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VACUUM COMPATIBILITY OF ENGINEERING MATERIALS (SOLIDS) II

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Huntsville, Alabama

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ABSTRACT

The rate and extent of weight loss of 62 solid materials in a vacuum environment were determined experimentally by continuous and intermittent weighing techniques. Test conditions ranged from 41°C to 200°C at pressures of 10^{-2} to 10^{-5} torr. The results are presented in 2 tables and 130 figures.

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RESEARCH AND DEVELOPMENT OPERATIONS

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SUMMARY

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The rate and extent of weight loss of 62 solid materials in a vacuum environment were determined by continuous and before-and-after weighings. The effects of temperature on weight loss were determined by testing the materials at temperatures ranging from 41°C to 200°C; however, most tests were made at either 50°C or 100°C. The weight loss varied from nil (limit of detections, 0.3 mg) to 23 percent. All continuous weighing tests were limited to 24 hours, and all intermittent tests were limited to 31 days of vacuum exposure. A comparison was made of results for the continuous and intermittent weighing techniques for an exposure of 24 hours; the agreement generally was good. author

INTRODUCTION

Vacuum compatibility is a major factor influencing the selection of materials for space vehicle applications. Many materials lose weight when exposed to a vacuum environment. The rate and extent of this loss depend on a number of factors, including the temperature, pressure, and chemical composition of the material. A knowledge of the rate and extent of material loss in a vacuum environment can be used for preliminary screening, thereby reducing the number of materials to be subjected to altitude simulation tests in hardware configuration.

A program for testing the compatibility of materials in vacuum was initiated by the Engineering Materials Branch in 1959 (presently the Materials Division). The equipment and test procedures used for these investigations and the results obtained for a number of materials have been discussed in previous reports (ref. 1, 2, 3, 4, and 5). This report presents additional results for a number of solid materials. Results for many materials, particularly those exhibiting small weight losses, depend on their physical state, the presence of trace impurities, and/or minor changes in composition. Therefore, results have been included for several materials that were at least superficially similar to materials that had been tested before. In some instances, the new materials were made by different manufacturers.

EXPERIMENTAL

Short-Term Exposure with Continuous Weighing

Four vacuum systems, designated 4A, 4B, 4D, and 4E, were used. All systems were equipped with 4-inch diffusion pumps and differed primarily in the degree of automatic operation. The 4A and 4D systems had manually operated pumping equipment. The 4E system was fitted with manually operated vacuum valves; however, the valve arrangement allowed the continuous operation of the fore and diffusion pumps when the bell jar was vented to the atmosphere. All four vacuum systems were equipped with automatic electrobalances (FIG 1) and ceramic ovens (FIG 2) for elevated-temperature experimentations.

An effort was made to standardize the test specimens to approximately one centimeter square; however, such factors as balance weight limitations, available material configurations, and sample density resulted in the variations in size and shape as noted in the tables. All specimens were desiccated for 24 hours before being weighed and placed in the vacuum chambers.

The balances used were of two types: (1) ordinary analytical balances for before-and-after weighing; (2) Cahn electrobalances for weighing in vacuum. In all of the systems, continuous records of weights were provided by a strip chart recording of the automatic balance outputs. The zero settings and calibration factors of the balances were determined before each test. Thermal effects on the automatic balances were considered to be small since thermocouples at various locations within the bell jar indicated that heating was confined largely to the ceramic ovens.

After a weighed specimen was placed in the vacuum chamber, a pressure below 10^{-4} torr was achieved in less than 10 minutes; then the specimens were heated to the preselected test temperature within 15 to 30 minutes. Ultimate pressure in all cases was less than 10^{-5} torr. Most of the specimens were tested at 50°C and 100°C; the exceptions to those temperatures are noted in the tables.

In most cases, the continuous weight loss determinations for the specimens were terminated after 24 hours. After the specimens cooled to room temperature, they were removed from vacuum and weighed on the analytical balance. A more detailed description of this procedure has been presented in a previous report (ref. 1). Experience has indicated that variations due to weighing errors and other causes normally do not exceed 0.3 mg based on sample weights used in this investigation. The corresponding percentage errors ranged from 3.6 to 0.01; therefore, changes less than these values were not considered significant.

Extended Exposure with Intermittent Weighing

The continuous weighing systems made it necessary for each specimen to be tested alone, so the testing period could not be extended beyond 24 hours without severely restricting the amount of data that could be acquired with the limited number of balances and vacuum systems available. To alleviate this situation, intermittent weighing tests were used to obtain data for vacuum exposures greater than 24 hours.

Groups of specimens of approximately 10 materials were spaced on a support screen and placed in one cubic foot vacuum ovens. Each oven was fitted with a mechanical fore pump and a two-inch oil diffusion pump, thus achieving an ultimate pressure of less than 10^{-3} torr. The test temperature was maintained by a conventional oven temperature control system. No precaution was taken to preclude cross-contamination of the individual specimen by gaseous constituents evolved from other specimens. The specimens were weighed on an analytical balance before being placed in the vacuum oven; then, they were exposed for 24 hours, cooled to room temperature in vacuo, removed to a desiccator, weighed, and returned to the vacuum oven for an additional exposure period. This test sequence was repeated for 5 days and then once a week, for a total test time of 31 days.

At the conclusion of the vacuum exposure period, the samples were allowed to stand in air for 24 hours and weighed, then desiccated for 24 hours and reweighed. Any gain in weight resulting from air exposure was attributed to that portion of the total weight loss associated with moisture or other atmospheric constituents rather than a loss of the material itself.

DISCUSSION OF RESULTS

Weight loss determinations were made on 62 materials that were obtained from commercial manufacturers. Specimens varied in surface area, thickness, and weight as dictated by balance limitations and available sample configurations. Tests were made at one or two temperatures, ranging from 41°C to 198°C; however, most samples were tested at 50°C and 100°C. The results are summarized in Table I for continuous weighing and in Table II for intermittent weighing. Figures 3 through 129 illustrate the rate and extent of weight loss for each material.

It should be noted that each weight loss history is a composite graphic representation of the results from both continuous and intermittent weighing tests for each material. Continuous weighing results, limited to 24 hours, are presented as a function of linear time. The extended exposure results that were obtained by the intermittent weighing

test are presented as a function of log time. The combined log-linear time scale is not intended to be indicative of the mechanism of evaporation but is only a device to more clearly present the results.

