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RESISTORS, FIXED FILM TYPE
GENERAL PURPOSE
QUARTERLY PROGRESS REPORT #14
1 October 1962 through 31 December 1962

CONTRACT NO. DA-36-039-SC-81283
ORDER NO. 7630-PP-59-81-81

405949

Prepared for the U. S. Army Signal Agency
by
RESEARCH AND DEVELOPMENT DIVISION
INTERNATIONAL RESISTANCE COMPANY

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JUN 6 1962
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RESISTORS, FIXED FILM TYPE
GENERAL PURPOSE
QUARTERLY PROGRESS REPORT #14

1 October 1962 through 31 December 1962

Contract No. : DA-36-039-SC-81283
Order No. : 7630-PP-59-81-81
Applicable Specifications: SCS-22A
Report Prepared at: International Resistance Co.
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ABSTRACT

Reliability testing (100°C load life) is continuing with 8000 hours completed to date.

Pilot run testing of the RC-20, 50Ω range has been completed except for Group VII shelf life.

The RC-20 pilot run ranges, 10,000Ω, 500,000Ω and 300Ω have been produced and are ready for testing. The remaining three ranges, 100,000Ω, 1,000Ω and .27 meg Ω, are undergoing screening tests.

The first RC-07 pilot run range (50Ω) is in the initial stages of production.

Four screening tests were incorporated into the process in order to eliminate "sports" and potential failures prior to pilot run testing.

BACKGROUND

The purpose of this contract is to establish a production facility with capacity necessary to manufacture a minimum of 35,000 each of 1/4 watt (RC-07) and 1/2 watt (RC-20) resistors per eight (8) hour shift.

The resistors are to have the performance characteristics as set forth in SCS-22A (dated 15 January 1959) as modified by this contract. In addition to other performance tests, the resistors must pass (1) a moisture resistance (10 cycles) test with a performance goal of $\pm 3.0\%$ and (2) a load-life test at 100°C for 2000 hours with a performance goal not to exceed 6% for individual units while the average of the group is not to exceed 3%.

As defined in the contract, the desired maximum failure rate of these resistors shall not be greater than one in one thousand (1 in 1000). The failure rate shall be ascertained during the reliability evaluation and the Pilot Run.

During the period between September 15, 1958 to July 8, 1959, process development work was continued by IRC in an effort to improve the performance characteristics and reliability of the High Stability Resistor beyond the level which was attained at the conclusion of Contract DA-36-039-SC-73235. This work was performed at IRC expense, and

improvements were made in the following areas:

- (1) overcoat materials development for improved moisture resistance.
- (2) contact paint development for improved performance of unspiralled, intermediate range (300 ohm to 0.25 megohm) resistors.
- (3) establishment of processing conditions (specifically arcspiralling parameters) for improvement of short-time overload performance.

Development work was continued at IRC expense on the high-range (above 10 megohm) resistor process.

One of the objectives of this contract is to provide a "high stability," mass-produced resistor at a cost approximately equal to that of the carbon composition resistor. To accomplish this, it will be necessary to set up a highly mechanized operation with a minimum of hand and/or transfer operations. This has already been accomplished with the IRC type BT resistor and will serve as a guide for the contract work.

Resistor element development is being done in three areas: low, intermediate, and high range.

I. Product and Process Development

No activity during this quarter.

II. Reliability Evaluation

Reliability testing (100° Load Life) is still continuing with (8000 hrs.) already completed. Next month, January 18, 1963 to be exact, (1) year after start of reliability testing, 100° load life will be discontinued as specified by the contract. As of now, only one range, (RC-20, 0.24 meg.) has been discontinued due to an excessive number of failures.

An up-to-date summary of load life data, (average, maximum, minimum, and number of failures) is shown in Table I.

The Final Reliability Report, which is presently being assembled and written, will be ready for submission sometime in late February or early March.

III. Pilot Plant - Phase II

The following is the status of the seven RC-20 ranges that are being processed for test and delivery to the Signal Corps. as part of Phase II, Pilot Plant.

RC-20 Ranges - (50Ω)

All tests, except shelf life, have now been completed and no failures were obtained for any of the tests. The 100° full power and 125° c half power load life tests are still continuing after 2,000 hours, for information purposes, as specified by the contract.

