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NAVY DEPARTMENT

Report of Test

on

Blown Fuse Transformers

Submitted by

Bendix Aviation Corporation, Marine Division
Brooklyn, New York

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WASHINGTON, D. C.

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Date of Test: October - November 1941

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Distribution:
BuShips (6)

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APPENDICES

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AUTHORIZATION FOR TEST

1. This problem was authorized by reference (a), and other references pertinent to this problem are listed as references (b), (c), and (d).

Reference: (a) BuShips ltr. S62-2(355) of 26 September 1941
(b) Specification SGS (71)-1190 of 1 Feburary 1938
(c) Bendix Drwg. No. CAL-12175 - BuShips File No. 11-T-1591-L-Alt.0
(d) BuShips ltr. S62-2 (665-355) of 13 November 1941

OBJECT OF TEST

2. The object of this test was to determine conformance of the sample transformers with the specification, reference (b), and their suitability for Naval use.

ABSTRACT OF TEST

3. The sample transformers were set up at this Laboratory in a suitable test circuit as shown by Plate 2, where their performance was carefully observed for compliance with the specifications, reference (b) as modified by reference (d). An inspection of the sample to determine compliance in the matter of materials, design, and workmanship, concluded the test.

CONCLUSIONS

(a) These blown fuse indicator transformers are of good design and of first class workmanship. They meet the specification in all instances except at loads of less than 1 watt under conditions of under voltage and frequency, and less than 10 watts under all other test conditions.

(b) Since the specification, reference (b) does not indicate any load requirements and the transformers are designed to operate under a load greater than 10 watts, it can be definitely stated that these blown fuse transformers comply with the specification in its entirety.

(c) At loads of less than one watt, under conditions of closed or open circuit, the shape of the voltage wave across the VG-7 indicator lamp departs from the normal sine wave. The wave is distorted to a wave form containing harmonics and sharp extended peaks. In each case the voltage readings recorded when distortion occurred are the average voltages of the distorted wave.

(d) At loads from 1 to 10 watts the voltage wave attains more nearly a normal sine wave form. At loads greater than 10 watts departures therefrom are almost imperceptible.

RECOMMENDATIONS

(a) It is recommended that this type of transformer be approved for Naval use.

(b) That non-compliance with the specification, as stated under conclusions (a), be waived since loads under service conditions are normally greater than 10 watts.

DESCRIPTION OF MATERIAL UNDER TEST

4. Four sample transformers of blown fuse type were submitted, one of which is shown by photograph, Plate 1.

5. This type of transformer has two windings, a single primary and a single secondary, having a 1:1 ratio. The primary is normally connected across the fused or load side of the line. The secondary is in series with a Navy standard VG-7 lamp and is connected across the power or unfused side of the line. If either or both fuses blow, the opposing voltage of the primary is removed and the indicator lamp will glow.

6. The transformer case is of formed steel and is coated with aluminum paint. This case has a molded phenolic cover secured by four fillister headed machine screws which thread into flanges spot welded to the case. The cover is fitted with four screw terminals which are provided with standard 9-S-1841-L terminals. Engraved on the cover are markings indicating "primary" and "secondary" and the letters S and F denoting corresponding terminals of the windings. Further details with regard to design and construction of this type of transformer are shown by drawing, reference (c), and Photograph, Plate 1.

METHOD OF TEST

7. The tests conducted were made in the following order:

(a) Voltage drop across indicator lamp with fuses in and fuses out.
(b) Temperature rise in windings when continuously energized for a period of 8 hours at an ambient of 54.4° C (Four hours operation with fuses in and four hours with fuses out).
(c) Impedances of primaries at 115 volts, a.c., 60 cycles at zero load.
(d) Insulation resistance.
(e) Dielectric strength to ground.
(f) Insulation resistance.
(g) Inspection of one of the sample transformers relative to design, materials, workmanship, and a check against drawing, reference (c).