The apparent nonlinearity of the percent weight remaining versus time curves that were obtained by the continuous weighing procedure and also the extended exposure tests indicates a complex physical and chemical mechanism for weight loss. As expected, both rate and extent of weight loss increased with an increase in test temperature for most materials tested. However, in some materials, e.g., Dow Corning DC 7170 (FIG 3 and 4), there were no discernible differences in weight loss for the 50°C and the 100°C tests. Other materials, e.g., Geon 2046 (FIG 7 and 8) and PRP 73770 (FIG 54 and 55), showed moderate weight losses at 50°C with large increases in rate and extent of weight losses at 100°C. Such results suggest threshold temperatures corresponding to decomposition and/or evaporation of individual components of the various materials. For many of the continuous weighing tests, a slight but apparent weight loss followed by a regain in weight was registered during the first two to three hours of testing. Further examination of the experimental procedure and resultant data showed that this phenomenon began immediately after the specimen heating furnace had been turned on, which indicated a thermal effect. Experimental verification, using steel weights, indicated that an apparent weight loss of 0.5 mg was registered within the first two hours; then the indicated weight returned to the correct value. These data suggested that the deviation was caused by a temperature gradient within the balance system which resulted from some slight furnace heating; however, as thermal equilibrium was approached, the apparent weight loss diminished, and the proper value was recorded.

Preliminary examination of the results showed a good correlation between the rate and extent of weight loss obtained from continuous weighing and intermittent weighing techniques. In most cases, the latter test produced a relatively smooth extension of the continuous weighing weight loss curve. However, in a few cases, several days were required before the intermittent weighing test curves coincided with the extrapolated continuous weight loss curves, e.g., PRP 8187 (FIG 57.) This suggested an induction period for some materials in the intermittent weighing tests. In the continuous tests, bell jar pressures were reduced to 10^{-5} torr within 10 minutes and to ultimate pressures less than 10^{-5} torr within one hour. The intermittent test ovens exhibited much slower pumping speeds than the bell jar systems. During the first 5 days of testing, each oven was opened once every 24 hours, and the maximum rate of outgassing occurred. Pressures of 10^{-2} torr were attained in 4 to 6 hours, and pressures less than 10^{-3} torr were reached only after a 24-hour pumpdown time. It should be noted that the deviations between continuous and intermittent test results were

generally confined to the first three days of intermittent weighing test time, e.g., PRP 8187 (FIG 57). After this time, good agreement between the two test methods was obtained.

A possible source of error in the intermittent test results arises from the simultaneous testing of numerous samples of different materials in a single oven. However, for the same widely accepted reasons that material evaporating from a given sample is not expected to return to that sample when the pressure is low, material evaporating from any given sample would not be expected to contaminate other samples appreciably.

A previous report (ref. 2) showed that some materials regained weight on standing in air after vacuum exposure. This was considered to be caused by absorption of moisture and/or atmospheric gases. It was suggested that weight regain characteristics would be valuable in discerning between actual material loss and simple outgassing of the sample. To obtain this information, the intermittent weighing test specimens were allowed to stand in air for 24 hours and weighed, then desiccated for 24 hours and reweighed. The reweighings are represented on the weight loss histories by open triangles and closed triangles. Most of the materials that were tested reflected little change in this final treatment; however, some slight weight regains were exhibited, as shown by FM-1000 adhesive (FIG 86 and 87).

The agreement of the results of continuous weighing and intermittent weighing test methods for a 24-hour exposure was quite good, as shown in FIG 130. Inspection of the plotted data indicates that they are compatible with a straight line with intercept equal to zero and slope equal to unity or to conform to the equation,

$$y = x$$

where:

y = weight loss by continuous weighing (percent)
x = weight loss by intermittent weighing (percent)

The root mean square deviation of values computed with this equation, 0.55 percent, is consistent with the expected experimental variations inherent in the test methods.

A previous report (ref. 3) stated that close agreement obtained under these diverse conditions indicates that extreme high vacuum may not be required for preliminary compatibility testing of many materials. The results of this investigation are consistent with the previous work. However, more extensive investigations with particular interest in rates of weight loss at various pressure levels may be necessary before firm conclusions concerning the merits of the two procedures can be drawn.

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TABLE I. - CONTINUOUS WEIGHING TEST

