short circuit test: No injury shall occur to transformer when the secondary is shorted for 15 seconds, with 120 volts across the primary.	Shorted as required, without apparent damage to windings. (Pri.volts, 120).
Insulation resistance: Not specified. Pri. to core, Sec. to core, and between windings following the short circuit test.	Following short circuit test, an average of 200 megohms by 1000 V. megger. *Following dielectric test, zero resistance by 1000 V. megger, between secondary and ground.

Dielectric strength: Shall withstand 2500 V. A.C., 60 cycles, for 1 min., between primary and core with secondary grounded to core, and 1250 V. A.C., 60 cycles between secondary and core with primary grounded.	*Breakdown occurred between secondary and core, occurring between lead wires and cover.
Dimensions: Overall dimensions shall not exceed 6 x 12 x 6 inches.	6 x 6 x 9.75 inches.
Painting: Inside of case, one priming coat of zinc chromate paint, plus two coats of aluminum paint, followed by two coats of varnish. Outside of case two coats of battleship gray over same base coats.	Complied with.
Watertightness: Shall not leak when sprayed with a stream of water from a 1" nozzle, under head of 35 feet from a distance of 10 feet, for a period of 5 minutes.	Complied with.
Shock integrity: Not specified.	*After application of 5 shocks of the normally required twenty of 250 foot pounds each, the transformer broke away from the case and one of the case mounting lugs fractured.
Transformer Mounting: Bosses provided on inside of case.	Bosses, provided with steel inserts, tapped and provided with fillister head steel machine screws.
Terminal connections: A terminal block of phenolic material equipped with terminals for both primary and secondary leads and line connections.	Complied with.
Bosses for terminal tubes: Shall be drilled and tapped for two size "A" and one size "E" terminal tubes.	Complied with.
Case construction: Shall be of aluminum alloy, provided with two lugs at each end, the cover secured with through bolts, and provided with a knife-edge for making a watertight joint. A square rubber gasket, recessed into the open end of case, for making a watertight joint with the knife edge, shall be provided.	Complied with.
Steel parts when in contact with aluminum: Shall be cadmium plated.	Complied with.
Total Weight: Shall not exceed 15 lbs.	*16.5 lbs.

*Denotes failure to comply with specifications.

CONCLUSIONS

18. The subject transformer, under test for conformance with the specifications, reference (b), failed to meet the following requirements:

(a) The secondary voltage is 17.8 volts at rated load (200 V.A.) with a primary voltage of 115 volts, while that required is 18.0 volts at full load, 100% P.F.

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(c) The total weight of the transformer is 16.5 lbs. while that allowed by the specifications is 15 lbs.

19. Under inspection of the design and materials, it was observed that the lead wires from transformer windings to the terminal block pass through uninsulated holes in the upper transformer cover. These wires would probably become grounded or shorted under service conditions, due to vibration and the chafing of the wires. Possibly these covers could be eliminated. In addition, it was noted that no nameplate was provided on the exterior of the case for identification. This nameplate should be in accordance with specifications 17N1(INT) of 15 May 1936.

20. When the complete unit was mounted on a Bureau of Engineering shock stand in the vertical plane, six inches below point of impact, and given shocks of 250 foot pounds, the transformer broke away from the case, due to the stripping of threads on the securing screws. In addition, one of the mounting lugs was found fractured. Neither the mounting of the transformer nor the design of the lugs is sufficiently rugged to withstand shocks encountered in the service. The radii of the fillets and the thickness of the lugs should be increased.

