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SUBJECT

Report of Test on

Tachometer, "Type C, Class a" submitted by Corbin Screw

Corporation, New Britain, Conn.

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NAVAL RESEARCH LABORATORY
BELLEVUE, D. C.

NAVY DEPARTMENT

Report of Test

on

Tachometer, "Type C, Class a"

Submitted by

Corbin Screw Corporation
New Britain, Connecticut

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

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Authorization: BuShips ltr. S87-4(355) of 24 October 1941

Date of Test: January to March 1942

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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) and (c).

Reference: (a) BuShips ltr. S87-4(354) of 24 October 1941
(b) Manufacturer's drawings S-375-1, S-376,
S-376-U
(c) Specification 18T22

OBJECT OF TEST

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

ABSTRACT OF TEST

3. The sample tachometer was operated at this Laboratory in suitable test devices where its performance was carefully observed for compliance with the specification.. An inspection of the sample to determine compliance in the matter of materials, design, and workmanship, concluded the test.

CONCLUSIONS

(a) This sample tachometer, manufactured by the Corbin Screw Corporation and submitted as a type C, class a, failed to meet the accuracy requirement after 112 hours of the endurance test. At the end of the endurance test the maximum error observed was 7.23% while that allowed is 2%. The curves of Plate 3 show a definite increase in error as the endurance test progressed (total 612 hours) and it is expected they would increase further with additional running time.

(b) The gear box submitted (ratio 1.284:1) with the tachometer and flexible cable failed after 112 hours of the endurance test due to wear of the key which forms an integral part of the driving shaft.

(c) The replacement gear box (ratio 3.33:1) furnished by the manufacturer operated satisfactorily for a complete 500 hour endurance test in conjunction with the tachometer and flexible cable.

(d) An additional tachometer, similar to the sample tested and reported herein but incorporating a revolution counter was submitted but not tested by agreement with the manufacturer's representative inasmuch as counters are not required.

RECOMMENDATIONS

(a) In view of the failure of the tachometer to maintain the specified accuracy throughout the test, it is not recommended for Naval use.

DESCRIPTION OF MATERIAL SUBMITTED FOR TEST

4. This sample was submitted as a type C, class a (Fixed, continuously indicating, wide range) tachometer. It covers the range between 800 and 18,000 r.p.m., having a scale which is substantially linear over the full range. It is designed to be driven by a flexible cable.

5. The dial is graduated in increments of 200 and has numerals at each thousand r.p.m. Three final cyphers are omitted from each of these numerals, but the dial bears the note, "R.P.M. in thousands." The dial is a photographic print (paper) cemented to an aluminum disc and has white markings on a black background. The pointer is also white.

6. The internal mechanism is of the centrifugal type, employing four springs, so mounted that only one is effective at low speeds. As the speed increases, this spring is supplemented, in turn, by each of the remaining springs until, at the highest speeds, all four resist the force produced by the centrifugal unit. Also incorporated in this unit is a helical spring which appears to be effective at the lowest speeds only, and to serve to return the pointer to the minimum speed position for zero speeds.

7. Motion of the centrifugal weights is communicated to the pointer through a gear train actuated by a phenolic spur gear which engages a cylindrical gear rack which rotates but moves longitudinally along the centrifugal work shaft as a measure of speed. A steel worm on the work shaft is presumably provided to permit the incorporation of a revolution counter in the tachometer head.

8. The pointer gear train has two brass spur gears and a friction brake. An adjustable stop pin is built into the gear mounting plates. The pointer is clamped on a tapered, splined, steel shaft and is locked in position with a small hexagon nut.

9. The mechanism is housed in a formed brass case having a threaded flange. A beveled edge plate glass window is mounted in a threaded brass ring. The glass is retained by spinning over a portion of the mounting ring. A decorative internal bezel and a removable mounting flange complete the case. All case parts are nickel-plated and, in addition, all face surfaces are chromium plated.

10. Further details of the design of the tachometer head with right-angle drive, flexible cable, and reduction gear box, are given by manufacturer's drawings, reference (b), and photographs, Plates 1 and 2.