Material	Sample Dimensions cm	Surface Area cm^2	Temperature, °C Programmed	Temperature, °C Actual	Initial Weight, g	Weight Loss Total, g	Weight Loss %	Minimum Pressure, torr	Figure No.	Run Designation
DC 7170	1.520 x 1.520 x 0.155	5.600	50	49	0.5162	0.0001	0.15	10^{-4}	3	463-29
Silicone Dielectric	1.491 x 1.423 x 0.153	5.136	100	98	0.4783	0.0006	0.13	10^{-6}	4	563-79
Dow Corning Corporation										
Marlex 6002	1.520 x 1.520 x 0.036	4.600	50	50	0.0744	0.0001	0.01	10^{-5}	5	563-40
Polyurethane Dielectric	0.539 x 0.613 x 0.035	0.742	50	53	0.0111	0.0001	0.91	10^{-5}	5	164-8
Phillips Chemical Company	1.520 x 1.520 x 0.036	4.600	100	100	0.0721	0.0003	0.42	10^{-4}	6	463-30
Geon 2046	1.465 x 0.627 x 0.150	2.462	50	52	0.1801	0.0043	2.40	10^{-5}	7	963-9
PVC Dielectric	1.490 x 0.930 x 0.127	3.400	50	43	0.2303	0.0028	1.22	10^{-6}	7	563-48
B. F. Goodrich Chemical Company	1.520 x 1.020 x 0.150	3.900	100	99	0.3174	0.0317	9.99	10^{-5}	8	563-37
Geon 8800	0.936 x 0.973 x 0.305	2.985	50	50	0.3684	0.0006	0.16	10^{-6}	9	664-8
PVC Dielectric	1.520 x 1.140 x 0.305	3.900	100	100	0.7095	0.0182	2.57	10^{-5}	10	563-36
B. F. Goodrich Chemical Company	0.920 x 0.352 x 0.292	1.389	100	99	0.1172	0.0013	1.11	10^{-6}	10	763-9
Estane 5740	1.180 x 1.305 x 0.061	3.383	50	50	0.1061	0.0006	0.57	10^{-6}	11	963-21
Polyurethane Dielectric	1.520 x 1.520 x 0.074	5.100	50	73	0.1924	0.0011	0.57	10^{-5}	11	563-47
B. F. Goodrich Chemical Company	1.520 x 1.520 x 0.074	5.100	100	97	0.1921	0.0024	1.25	10^{-5}	12	463-31
Royaline-R	1.400 x 1.400 x 0.100	4.400	50	49	0.2290	0.0007	0.31	10^{-5}	13	563-45
Polyolefin Dielectric	0.054 x 0.461 x 0.610	0.678	50	52	0.0325	0.0001	0.31	10^{-6}	13	164-10
Raytherm Corporation	1.400 x 1.400 x 0.100	4.400	100	99	0.2482	0.0028	1.13	10^{-6}	14	563-34
Kel-F 81	0.989 x 1.000 x 0.309	3.207	50	48	0.6259	0.0000	0.02	10^{-6}	15	664-3
Fluorocarbon Dielectric	1.400 x 1.400 x 0.300	4.600	100	100	1.4147	0.0002	0.01	10^{-5}	16	563-35
Minnesota Mining & Manufacturing Company										
Tedlar	1.623 x 1.540 x 0.064	5.390	50	50	0.0201	0.0000	0.00	10^{-5}	17	563-76
PVF Dielectric	1.048 x 0.989 x 0.006	2.095	50	51	0.0083	0.0000	0.00	10^{-6}	17	664-13
Du Pont	1.270 x 15.240 x 0.005	38.710	100	99	0.1304	0.0001	0.08	10^{-6}	18	463-25
	1.520 x 3.180 x 0.005	9.700	100	100	0.0392	0.0000	0.00	10^{-4}	18	563-33
	1.270 x 15.240 x 0.005	38.710	100	87	0.1159	0.0003	0.26	10^{-4}	18	463-24
Teflon FEP	0.714 x 0.384 x 0.103	0.775	50	47	0.0566	0.0000	0.00	10^{-6}	19	164-11
Fluoroethylene Film	0.890 x 1.080 x 0.380	2.200	100	101	0.1884	0.0000	0.00	10^{-5}	20	563-39
Du Pont										

TABLE I. - CONTINUOUS WEIGHING TEST (Continued)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature, °C Programmed	Temperature, °C Actual	Initial Weight, g	Weight Loss Total, g	Weight Loss %	Minimum Pressure, torr	Figure No.	Run Designation
Duroid 5600 Teflon-glass Dielectric Rogers Corporation	1.000 x 0.989 x 0.314	3.227	50	48	0.6336	0.0007	0.11	10^{-6}	21	664-1
	1.680 x 1.680 x 0.460	8.700	100	101	2.6509	0.0040	0.15	10^{-5}	22	563-38
Acrylic Coat Thermal Control Coating Sherwin-Williams Company	2.413 Dia. (Al disc)	4.580	50	50	1.2876	0.0003	0.02	10^{-4}	23	563-46
	2.401 Dia. (Al disc)	4.140	100	101	0.3120	0.0004	0.14	10^{-6}	24	963-2
Silicone Thermal Coating Thermal Control Coating W. P. Fuller Company	2.410 Dia. (Al disc)	4.580	50	50	1.3515	0.0012	0.09	10^{-5}	25	563-49
RTV-60 Silicone Potting Compound General Electric Company	0.915 x 0.947 x 0.095	2.087	50	47	0.1222	0.0001	0.08	10^{-6}	27	364-24
	0.081 x 0.520 x 0.555	0.749	100	102	0.0487	0.0007	1.44	10^{-6}	28	164-5
	0.570 x 0.760 x 0.356	2.000	100	120	0.2232	0.0026	1.16	10^{-6}	28	563-51
RTV-501 Silicone Potting Compound Dow Corning Corporation	2.794 (Dia.) x 0.310	14.900	50	51	2.2111	0.0192	0.80		29	563-53
RTV-601 Silicone Potting Compound Dow Corning Corporation	2.790 (Dia.) x 0.310	14.820	50	54	2.7146	0.0173	0.70	10^{-4}	30	563-54
		0.807	50	50	0.3019	0.0016	0.53	10^{-6}	30	763-21
		0.807	100	94	0.2564	0.0031	1.21	10^{-6}	31	763-5
		0.807	100	106	0.3105	0.0042	1.38	10^{-6}	31	963-1
		0.807	100	105	0.3229	0.0047	1.49	10^{-6}	31	963-22
	0.826 x 0.508 x 0.318	9.309	100	119	0.1619	0.0019	1.20	10^{-4}	31	563-55
DCR-7521 Silicone Potting Compound Dow Corning Corporation	1.239 (Dia.) x 0.550	4.540	50	53	0.7481	0.0006	0.09		32	563-56
	1.232 (Dia.) x 0.476	4.220	100	114	0.4561	0.0039	0.20	10^{-4}	33	563-57
EC 2273 Potting Compound Minnesota Mining & Manufacturing Company	1.235 x 1.215 x 0.725	6.560	50	52	1.3668	0.0104	0.77	10^{-4}	34	563-58
	1.483 x 0.188 x 0.066	0.779	50	54	0.0957	0.0001	0.20	10^{-5}	34	1263-1
	1.041 x 1.042 x 0.357	3.646	50	49	0.4463	0.0035	0.78	10^{-6}	34	664-7
	0.066 x 0.817 x 0.704	1.354	100	104	0.0467	0.0013	2.79	10^{-5}	35	963-31
	1.045 x 1.055 x 0.354	3.692	100	98	0.4363	0.0105	2.41	10^{-5}	35	664-9