8. Each transformer was properly connected in a test circuit (Plate 2) with the primary across the "load" side of two fuses and the secondary across the "line" side in series with a Navy standard VG-7 lamp. This lamp consumed 1.89 milliamperes on 115 v. a.c., 60 cycles and had a d.c. flash voltage of 73.8.

9. The potential drop across the VG-7 lamp was measured under specified conditions of frequency and voltage and under loads varying from 0 to a short circuit with fuses intact in order to determine the amount of unbalance in the transformer windings.

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10. Under the same conditions outlined in paragraph 9, the voltage drop across the indicator lamp was measured with fuses out.

11. Measurements of voltage drops were made using a Ballantine electronic voltmeter consuming approximately zero power.

12. The temperature rise of the transformer windings was determined by the resistance method under conditions of rated voltage and frequency in a thermostatically controlled oven at an ambient of 54.4° C. for a period of 8 hours. This test consisted of 2 parts; namely, four hours of operation with fuses intact and four hours of operation with fuses out.

13. The impedances of the primaries were determined by impressing 115 V. a.c. 60 cycles directly across the terminals of the windings.

14. The test was concluded with determination of their insulation resistance, dielectric strength, and examination of one sample transformer relative to material, construction, and compliance with submitted drawings.

RESULTS OF TEST

15. The results of tests, conducted in the order outlined in paragraph 7, are as follows:

INDICATOR LAMP VOLTAGES

25° C. Room Temperature

VG-7 Lamp - 1.89 MA on 115 V. a.c. 60 cycle - Flash Voltage 73.8 d.c.

Transformer #	Load in Watts	54 Cycles 97.75 v		60 Cycles 115 v		66 Cycles 126.5 v	
		Fuses In Volts	Fuses Out Volts	Fuses In Volts	Fuses Out Volts	Fuses In Volts	Fuses Out Volts
1	0	5.6	69.0	8.0	76.0	7.9	80.0
	.1	5.6	75.0	8.0	84.0	7.9	89.0
	1.0	5.6	84.0	8.0	96.0	7.9	100.0
	10	5.6	93.0	8.0	109.5	7.9	119.5
	100	5.6	95.0	8.0	113.5	7.9	123.5
	short	---	95.0	---	112.5	---	123.5
2	0	4.6	64.0	7.0	70.0	7.0	74.0
	.1	4.7	74.0	7.0	82.0	7.1	88.0
	1.0	4.8	83.0	7.0	95.0	7.1	99.0
	10	4.8	93.0	7.0	109.5	7.1	119.5
	100	4.8	94.0	7.0	113.5	7.2	124.0
	short	---	95.0	---	112.5	---	123.5
3	0	5.0	67.0	7.1	74.0	7.3	79.0
	.1	4.9	75.0	7.1	83.5	7.3	89.0
	1.0	4.9	83.0	7.05	96.0	7.3	101.5
	10	4.9	93.0	7.1	109.5	7.3	120.0
	100	4.9	96.0	7.0	112.0	7.3	123.0
	short	---	95.0	---	113.0	---	123.0

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Transformer #	Load in Watts	54 Cycles 97.75 v		60 Cycles 115 v		66 Cycles 126.5 v	
		Fuses In Volts	Fuses Out Volts	Fuses In Volts	Fuses Out Volts	Fuses In Volts	Fuses Out Volts
4	0	4.3	67.0	6.0	74.0	6.0	78.0
	.1	4.3	74.5	6.0	84.0	6.1	88.0
	1.0	4.3	83.0	6.0	95.0	6.1	100.0
	10	4.3	93.0	6.0	110.0	6.1	119.5
	100	4.35	96.0	6.0	113.0	6.1	124.0
	short	---	95.0	---	112.0	---	123.5