METHOD OF TEST

11. The tests conducted, and the order in which they were made, were as follows:

- (a) Accuracy
- (b) Damping
- (c) Shock
- (d) Vibration
- (e) Magnetizing
- (f) Endurance
- (g) Accuracy

RESULTS OF TEST

12. The results obtained were as follows:

<u>Requirements</u>	<u>Test Values</u>
Accuracy: Para. E-3a(7)	Satisfactory as received
Damping: Para. E-3a(8)	Complied
Shock Test: Para. F-2d(3)a	No damage or increased error observed during tests. The pointer stopped at 3000 r.p.m. instead of zero when the tachometer was secured. However, a slight tap returned pointer to zero.
Vibration Test: Para. F-2d(4)c	Satisfactory. No apparent damage observed.
Magnetizing: Para. F-2d(5)	No apparent change in accuracy
Endurance: Para. F-2d(7)	Complied. No mechanical failure observed during the 612 hour test.
Accuracy after all tests Para. F-2d(8)	*Unsatisfactory. See Table 1 and Plate 3.
Splashproof Test: Para. F-2d(9)	*Unsatisfactory. Case leaked about 3 cc. of water causing the paper dial to blister.
Dials: Para. E-3a(10)c	*Unsatisfactory. Paper dial cemented to aluminum disc.

Requirements

Test Values

Weight: Para. E-3a(11)

4 pounds complete with flexible shaft and fittings.

Dimensions: Para. E-3a(11)

5" x 5" x 3"

* Denotes failure to comply with specification.

CONCLUSIONS

13. This sample tachometer, manufactured by the Corbin Screw Corporation and submitted as a type C, class a, failed to meet the accuracy requirement after 112 hours of the endurance test. At the end of the endurance test the maximum error observed was 7.23% while that allowed is 2%. The curves of Plate 3 show a definite increase in error as the endurance test progressed (total 612 hours) and it is expected they would increase further with additional running time.

14. The gear box submitted (ratio 1.284:1) with the tachometer and flexible cable failed after 112 hours of the endurance test due to wear of the key which forms an integral part of the driving shaft.

15. The replacement gear box (ratio 3.33:1) furnished by the manufacturer operated satisfactorily for a complete 500 hour endurance test in conjunction with the tachometer and flexible cable.

16. An additional tachometer, similar to the sample tested and reported herein but incorporating a revolution counter was submitted but not tested by agreement with the manufacturer's representative inasmuch as counters are not required.

TABLE I

(A) Accuracy Test Results

Driving Speed	Rev. Per Minute Equivalent Indication	Before Endurance			Maximum Error %	After All Tests
		Indicated	R.P.M.	R.P.M.		
		CCW	CW			
500	1926	2200	2150	+1.52	Test on this unit with original gear box. Ratio (1.284:1) secured at 112th hour of endurance test at room temperature (76° F) because of failure.	
1000	3852	4025	4000	+0.96		
1500	5778	5975	5950	+1.09		
2000	7704	7800	7500	+0.53		
2500	9630	9700	9600	+0.39		
3000	11556	11600	11600-11800	+1.36		
3500	13482	13600	13600-13700	+1.21		
4000	15408	15600	15400-15700	+1.62		
4200	16178	16300	16300-16400	+1.23		

(B) New Testing Using Replacement Gear Box - Ratio 3.33:1
(112 hours of endurance preceded this test)

Driving Speed	Rev. Per Minute Equivalent Indication	Before Endurance			After All Tests		
		Indicated	R.P.M.	Maximum	Indicated	R.P.M.	Maximum
		CCW	CW	Error %	CCW	CW	Error %
200	2000	2700	2500	+3.89*	3200	3300	+7.23*
400	4000	4500	4500	+2.78*	5000	5000	+5.56*
600	6000	6400	6400	+2.22*	6800	6900	+5.00*
800	8000	8300	8300	+1.66	8600	8700	+3.89*
1000	10000	10300	10300	+1.66	10700	10600	+3.89*
1200	12000	12300	12300	+1.66	12600	12600	+3.33*
1400	14000	14300	14300	+1.66	14500	14500	+2.78*
1600	16000	16200	16200	+1.11	16400	16500	+2.78*
1800	18000	18200	18200	+1.11	18500	18400	+2.78*

NOTES: *Denotes Error in Excess of Allowable Error $\pm 2\%$
Full Scale Reading.



PLATE I



PLATE 2

ACCURACY CURVES TAKEN FROM TABLE

--- ALLOWABLE ERROR $\pm 2\%$ OF FULL SCALE READING
 --- AS RECEIVED
 --- AFTER 112 HOURS ENDURANCE
 --- AFTER ALL TESTS (612 HOURS)