TABLE I. - CONTINUOUS WEIGHING TEST (Continued)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature, °C Programmed	Temperature, °C Actual	Initial Weight, g	Weight Loss Total, g	Weight Loss %	Minimum Pressure, torr	Figure No.	Run Designation
Durock D-133	0.526 x 0.558 x 0.550	1.691	50	57	0.6559	0.0002	0.04	10^{-3}	36	563-61
Silico-ceramic Potting Compound	0.510 x 0.550 x 0.433	1.482	100	114	0.4197	0.0001	0.03		37	563-60
Physical Sciences Corporation										
FM-47	0.944 x 0.957 x 0.036	1.944	50	55	0.0296	0.0002	0.68	10^{-7}	38	364-17
Vinyl-phenolic Adhesive	0.967 x 0.991 x 0.035									
Bloomingdale Division,	* 0.965 x 0.963 x 0.035	6.027	50	51	0.0937	0.0009	0.96	10^{-6}	38	764-9
American Cyanamid Company	0.956 x 0.963 x 0.036									
	1.580 x 0.910 x 0.023	2.984	100	100	0.0306	0.0001	0.36	10^{-5}	39	963-4
Paraplex P-43	1.222 x 0.567 x 0.321	1.500	50	58	0.3289	0.0012	0.37	10^{-4}	40	563-64
Polyester-glass Laminate	0.325 x 1.031 x 1.268	2.759	50	50	0.6346	0.0005	0.13	10^{-6}	40	963-25
Rohm and Haas Company	0.318 x 0.122 x 0.274	1.010	100	105	0.1435	0.0029	2.03		41	563-65
	0.998 x 0.990 x 0.324	3.264	100	99	0.4608	0.0120	2.60	10^{-6}	41	664-11
CTL-91-LD	1.149 x 0.855 x 0.325	3.270	50	54	0.4942	0.0044	0.90	10^{-5}	42	563-67
Phenolic Laminate	1.066 x 0.476 x 0.328	2.027	100	105	0.2753	0.0049	1.78	10^{-5}	43	563-66
Coast Manufacturing Company	1.335 x 0.394 x 0.292	2.061	100	104	0.2003	0.0031	1.55	10^{-6}	43	1063-6
Epon 828	1.322 x 0.653 x 0.314	2.979	50	55	0.4436	0.0007	0.16	10^{-5}	44	563-69
Epoxy Laminate	1.000 x 0.990 x 0.309	3.210	50	48	0.5321	0.0004	0.08	10^{-6}	44	664-2
Shell Chemical Corporation	1.139 x 0.487 x 0.312	2.121	100	101	0.2964	0.0008	0.27	10^{-6}	45	763-10
DC-2104	0.087 x 0.635 x 0.713	1.141	50	50	0.0460	0.0000	0.00	10^{-6}	46	164-9
Silicone Laminate	1.116 x 0.397 x 0.282	1.742	100	100	0.1353	0.0002	0.15	10^{-6}	47	663-3
Dow Corning Corporation										
DC-2106	1.157 x 0.483 x 0.356	2.285	50	41	0.3091	0.0004	0.13	10^{-5}	48	563-71
Silicone Laminate	0.735 x 0.846 x 0.360	2.382	50	47	0.3362	0.0004	0.12	10^{-6}	48	164-6
Dow Corning Corporation	1.133 x 0.392 x 0.357	2.087	100	103	0.2530	0.0008	0.32	10^{-6}	49	563-70
	0.373 x 0.368 x 0.783	1.434	100	105	0.1472	0.0003	0.21	10^{-6}	49	963-30
	0.467 x 1.646 x 1.628	8.410	150	150	1.8891	0.0016	0.08		49	363-6
HRP Honeycomb			50	51	0.1493	0.0016	1.08	10^{-5}	50	563-72
Phenolic Laminate			100	103	0.1402	0.0018	1.29	10^{-5}	51	563-73
Applied Plastics Company, Incorporated										

* Three items used to attain required sample weight.

TABLE I. - CONTINUOUS WEIGHING TEST (Continued)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature, °C Programmed	Temperature, °C Actual	Initial Weight, g	Weight Loss Total, g	Weight Loss %	Minimum Pressure, torr	Figure No.	Run Designation
Viton B A495VA			50	48	0.2213	0.0002	0.10	10^{-5}	52	563-74
Rubber	1.580 (Dia.) x 0.254	5.170	100	100	1.1158	0.0007	0.06	10^{-6}	53	263-1
R-P&VE-MN			200	198	1.1121	0.0127	1.14	10^{-6}	53	363-3
Marshall Space Flight Center	1.580 (Dia.) x 0.254	5.170	150	149	1.0999	0.0018	0.16	10^{-6}	53	263-2
PRP 73770	1.290 x 1.310 x 0.184	4.434	50	47	0.4126	0.0083	2.02	10^{-5}	54	563-77
Acrylo-nitrile Elastomer	0.632 x 1.332 x 0.179	2.389	100	99	0.2005	0.0221	12.82	10^{-6}	55	563-78
Precision Rubber Products Corporation	0.956 x 0.632 x 0.191	1.814	100	101	0.1434	0.0152	10.60	10^{-6}	55	763-17
PRP 8187	1.442 x 1.295 x 0.186	4.755	50	46	0.4483	0.0018	0.41	10^{-5}	56	563-80
Elastomer	1.320 x 0.426 x 0.184	1.768	100	100	0.0937	0.0055	5.87	10^{-5}	57	563-81
Precision Rubber Products Corporation	0.193 x 0.625 x 1.282	2.190	100	101	0.1874	0.0108	5.77	10^{-5}	57	963-3
Urethane DS-620 Urethane Thermal Insulation American Latex Products	1.295 x 1.210 x 0.752	6.902	50	56	0.0488	0.0019	3.89	10^{-8}	58	464-5
Eccofoam Q	1.946 x 1.220 x 0.667	8.980	50	51	0.2886	0.0004	0.14	10^{-5}	60	663-5
Ceramic Thermal Insulation	1.160 x 1.117 x 1.050	7.373	50	50	0.2768	0.0001	0.04	10^{-6}	60	564-4
Emerson & Caming, Incorporated	1.225 x 1.215 x 1.186	8.765	100	99	0.2999	0.0001	0.03	10^{-6}	61	564-5
Refrasil B-100	1.910 x 1.370 x 0.199	6.535	50	51	0.0803	0.0005	0.63	10^{-6}	62	663-9
SiO_2-glass Thermal Insulation H. I. Thompson Company	* 0.967 x 0.952 x 0.277 0.923 x 0.912 x 0.277 0.924 x 0.913 x 0.277	8.310	50	50	0.0773	0.0003	0.81	10^{-6}	62	764-18
	1.628 x 1.349 x 0.286	6.075	100	101	0.0699	0.0006	0.86	10^{-5}	63	663-8
	* 1.055 x 0.985 x 0.278 0.975 x 0.909 x 0.277 0.967 x 0.971 x 0.277	8.986	100	101	0.0823	0.0008	0.97	10^{-6}	63	764-20
CPR-20	2.420 x 1.320 x 0.840	12.680	50	43	0.1875	0.0031	1.66	10^{-5}	64	663-10
Polyurethane Thermal Insulation Chemical Products Company	0.532 x 0.631 x 0.708	2.319	50	48	0.0147	0.0002	1.47	10^{-6}	64	164-13

* Three items used to attain required sample weight.