TEMPERATURE RISES IN °C - RESISTANCE METHOD

54.4° C. Ambient for 8 Hours

Transformer Number		Fuses Intact 22° C. Allowed	Fuses Out 33° C. Allowed
1	PRI	3.2	1.1
	sec.	3.4	1.2
2	PRI	3.1	1.1
	sec.	3.3	1.2
3	PRI	3.8	1.1
	sec.	4.0	1.1
4	PRI	2.5	1.2
	sec.	2.6	1.2

PRIMARY IMPEDANCE WITH SECONDARY OPEN AT
115 VOLTS A.C. 60 CYCLES USING ELECTRONIC VOLTMETER

Trans. #	Milliamp.	(ohms) Impedances
1	8.85	13,000
2	8.10	14,200
3	8.65	13,300
4	7.52	15,300

Voltage Readings are across terminals of primary winding.

Requirements	Test Values
Insulation Resistance: Shall be not less than 5 megohms at 500 volts between electrical point and ground.	All samples had a resistance greater than 100 megohms by a 500 volt megger.
Dielectric Strength to ground: Shall withstand 1500 volts rms. 60 cycle a.c. for 1 second.	All samples complied.

Requirements	Test Values
Insulation Resistance: Insulation resistance following dielectric shall be not less than 5 megohms at 500 volts.	All samples had a resistance greater than 100 megohms by a 500 volt megger.
Filling Compound: Shall be tar or pitch or other approved material remaining moisture proof and air tight over the range 32° F to 210° F.	Compound used (Mitchell-Rand rubber seal) showed only slow creep at 210° F and would not run from case.
Case finish: Shall be covered with aluminum paint.	Finished with aluminum paint.
Weight: Shall not exceed 34 oz.	16 oz.
Maximum Dimensions	
Width 2.50"	2.25"
Depth 2.50"	2.25"
Length 4.62"	3.50"

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CONCLUSIONS

16. These blown fuse indicator transformers are of good design and of first class workmanship. They meet the specification in all instances except at loads of less than 1 watt under conditions of under voltage and frequency, and less than 10 watts under all other test conditions.

17. Since the specification, reference (b), does not indicate any load requirements and the transformers are designed to operate under a load greater than 10 watts, it can be definitely stated that these blown fuse transformers comply with the specification in its entirety.

18. At loads of less than one watt, under conditions of closed or open circuit, the shape of the voltage wave across the VG-7 indicator lamp departs from the normal sine wave. The wave is distorted to a wave form containing harmonics and sharp extended peaks. In each case the voltage readings recorded when distortion occurred are the average voltages of the distorted wave.

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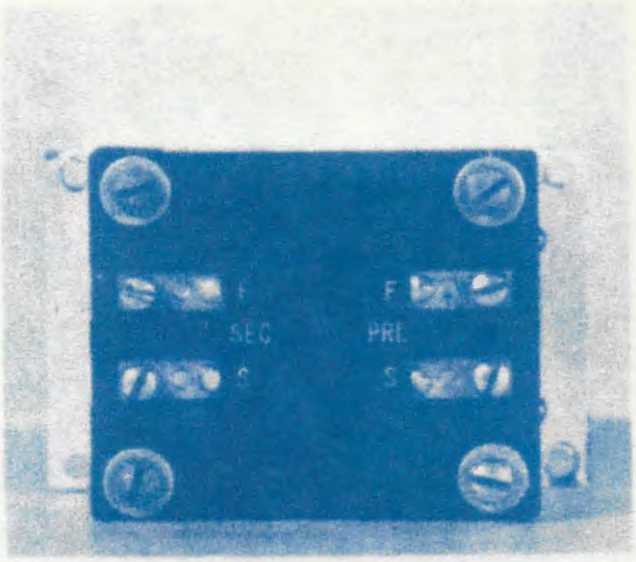