A complete summary of test results, except for shelf life, is shown in Table II. Shelf life results for (2) months show no failures.

(10K^Ω, 0.5 meg, 300^Ω)

These ranges have been processed and screened and are now awaiting the Signal Corps. for selection of samples to be submitted to test.

(100K^Ω, 1K^Ω, 0.27 meg.)

These three ranges are either in the final stages of processing or are undergoing the various screening tests.

RC-07 Ranges

Filament for the first range (50^Ω) has been drawn and cut but as yet has not been assembled. The sub-assembly machine requires final adjustment and "manicuring" before it is ready for a production run. This work is 95% complete and the machine should be in operation by January, 1963.

Pilot Plant - Phase II (Continued)

IV. Screening Tests

Consistant with the high reliability objectives of this contract, a number of screening tests were incorporated into the process in order to eliminate "sports" and potential failures prior to pilot run testing.

These screening tests are as follows:

1. Pull Test - A five pound tensile force is applied axially to the unmolded sub-assembly. The purpose of this test is to eliminate sub-assemblies that are not mechanically sound and to test the mechanical integrity of the CP joint.
2. Noise - All units are checked for electrical noise level. A reject is considered any unit that exhibits an electrical noise level beyond the calculated three sigma limits of the normal distribution of the lot.

3. X-Ray - All resistors are x-rayed prior to testing.

Any unit whose sub-assembly was damaged during molding or whose sub-assembly is not properly centered in the mold jacket is considered a reject.

4. Instability - The resistor leads are clamped in a contact block and resistance is measured with an electronic direct reading percentage deviation * bridge. During this resistance measurement, the body is twisted approximately 90° in each direction. Any units that exhibit electrical instability during twist are considered rejects.

* Similar to General Radio Model #1652A

Below is a table of percent rejects obtained from these various screening tests and is presented as well as the noise distributions shown in Figs. I & II for information purposes only.

<u>Test</u>	<u>50Ω</u>	<u>10KΩ</u>	<u>0.5 megΩ</u>	<u>300Ω</u>
5# pull test	18/3840=0.31%	34/3145=1.08%	28/3389=0.72	55/3300=1.7%
Noise	45/2776=1.62	116/2266=5.11%	360/2935=14.6	66/2500=2.6%
X-Ray	152/2723=5.6	52/2094=1.8%	18/2150=0.83	62/2350=2.7
Instability	0.0%	0.0%	0.0%	0.0%

CONCLUSIONS

8000 hours of reliability testing has been completed and only one range (RC-20, .24 meg Ω) has been discontinued due to an excessive number of failures.

All pilot run tests, except for shelf life, have been successfully completed for the 50 Ω range. All six remaining pilot run ranges have been produced and the 10,000 Ω , .50 meg Ω and 300 Ω ranges will begin Pilot Run testing during the first quarter 1963.

Production of 50 Ω resistors for the RC-07 Pilot Run testing has begun.

Noise, x-ray, pull and instability tests are being used to screen-out "sports" and potential failures prior to Pilot Run testing.

PROGRAM FOR NEXT QUARTER

(January, February, March, 1963)

1. Write and submit the final reliability report.
2. Begin Pilot Run testing of the 10,000 Ω , .50 meg Ω
and 300 Ω RC-20 ranges.
3. Continue with production of the RC-07 ranges for Pilot
Run testing.
4. Submit RC-07 and RC-20 pre-production shelf life report.

PERSONNEL

Time Spent on Contract (October 1 through December 31, 1962

PRODUCT AND PROCESS

S. Soroka	6.5
F. Surowiec	2.0
H. Pugh	64.5
J. Burns	173.0
D. Osborne	175.0
D. Williams	41.5
M. Packer	17.5
W. Ogden	412.5