TABLE I. - CONTINUOUS WEIGHING TEST (Continued)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature, °C Programmed	Temperature, °C Actual	Initial Weight, g	Weight Loss Total, g	Weight Loss %	Minimum Pressure, torr	Figure No.	Run Designation
CPR-1021	2.140 x 1.182 x 1.170	12.830	50	54	0.0996	0.0026	2.62	10^{-5}	66	663-12
Polyurethane Thermal Insulation	2.540 x 2.540 x 2.540	38.712	50	50	0.4342	0.0087	2.20	10^{-6}	66	363-16
Chemical Products Company	2.540 x 2.540 x 2.540	38.712	100	99	0.4343	0.0067	1.54	10^{-6}	67	363-17
Duroid 5813	0.749 x 0.473 x 0.437	1.780	50	50	0.3608	0.0002	0.06	10^{-5}	68	663-7
Teflon-glass	0.505 x 0.437 x 0.397	1.290	100	101	0.2018	0.0001	0.05	10^{-6}	69	663-6
Rogers Corporation										
Epon VIII										
Epoxy Adhesive	* 1.005 x 0.985 x 0.020 1.035 x 0.987 x 0.020 0.996 x 0.979 x 0.020	6.213	50	51	0.0637	0.0003	0.47	10^{-6}	70	764-15
Shell Chemical Corporation										
	* 1.014 x 1.017 x 0.023 1.021 x 1.027 x 0.017 1.008 x 0.988 x 0.020	6.394	100	100	0.0660	0.0013	1.97	10^{-6}	71	764-13
APCO 1252	1.881 x 1.465 x 0.027	5.688	50	52	0.0665	0.0001	0.16	10^{-4}	72	663-16
Polyurethane Adhesive	0.959 x 0.981 x 0.029	1.995	50	54	0.0219	0.0001	0.45	10^{-8}	72	364-23
Hexcel Corporation	** 0.996 x 0.910 x 0.063 0.989 x 0.926 x 0.050	4.077	100	100	0.0675	0.0011	1.63	10^{-6}	73	764-3
Shell 929	1.525 x 1.182 x 0.125	4.266	50	52	0.2960	0.0015	0.53	10^{-4}	74	663-18
Epoxy Adhesive	1.143 x 0.957 x 0.113	2.664	100	105	0.1657	0.0024	1.45	10^{-6}	75	663-21
Shell Chemical Corporation										
Shell 934	1.608 x 1.472 x 0.652	5.143	50	43	0.2495	0.0012	0.48	10^{-4}	76	663-20
Epoxy Adhesive	1.004 x 1.081 x 0.079	5.465	50	50	0.1085	0.0007	0.65	10^{-6}	76	664-5
Shell Chemical Corporation	1.234 x 0.564 x 0.085	1.680	100	78	0.0750	0.0006	0.80		77	663-19
	1.219 x 1.105 x 0.089	3.110	100	100	0.1548	0.0020	1.31	10^{-5}	77	963-7
Narmco "A" 3170-7133	1.571 x 1.331 x 0.070	4.576	50	50	0.1474	0.0019	1.29	10^{-5}	80	663-25
Modified Epoxy Adhesive										
Narmco Industries										

* Three items used to attain required sample weight.
** Two items used to attain required sample weight.

TABLE I. - CONTINUOUS WEIGHING TEST (Continued)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature, °C Programmed	Temperature, °C Actual	Initial Weight, g	Weight Loss Total, g	Weight Loss %	Minimum Pressure, torr	Figure No.	Run Designation
Narmco "C" 7343-7139 Polyurethane Adhesive Narmco Industries	0.964 x 0.955 x 0.054	2.047	50	54	0.0458	0.0004	0.87	10^{-8}	82	364-19
	1.121 x 0.659 x 0.052	1.663	50	57	0.0392	0.0004	1.03	10^{-6}	82	1263-6
Aerobond 430 Epoxy-phenolic Adhesive Adhesive Engineering Company	1.396 x 0.893 x 0.024	0.858	50	57	0.0358	0.0003	0.85	10^{-6}	84	1263-11
	0.988 x 0.978 x 0.025	2.030	50	50	0.0282	0.0001	0.35	10^{-6}	84	664-14
	* 0.986 x 0.957 x 0.028; 0.974 x 0.996 x 0.026; 0.993 x 0.939 x 0.026	5.985	50	50	0.0859	0.0006	0.70	10^{-8}	84	764-10
FM-1000 Epoxy-nylon Adhesive Bloomingdale Division, American Cyanamid Company	0.035 x 0.716 x 0.616	0.975	100	100	0.0135	0.0003	2.23	10^{-6}	87	1163-2
	** 0.995 x 0.969 x 0.027; 0.943 x 0.944 x 0.027	3.837	100	101	0.0537	0.0015	2.79	10^{-5}	87	764-1
AF-6 Nitrile-phenolic Adhesive Minnesota Mining & Manufacturing Company	1.650 x 0.616 x 0.013	2.087	100	100	0.0170	0.0008	4.71	10^{-6}	91	763-1
AF-40 Epoxy-nylon Adhesive Minnesota Mining & Manufacturing Company	1.715 x 1.215 x 0.046	4.438	50	48	0.0491	0.0008	1.63	10^{-6}	92	763-16
	1.621 x 0.452 x 0.025	1.563	100	102	0.0191	0.0002	1.05	10^{-3}	93	763-2
Narmco 4021 Nitrile-phenolic Adhesive Narmco Industries	* 0.978 x 0.958 x 0.031; 0.968 x 0.960 x 0.027; 0.948 x 0.925 x 0.026	5.806	50	49	0.0678	0.0012	1.77	10^{-7}	94	764-6
	1.612 x 0.423 x 0.071	1.648	100	100	0.0308	0.0012	3.90	10^{-6}	95	763-3
Narmco 408 Modified Epoxy Narmco Industries	1.324 x 0.708 x 0.019	1.951	100	100	0.0173	0.0004	2.32	10^{-6}	97	763-4
	1.085 x 0.983 x 0.019	2.210	100	99	0.0185	0.0003	2.62	10^{-8}	97	464-7

* Three items used to attain required sample weight.
** Two items used to attain required sample weight.