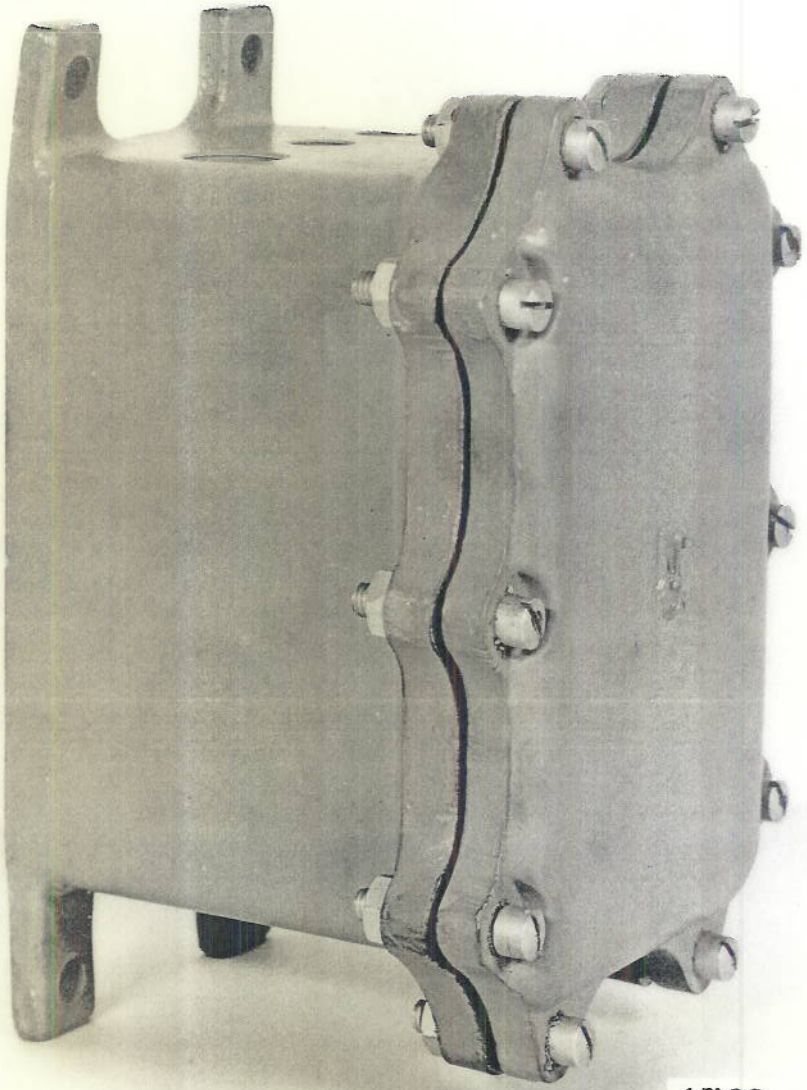

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Plate 1

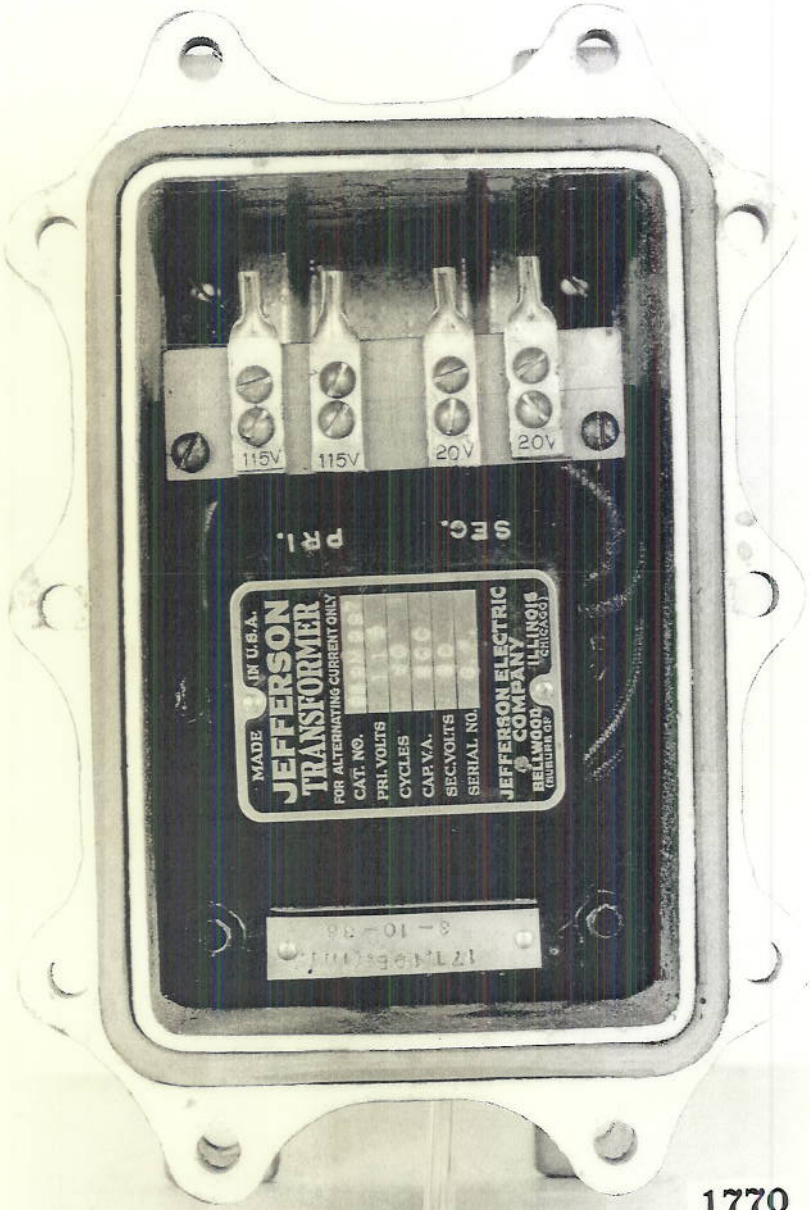

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Plate 2