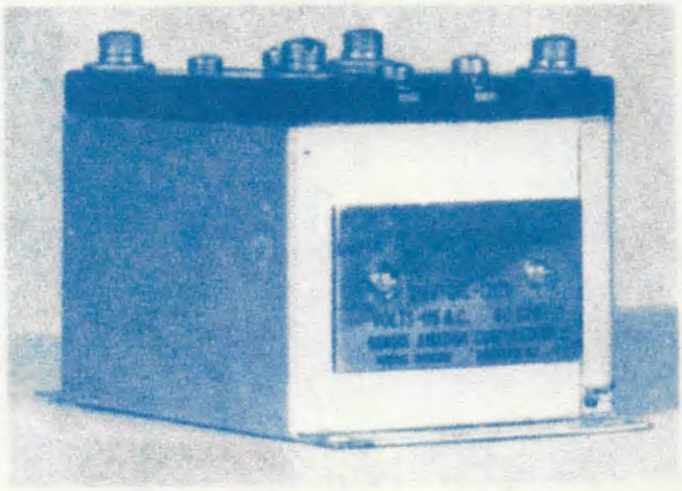
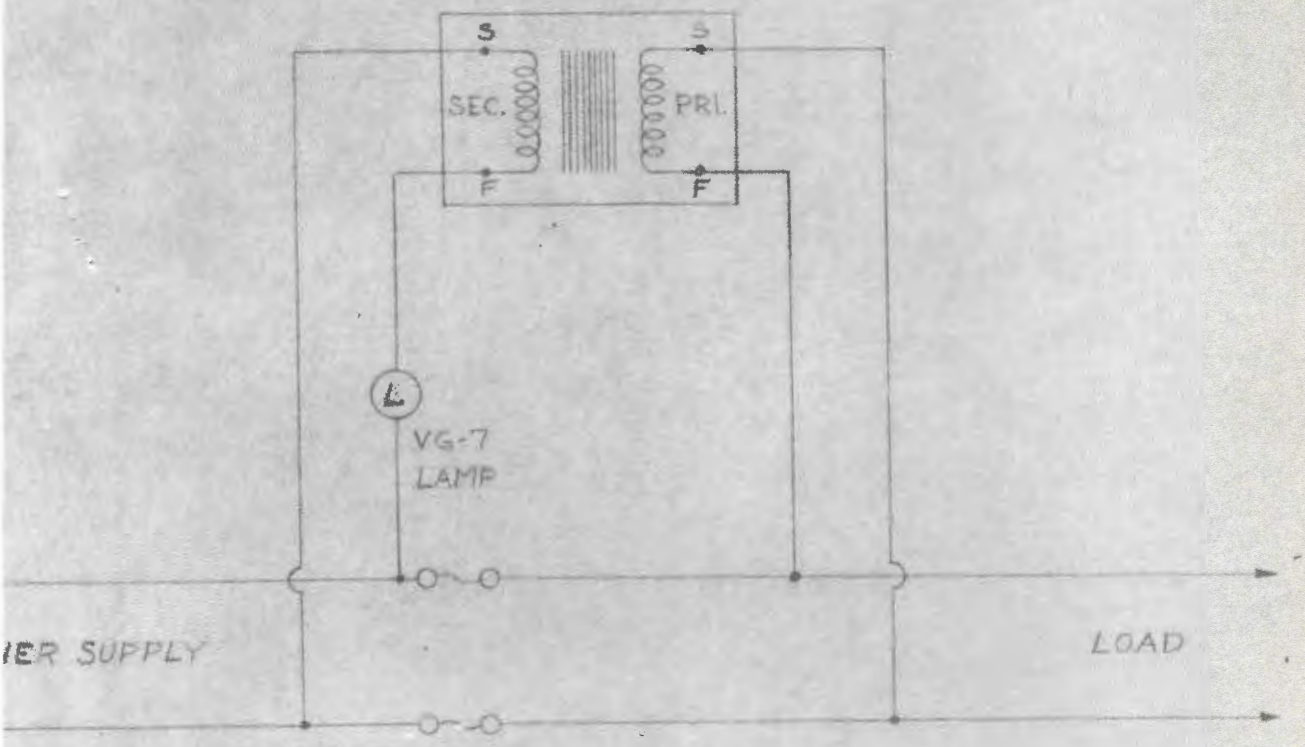
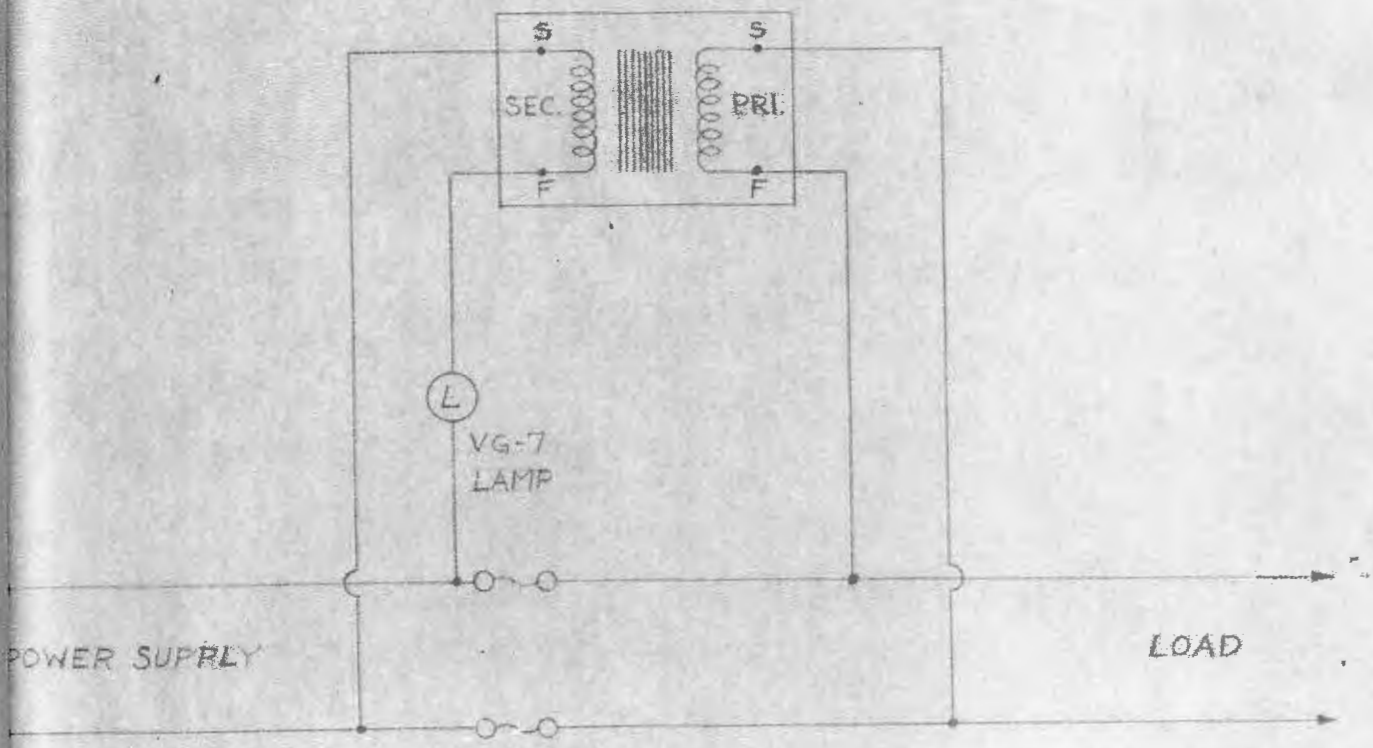


PLATE I



BLOWN FUSE TRANSFORMER
SKETCH OF TEST CIRCUIT

PLATE 2



BLOWN FUSE TRANSFORMER
SKETCH OF TEST CIRCUIT

PLATE 2