TABLE I. - CONTINUOUS WEIGHING TEST (Continued)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature, °C Programmed	Temperature, °C Actual	Initial Weight, g	Weight Loss Total, g	Weight Loss %	Minimum Pressure, torr	Figure No.	Run Designation
Selectron 5003 Polyester Laminate Pittsburgh Plate Glass Company	1.648 x 0.787 x 0.259	3.851	50	50	0.6114	0.0003	0.05	10^{-6}	98	763-23
	1.540 x 0.566 x 0.261	2.732	100	95	0.4194	0.0017	0.41	10^{-6}	99	763-6
Kynar Fluoroethylene Dielectric Pennsalt Chemical Corporation	* 1.019 x 1.006 x 0.017 1.031 x 0.996 x 0.016 0.983 x 0.967 x 0.016	6.201	50	50	0.0800	0.0000	0.00	10^{-8}	100	764-16
	* 0.980 x 0.987 x 0.017 0.993 x 0.989 x 0.017 0.971 x 0.969 x 0.017	5.981	100	100	0.0795	0.0001	0.13	10^{-7}	100	764-17
MB 406 Epoxy-phenolic Adhesive Narmco Industries	1.005 x 0.982 x 0.025	2.073	50	54	0.0215	0.0004	1.86	10^{-8}	104	364-16
MB 4021 Nitrile-phenolic Adhesive Narmco Industries	1.332 x 1.635 x 0.025	5.510	50	50	0.0506	0.0015	2.98	10^{-6}	106	963-23
	0.745 x 0.616 x 0.028	0.992	100	102	0.0112	0.0004	3.58	10^{-6}	107	1063-11
Scotchcast 212 Epoxy Potting Compound Minnesota Mining & Manufacturing Company	0.297 x 0.838 x 1.028	2.830	50	50	0.2979	0.0013	0.47	10^{-6}	108	963-16
	1.068 x 0.304 x 0.299	1.473	100	103	0.1041	0.0024	2.31	10^{-6}	109	963-17
EC-1949 Epoxy Potting Compound Minnesota Mining & Manufacturing Company	1.329 x 0.927 x 0.152	3.364	50	50	0.2267	0.0024	1.06	10^{-6}	110	763-26
	0.828 x 0.793 x 0.117	1.692	100	98	0.0955	0.0030	3.15	10^{-6}	111	763-27
EC-1663 Epoxy Potting Compound Minnesota Mining & Manufacturing Company	0.966 x 0.994 x 0.200	2.704	50	51	0.2828	0.0021	0.74	10^{-6}	112	764-7
	0.858 x 0.508 x 0.181	1.367	100	100	0.1191	0.0011	0.93	10^{-6}	113	963-11
PR-1538 Polyurethane Potting Compound Products Research Company	1.200 x 0.866 x 0.277	3.225	50	50	0.3542	0.0013	0.38	10^{-6}	114	963-19
	0.272 x 0.526 x 0.520	1.116	100	101	0.0876	0.0008	0.97	10^{-6}	115	963-18

* Three items used to attain required sample weight.

TABLE I. - CONTINUOUS WEIGHING TEST (Concluded)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature, °C Programmed	Temperature, °C Actual	Initial Weight, g	Weight Loss Total, g	Weight Loss %	Minimum Pressure, torr	Figure No.	Run Designation
Electrofilm 66-C			50	44	0.0339	0.0000	0.00	10^{-6}	118	763-32
MoS_2 Lubricant			50	49	0.0184	0.0000	0.00	10^{-8}	118	864-4
Electrofilm Corporation			100	100	0.0177	0.0001	0.56	10^{-8}	119	864-3
MLF-5	1.781 (Dia.) x 0.163	2.939	50	50	0.4821	0.0003	0.08	10^{-6}	120	963-14
MoS_2 Lubricant	1.781 (Dia.) x 0.163	1.474	100	100	0.2202	0.0002	0.10	10^{-6}	121	963-15
Midwest Research, Incorporated										
ETR-H			50	54	0.1697	0.0012	0.71	10^{-6}	122	863-2
Silicone Lubricant										
General Electric Company										
Epoxy Coating (on Aluminum)	2.412 Dia. (Al disc)	4.566	50	49	1.3748	0.0005	0.04	10^{-7}	124	764-21
Thermal Control Coating	2.415 Dia. (Al disc)	4.612	100	98	1.3624	0.0020	0.15	10^{-7}	125	764-19
Andrew Brown Company										
Epoxy Coating (off Glass)	0.953 x 0.983 x 0.030	1.990	50	47	0.0779	0.0006	0.77	10^{-6}	126	764-8
Thermal Control Coating	0.021 x 0.662 x 0.984	2.021	100	103	0.0191	0.0010	5.24	10^{-6}	127	1163-3
Andrew Brown Company										
Merlon	0.983 x 1.057 x 0.154	2.772	50	54	0.1871	0.0002	0.11	10^{-8}	128	364-33
Polycarbonate Insulator	0.982 x 1.062 x 0.153	2.711	50	55	0.1870	0.0002	0.11	10^{-8}	128	364-34
Mobay Chemical Company	0.976 x 1.036 x 0.154	2.631	140	137	0.1809	0.0004	0.22	10^{-7}	129	464-1
	0.985 x 0.934 x 0.153	2.450	140	140	0.1613	0.0004	0.25	10^{-7}	129	464-4