PERFORMANCE AND RELIABILITY REVIEW

O. Johnson	190.0
J. Saboe	238.5

TEST SECTION

508.1

TOTAL

1829.1

APPENDIX

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TABLE I

TABLE I HIGH STABILITY - RELIABILITY EVALUATION SUMMARY

PAGE 2 OF

TEST 100° Load Life Spec. Limit +6.0%

RUN NO. RANGE	HOURS										TOTAL NO FAILS	
	3500	4000	4500	5000	5500	6000	6500	7000	7500	8000		
RC 07	AV	+ 0.55	+ 0.93	+ 1.83	+ 4.08	+ 0.89	+ 1.48	+ 1.71	+ 1.53	+ 1.85	+ 0.92	
	SP	+ 2.03	+ 2.61	+ 3.73	+ 6.60	+ 2.80	+ 7.84	+ 7.01	+ 6.68	+ 7.01	+ 7.59	
	FAIL	0	0	0	0	0	0	0	0	0	0	
	AV	+ 0.95	+ 1.17	+ 1.27	+ 1.50	+ 1.59	+ 1.84	+ 1.86	+ 2.02	+ 2.12	+ 1.80	
RC 20	AV	+ 1.82	+ 2.06	+ 2.25	+ 2.52	+ 2.61	+ 2.90	+ 2.96	+ 3.17	+ 3.29	+ 3.43	
	SP	+ 0.42	+ 0.57	+ 0.64	+ 0.78	+ 0.86	+ 1.05	+ 1.03	+ 1.17	+ 1.26	+ 1.39	
	FAIL	0	0	0	0	0	0	0	0	0	0	
	AV	+ 4.69	+ 4.36	+ 5.63	+ 5.29	+ 6.49	+ 6.87	+ 7.23	+ 7.79	+ 7.98	+ 8.07	
RC 20	AV	+ 7.23	+ 7.97	+ 7.56	+ 8.15	+ 10.03	+ 10.56	+ 11.10	+ 11.57	+ 11.99	+ 12.45	
	SP	+ 2.10	+ 2.36	+ 2.67	+ 1.57	+ 2.99	+ 3.41	+ 3.59	+ 4.96	+ 3.91	+ 3.86	
	FAIL	5	6	7	9	10	12	14	17	18	19	
	AV	+ 1.64	+ 1.85	+ 2.04	+ 2.25	+ 2.37	+ 2.47	+ 2.61	+ 2.72	+ 2.68	+ 2.93	
RC 20	AV	+ 2.49	+ 2.73	+ 3.04	+ 3.14	+ 3.27	+ 3.37	+ 2.71	+ 3.63	+ 3.75	+ 3.91	
	SP	+ 1.09	+ 1.24	+ 1.42	+ 1.57	+ 1.68	+ 1.75	+ 1.88	+ 1.95	+ 1.99	+ 2.12	
	FAIL	0	0	0	0	0	0	0	0	0	0	
	AV	+ 1.07	+ 1.18	+ 1.66	+ 1.25	+ 1.77	+ 1.55	+ 1.96	+ 1.81	+ 2.02	+ 2.54	
RC 20	AV	+ 2.22	+ 2.66	+ 4.12	+ 4.65	+ 4.70	+ 7.14	+ 5.27	+ 6.79	+ 5.9	+ 6.32	
	SP	+ 0.24	+ 0.21	+ 0.90	- 0.13	+ 0.49	- 0.14	+ 0.14	- 0.14	+ 0.50	+ 0.97	
	FAIL	0	0	0	0	0	0	0	0	0	0	
	AV	+ 1.58	+ 1.75	+ 1.96	+ 2.11	+ 2.30	+ 2.44	+ 2.75	+ 2.85	+ 2.98	+ 3.24	
RC 20	AV	+ 2.76	+ 3.02	+ 3.31	+ 3.48	+ 2.77	+ 3.88	+ 4.16	+ 4.27	+ 4.40	+ 4.68	
	SP	+ 0.78	+ 2.10	+ 1.01	+ 1.11	+ 0.24	+ 1.33	+ 1.19	+ 1.75	+ 2.01	+ 2.34	
	FAIL	0	0	0	0	0	0	0	0	0	0	
	AV	+ 4.96	+ 5.55	+ 6.49	+ 7.51	+ 8.47	+ 9.54					
RC 20	AV	+ 8.27	+ 9.57	+ 9.61	+ 13.11	+ 13.55	+ 17.29					
	SP	+ 0.67	+ 0.89	+ 2.82	+ 1.41	+ 1.72	+ 4.87					
	FAIL	8+1 open	1+1 open	10+1 open	13+1 open	16+1 open	18+1 open					
	AV	+ 2.27	+ 2.49	+ 2.71	+ 2.99	+ 3.14	+ 3.32	+ 3.50	+ 3.58	+ 3.76	+ 3.90	
RC 20	AV	+ 3.45	+ 3.76	+ 4.09	+ 4.46	+ 4.77	+ 5.02	+ 4.90	+ 5.37	+ 5.60	+ 5.78	
	SP	+ 0.55	+ 1.26	+ 0.77	+ 0.91	+ 0.99	+ 1.07	+ 1.19	+ 1.25	+ 1.39	+ 1.52	
	FAIL	1 open	1 open	1 open	1 open	1 open	1 open	1 open	1 open	1 open	1 open	
	AV	+ 8.20pen	+ 2.20pen	+ 0.20pen	+ 13.10pen	+ 17.20pen	+ 19.20pen	+ 6.60pen	+ 20.10pen	+ 19.10pen	+ 21.10pen	

