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NAVY DEPARTMENT  
BUREAU OF ENGINEERING

Report of Test

on

Motor Operated Time Limit Remote Controlled  
Contact Maker, Type K - Class I

Clark Cooper Company, Manufacturer and Exhibitor

NAVAL RESEARCH LABORATORY  
ANACOSTIA STATION  
WASHINGTON, D.C.

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Authorization: BuEng. ltr. S62-2/L5(5-10-Ds) of 17 May 1938.

Date of Test: May and June 1938.

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APPENDICES

Photograph of contact maker, fully assembled . . .	Plate 1
Photograph of contact maker, case cover removed. .	Plate 2

## AUTHORIZATION FOR TEST

1. This problem was authorized by reference (a), and another reference pertinent to this problem is listed as reference (b).

Reference: (a) Bueng. ltr. S62-2/L5(5-10-Ds) of  
17 May 1938.  
(b) Specifications 17C16 (INT) of 1 April  
1938.

## OBJECT OF TEST

2. The object of this test was to determine how closely the sample contact maker complied with the specifications, reference (b), and its suitability for Naval use as a type K - Class I, time limit remote controlled contactor.

## ABSTRACT OF TEST

3. The subject contact maker, shown by photographs, Plates 1 and 2, was set up at this Laboratory in a circuit simulating service conditions where its performance was carefully checked for compliance with the specifications. The usual inspection of the sample to ascertain conformance with the requirements in the matter of materials, design and workmanship, concluded the test.

## Conclusions

(a) This contact maker, as manufactured by Clark Cooper Company, 159 West Jefferson Street, Philadelphia, Pennsylvania, operated consistently throughout all tests, although it failed to comply with many of the requirements. These deficiencies are noted by an asterisk under "Results of Test."

Recommendations

(a) Due to the many deficiencies, the subject contact maker is not recommended for Naval use in its present form.

(b) Inasmuch as the sample is extremely simple, light in weight and small in size, it is suggested that the Bureau invite the manufacturer to submit a modified sample for test.

## DESCRIPTION OF MATERIAL UNDER TEST

4. The sample contact maker is shown by photographs, Plates 1 and 2. It is manufactured by Clark Coolper Company, 159 West Jefferson Street, Philadelphia, Pennsylvania and was submitted for type approval.

5. The unit consists of one Struthers Dunn 30 ampere, single pole, 115 V. a.c. 60 cycle relay, (manufacturer's rating), one, 1-r.p.m. Holtzer-Cabor synchronous motor, 115 V. a.c., 60 cycles with one mfd. condenser, and two Burgess "micro-switches." All parts are mounted on a steel plate  $3/32$ " x 8.0" x 11.0". Located in each corner of the plate is a  $5/16$ " hole for mounting. Four buttons, located on the back of the plate, provide a  $1/4$ " space between it and the bulk-head. A cast steel bracket, secured at one end of the base plate with machine screws used as through bolts, is tapped for a  $1/2$ " (IPS) terminal tube. The formed steel cover is secured to the base plate with four wing nuts which thread on to steel studs. The case is made splashproof by means of a flat rubber gasket cemented to the base plate. A recess is provided in the terminal tube bracket for the gasket.

6. The operation of the contact maker is as follows:

(a) When the "General Alarm" secondary control circuit is closed from a remote station, the 1 r.p.m. (internal geared) motor becomes energized. Attached to the motor shaft is a 96 tooth gear which is provided with 2 studs located  $180^\circ$  apart on the outboard face of the gear. As the motor starts, a lever, having a follower, oscillates because the gear is used as a cam. Therefore, this lever operates a micro-switch at the rate of 96 contacts per minute. When the gear starts to rotate, a second lever operated micro-switch, connected across the control circuit is closed by the movement of one of the studs. Thus, the motor continues to rotate until the switch is opened by the other stud after a period of approximately 30 seconds. A friction brake is in constant contact with the inboard face of the gear. Closing the control circuit for 2 seconds or more will place the contact maker in operation. The relay follows the coded operating cycle and interrupts the primary circuit.