TABLE II. - INTERMITTENT WEIGHING TEST

Material	Sample Dimensions cm	Surface Area cm^2	Temperature °C	Initial Weight g	Weight Loss Total, g	Weight Loss %	Figure No.	Run Designation
DC 7170	1.444 x 1.062 x 0.154	3.839	50	0.3292	-0.0005*	-0.03*	3	A
Silicone Dielectric	1.524 x 1.524 x 0.155	5.593	100	0.5006	0.0003	0.06	4	A
Dow Corning Corporation								
Marlex 6002	1.382 x 1.029 x 0.035	3.013	50	0.0460	0.0002	0.48	5	A
Polyurethane Dielectric	1.524 x 1.524 x 0.036	4.867	100	0.0745	0.0004	0.54	6	A
Phillips Chemical Company								
Geon 2046	1.420 x 1.071 x 0.130	3.690	50	0.2607	0.0185	7.12	7	A
PVC Dielectric	1.524 x 1.524 x 0.150	5.562	100	0.3797	0.0883	23.26	8	A
B. F. Goodrich Chemical Company								
Geon 8800	1.532 x 1.169 x 0.306	5.235	50	0.7186	0.0000	0.00	9	A
PVC Dielectric	1.524 x 1.143 x 0.300	5.084	100	0.7046	0.0125	1.77	10	A
B. F. Goodrich Chemical Company								
Estane 5740	1.080 x 1.308 x 0.051	3.069	50	0.0845	0.0005	0.63	11	A
Polyurethane Dielectric	1.524 x 1.524 x 0.074	5.099	100	0.1879	0.0025	1.33	12	A
B. F. Goodrich Chemical Company								
Royaline-R	1.372 x 1.052 x 0.106	3.401	50	0.1735	0.0004	0.25	13	A
Polyolefin Dielectric	1.400 x 1.400 x 0.104	4.502	100	0.2343	0.0028	1.19	14	A
Raytherm Corporation								
Kel-F 81	1.370 x 1.170 x 0.309	4.776	50	0.9989	0.0002	0.04	15	A
Fluorocarbon Dielectric	1.400 x 1.400 x 0.310	5.656	100	1.3480	0.0002	0.02	16	A
Minnesota Mining & Manufacturing Company								
Teflon FEP	1.375 x 1.052 x 0.098	3.369	50	0.2932	0.0001	0.06	19	A
Fluoroethylene Film	1.524 x 1.524 x 0.099	5.252	100	0.4506	0.0000	0.00	20	A
Du Pont			100	0.4738	0.0006	0.15	20	B
Duroid 5600	1.440 x 1.085 x 0.785	7.089	50	2.5340	0.0017	0.08	21	A
Teflon-glass Dielectric	1.651 x 1.651 x 0.462	6.978	100	2.5597	0.0028	0.11	22	A
Rogers Corporation			100	1.9800	0.0026	0.14	22	B

* Weight Gain.

TABLE II. - INTERMITTENT WEIGHING TEST (Continued)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature °C	Initial Weight g	Weight Loss, Total, g	Weight Loss, %	Figure No.	Run Designation
Acrylic Coat Thermal Control Coating Sherwin-Williams Company	2.405 Dia. (Al disc)	4.555	50	1.2846	0.0004	0.04	23	A
	2.413 Dia. (Al disc)	4.572	100	1.2854	0.0013	0.10	24	A
Silicone Thermal Coating Thermal Control Coating W. P. Fuller Company	2.413 Dia. (Al disc)	4.572	50	1.3552	0.0001	0.03	25	A
	2.413 Dia. (Al disc)	4.572	100	1.3757	0.0038	0.28	26	A
RTV-60 Silicone Potting Compound General Electric Company	1.214 x 0.991 x 0.086	2.785	50	0.1552	0.0011	0.72	27	A
			100	0.4500	0.0043	0.96	28	A
RTV-501 Silicone Potting Compound Dow Corning Corporation	1.036 x 0.994 x 0.314	3.335	50	0.3860	0.0040	1.07	29	A
	[1.250 (Dia.) x 0.317] ÷ 4	4.640	50	0.6056	0.0084	1.40	29	B
RTV-601 Silicone Potting Compound Dow Corning Corporation	1.125 x 0.912 x 0.309	3.311	50	0.3905	0.0018	0.50	30	A
			50	0.3857	0.0023	0.63	30	B
	2.794 (Dia.) x 0.325	15.109	100	2.6860	0.0329	1.22	31	A
			100	0.9790	0.0123	1.27	31	B
	2.858 (Dia.) x 0.305	15.571	100	2.6289	0.0347	1.33	31	C
			100	0.3145	0.0040	1.30	31	D
DCR-7521 Silicone Potting Compound Dow Corning Corporation	1.240 (Dia.) x 0.572	4.641	100	0.7662	0.0102	1.33	33	A
EC 2273 Potting Compound Minnesota Mining & Manufacturing Company	3.548 x 2.042 x 0.051	15.060	50	0.0829	0.0010	1.22	34	A
Durock D-133 Silico-ceramic Potting Compound Physical Sciences Corporation	1.396 (Dia.) x 0.560	5.512	50	3.8907	0.0001	0.02	36	A
	1.397 (Dia.) x 0.762	6.407	100	5.1846	0.0000	0.00	37	B