DATE: 10-12-62 TITLE: High-Stability - Pilot Plant TYPE: RC-20

RUN NO: #1 CP-40 SSS -PC-29 Performance Summary Table II RANGE: 500

	Avg.	Max.	Min.	Sigma	95% C.L.	No. Open	Total No. Fails.	% Fails 70% C.L.
Group I - (N=490)								
Visual & Mech. Insp.	-	+3.82	-3.84	-	-	0	0	
D.C. Resistance								
Group II - (N=100)								
Temp. Coeff. (-55°C)	+3.47	3.72	+3.37	0.05	+3.32	3.62	0	
Temp. Coeff. (+105°C)	3.08	2.81	3.25	0.04	2.96	3.20	0	
Voltage Coeff.			NOT APPLICABLE					
Dielectric Strength	0.02	0.02	0.14	0.03	0.11	0.07	0	
Insulation Resistance			AS SPECIFIED				0	
150° No Load (2000 Hrs.)	+1.40	3.25	0.79	0.46	0.06	2.74	0	
Group III - (N=100)								
Low Temp. Storage	0.05	0.16	0.00	0.04	0.00	0.19	0	
Low Temp. Operation	0.02	0.02	0.14	0.03	0.00	0.05	0	
Temperature Cycling	0.11	0.06	0.22	0.06	0.00	0.17	0	
Moisture Resistance								
Wet: Load	+0.18	0.37	0.00	0.13	0.01	0.35	0	
Polar	0.29	0.40	0.14	0.15	0.13	0.14	0	
Dielectric	0.03	0.12	0.10	0.12	0.00	0.15	0	
Dry: Load	0.22	0.37	0.11	0.01	0.20	0.25	0	
Polar	0.29	0.41	0.13	0.01	0.26	0.32	0	
Insulation Resistance			AS SPECIFIED				0	
Short Time Overload	0.02	0.08	0.12	0.03	0.00	0.11	0	

TABLE II

*Note: Refer to Note #3 Page 15 of the Contract.