## METHOD OF TEST

7. The contact maker was first tested for endurance by operating it for 48 hours at coded operation for 30 seconds in each minute. During this time, an inductive load of 30 amperes, 115 V. a.c., 60 cycles, 62% power factor, was being interrupted by the relay. The ambient temperature during

the first 24 hours was 10° C. and that during the second 24 hours was 70° C. During the final hour of the test, the control circuit was continuously closed, causing the contactor to make and break the primary circuit. The temperature rises of the motor and relay windings were obtained during these tests, using the resistance method.

8. Next followed tests for accuracy obtained by timing the "make" and "break" periods when operating the unit at  $\pm 10$  percent in voltage and  $\pm 5$  cycles in frequency.

9. It was next placed on a Bureau of Engineering shock stand and subjected to 20 shocks of 250 foot pounds each, while the contact maker was electrically connected and under normal operation.

10. Upon completion of the shock test, the complete unit was placed on a vibrating machine and given six tests of 30 minutes each, consisting of 3 foot pound shocks at vibrations of 100, 150, 200, 250, 300, and 350 per minute.

11. Then followed tests for insulation resistance, dielectric strength and voltage drop across the primary contacts at 30 amperes per contact.

12. The usual inspection test to determine conformance with the specifications in the matter of design, workmanship, and materials, concluded the test.

#### RESULTS OF TESTS

##### Requirements

##### Test Values

Endurance: Para. F-2c

Operated throughout test without failure, breaking a 30 ampere 115 V. a.c., 60 cycle, 62% P.F. load.

Temperature rise: Relay contacts during last hour of endurance test shall not exceed 30° C.

\*56° C. by thermocouple method at ambient of 70° C.

Temperature rise of windings: Shall not exceed 30° C. at ambient temperature of 70° C. during last hour of endurance test.

Relay winding - 14.1° C.  
Motor windings - 14.7° C.

## Requirements

Temperature rise at contacts following endurance: Shall not exceed 15° C. after being closed for 1 hour, carrying rated load, at 70°C. ambient.

Accuracy test: The coded operating cycle shall be 30 seconds of equal make and break periods. (1/3 second.)

Operation at voltage and frequency variations: Shall meet all requirements at ~~±10%~~ in voltage and ±5 cycles in frequency.

Inclination: Shall operate satisfactorily in all planes 45° to the vertical.

Shock integrity: Shall withstand 20 shocks of 250 foot pounds each while energized and operating.

Vibration test: Paragraph F-2e(3).

Voltage drop across relay contacts: Shall not exceed 10 millivolts at rated load.

Current consumed by relay: Not specified.

Dielectric test: Shall withstand 1500 V. a.c. 60 cycles for a period of one minute.

Insulation resistance: Shall be not less than 10 megohms at 500 volts.

Nameplate: Specification 42N2.

## Test Values

\* 40° C. rise, by thermocouple.

\* Duration of cycle - 30 sec.  
Make period - 0.42 sec.  
Break period - 0.20 sec.  
Note: The contactor operates at the rate of 96 per minute instead of 90 per minute as required.

Satisfactory, except that frequency variations caused a proportional change in timing.

Satisfactory.

Satisfactory, except for micro-switch securing screw becoming loosened.

Satisfactory, there being no apparent change in operation.

\* 25 millivolts, measured at end of endurance test.

0.110 amperes at 115 V. a.c., 60 cycles.

\* A breakdown occurred between condenser lead and ground.

200 megohms by 1000 volt megger.

Nameplate of unidentified material furnished.

Requirements

Test Values

Wiring: Specification 15C1.	* Does not comply.
Splashproofness: Shall be of splashproof construction.	Splashproof construction.
Terminal block: Shall be of phenolic material equipped with 9-S-1841-L terminals. Connections must be identified.	* None furnished.
Case material: Not specified.	Sheet steel finished in crackled black.
Terminal tube provision: Not specified.	One hole tapped for 1/2" (IPS) terminal tube.
Contact area: Current density shall not exceed 75 amperes per sq. in.	* Approximately 289 amperes per sq. in. (3/8" diameter contacts permit current of only 8.28 amperes.)
Additional control circuit: Provisions shall be made for a second control circuit for closing the primary circuit.	Provision made, but not identified by terminal markings.
Total weight: Not specified.	12 pounds, 8 ounces.
Radiation of radio frequency energy: Paragraph E-7k.	* No provision made.

\* Denotes failure to comply with the specifications.