DATE: 10-12-62

TITLE: High Stability Pilot Plant
Performance Summary

TYPE: RC-20

RUN NO: #1
CP-40SSS
DAP-5201
-PC-29

Table II

RANGE: 500

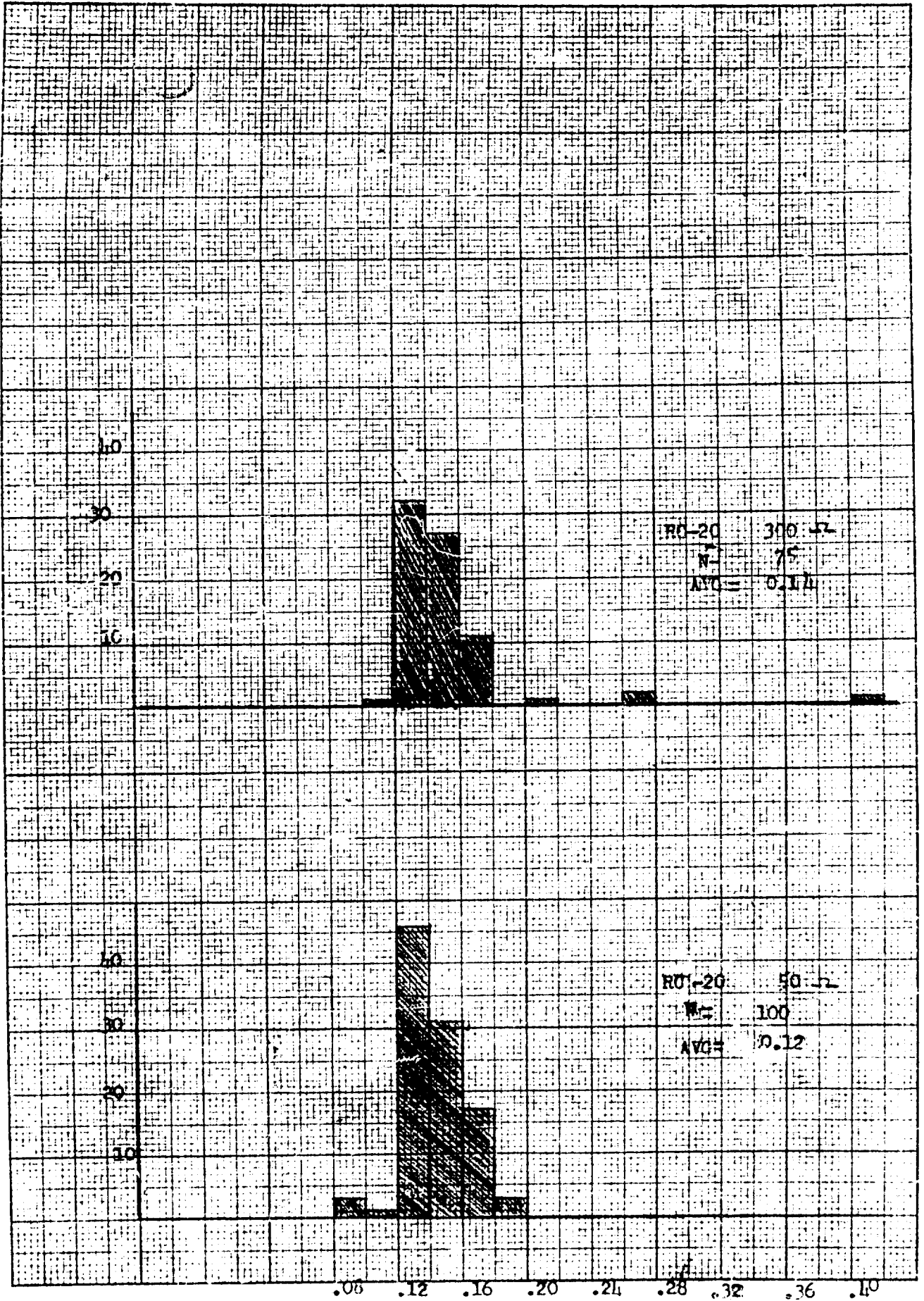
	No. Allow. Fails.	Spec. Limit	Avg.	Max.	Min.	Sigma	95% C.L.	No. Open	Total No. Fails	% Fails 70% C.L.
Group IV - (N=60) 100° Load Life (2000 Hrs.)	3.0% Avg. 6.0% Inds.	1.14	1.81	0.44	0.37	0.08/2.32	0	0	0	
Group V - (N=100) Terminal Strength Effect of Soldering Solder Ability	0.5% 1.0%	0.02 0.07	0.12 0.20	0.12 0.02	0.03 0.04	0.00/0.10 0.00/0.20	0	0	0	
AS SPECIFIED										
Group VI - (N=100) Acceleration Shock Hi-Freq. Vibration	1.5% 1.5% 1.5%	0.01 0.11 0.19	0.12 0.01 0.50	0.16 0.27 0.04	0.03 0.06 0.07	0.09/0.11 0.09/0.31 0.09/0.42	0	0	0	
Group VII - (N=100) Shelf-Life	1.0%									
Group VIII (N=100) 125° Load Life (2000 Hrs.) 50% Load		0.42	0.81	0.20	0.14	0.00/0.90	0	0	0	

*Note: Refer to Note #8, Page 15 of the Contract.

TABLE II

FIG-1 PILOT PLANT * NOISE * MICRO-VOLTS/VOLT

NO. 310 F
20 X 20 TO 1 INCH



J. H. WEIL & CO., PHILA.

FIG II- PILOT PLANT- NOISE - MICRO- VOLTS/VOLT

NO DATA
20 X 20 TO 1 INCH

J. H. WEIL & CO., PHILA.