TABLE II. - INTERMITTENT WEIGHING TEST (Continued)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature °C	Initial Weight g	Weight Loss, Total, g	%	Figure No.	Run Designation
FM-47	1.232 x 1.275 x 0.025	3.267	50	0.0379	0.0006	1.61	38	A
Vinyl-phenolic Adhesive	3.117 x 1.788 x 0.079	11.921	50	0.0240	0.0003	1.26	38	B
Bloomingdale Division,	1.410 x 1.346 x 0.020	3.906	100	0.0434	0.0007	1.62	39	B
American Cyanamid Company	2.403 x 1.623 x 0.079	8.436	100	0.0175	0.0003	1.72	39	C
Paraplex P-43	1.377 x 1.220 x 0.321	3.527	50	0.8138	0.0026	0.39	40	A
Polyester-glass Laminate								
Rohm and Haas Company								
CTL-91-LD	1.349 x 1.205 x 0.332	4.947	50	0.8996	0.0125	1.45	42	A
Phenolic Laminate	1.270 x 1.905 x 0.330	6.935	100	1.2548	0.0232	1.85	43	A
Coast Manufacturing Company								
Epon 828	1.376 x 1.129 x 0.315	4.685	50	0.8457	0.0016	0.23	44	A
Epoxy Laminate	2.540 x 1.118 x 0.318	8.005	100	1.5504	0.0043	0.28	45	A
Shell Chemical Corporation								
DC-2104	1.288 x 1.295 x 0.102	3.863	50	0.1754	0.0004	0.24	46	A
Silicone Laminate	2.540 x 1.270 x 0.254	8.387	100	1.0600	0.0017	0.14	47	A
Dow Corning Corporation			100	1.3767	0.0034	0.25	47	B
DC-2106	1.407 x 1.155 x 0.360	5.095	50	0.9246	0.0017	0.24	48	A
Silicone Laminate	1.270 x 1.905 x 0.292	8.331	100	1.3300	0.0036	0.27	49	A
Dow Corning Corporation								
HRP Honeycomb	1.508 x 1.190 x 0.353	5.494	50	0.0939	0.0008	0.95	50	A
Phenolic Laminate			50	0.3124	0.0033	1.06	50	B
Applied Plastics Company,			100	0.7047	0.0066	0.94	51	A
Incorporated			100	0.2849	0.0032	1.06	51	B
Viton B A495VA	1.270 (Dia.) x 0.339	3.855	50	0.2358	0.0003	0.15	52	A
Rubber	3.302 (Dia.) x 0.267	27.488	100	1.7843	0.0022	0.12	53	A
R-P&VE-MN			100	1.7525	0.0029	0.17	53	B
Marshall Space Flight Center	1.151 (Dia.) x 0.343	3.324	100	0.2070	0.0003	0.17	53	C

TABLE II. - INTERMITTENT WEIGHING TEST (Continued)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature °C	Initial Weight g	Weight Loss Total, g	Weight Loss %	Figure No.	Run Designation
PRP 73770	1.180 x 1.017 x 0.190	3.235	50	0.2888	0.0256	8.89	54	A
Acrylo-nitrile Elastomer	1.270 x 1.334 x 0.191	4.383	100	0.4215	0.0490	11.63	55	A
Precision Rubber Products Corporation								
PRP 8187	1.154 x 1.171 x 0.193	3.600	50	0.2841	0.0086	3.06	56	A
Elastomer	1.397 x 1.334 x 0.191	4.770	100	0.4455	0.0270	6.06	57	A
Precision Rubber Products Corporation								
Urethane DS-620	1.135 x 1.280 x 1.232	8.857	50	0.0631	0.0030	4.91	58	A
Urethane Thermal Insulation			100	0.1076	0.0047	4.37	59	A
American Latex Products	1.207 x 1.069 x 0.691	5.726	100	0.0361	0.0018	4.99	59	B
Eccofoam Q	1.257 x 1.280 x 0.912	7.845	50	0.2691	0.0006	0.23	60	A
Ceramic Thermal Insulation			100	0.7256	0.0016	0.22	61	A
Emerson & Cuming, Incorporated								
Refrasil B-100	1.301 x 0.985 x 0.237	3.647	50	0.0386	0.0001	0.29	62	A
SiO_2-glass Thermal	2.667 x 3.592 x 0.729	28.286	50	0.0345	0.0001	0.30	62	B
Insulation			100	0.1923	0.0002	0.10	63	A
H. I. Thompson Company	1.567 x 3.818 x 1.074	23.533	100	0.0269	0.0003	0.30	63	B
CPR-20	1.347 x 0.889 x 0.802	5.981	50	0.0538	0.0011	2.09	64	A
Polyurethane Thermal Insulation			100	0.8866	0.0193	2.18	65	A
Chemical Products Company	1.285 x 1.214 x 0.655	6.394	100	0.0535	0.0016	3.00	65	B
CPR-1021	4.440 x 2.578 x 1.588	45.182	50	0.0333	0.0014	4.21	66	B
Polyurethane Thermal			100	1.0892	0.0365	3.35	67	A
Insulation	2.390 x 4.178 x 1.613	41.159	100	0.0351	0.0017	4.21	67	B
Chemical Products Company								
Duroid 5813	1.220 x 1.046 x 0.437	4.532	50	1.3016	0.0006	0.06	68	A
Teflon-glass	1.267 x 1.207 x 0.445	5.261	100	1.5462	0.0005	0.04	69	A
Rogers Corporation								

TABLE II. - INTERMITTENT WEIGHING TEST (Continued)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature °C	Initial Weight g	Weight Loss Total, g	Weight Loss %	Figure No.	Run Designation
Epon VIII Epoxy Adhesive Shell Chemical Corporation	1.521 x 1.006 x 0.028	3.202	50	0.0390	0.0005	1.29	70	A
			100	0.1270	0.0014	1.10	71	A
APCO 1252 Polyurethane Adhesive Hexcel Corporation	1.514 x 1.529 x 0.038	4.861	50	0.0560	0.0000	0.00	72	A
	1.300 x 1.341 x 0.041	3.704	100	0.0497	0.0002	0.41	73	A
			100	0.0869	0.0018	2.08	73	B
Shell 929 Epoxy Adhesive Shell Chemical Corporation	1.529 x 1.468 x 0.127	5.250	50	0.3770	0.0058	1.54	74	A
			100	0.3447	0.0032	0.94	75	A
	1.339 x 1.356 x 0.132	4.342	100	0.3164	0.0067	2.12	75	B
Shell 934 Epoxy Adhesive Shell Chemical Corporation	1.468 x 1.476 x 0.089	4.840	50	0.2510	0.0027	1.08	76	A
			100	0.1844	0.0013	0.70	77	A
	1.359 x 1.313 x 0.081	4.002	100	0.1825	0.0024	1.33	77	B
HT-424 Epoxy-phenolic Adhesive Bloomingdale Division, American Cyanamid Company	1.420 x 1.422 x 0.028	4.197	50	0.0652	0.0003	0.47	78	A
			100	0.1623	0.0013	0.81	79	A
	1.402 x 1.720 x 0.028	4.998	100	0.0787	0.0004	0.56	79	B
Narmco "A" 3170-7133 Modified Epoxy Adhesive Narmco Industries	1.433 x 1.461 x 0.069	4.586	50	0.1168	0.0021	1.80	80	A
	1.328 x 1.337 x 1.211	10.006	100	2.1704	0.0147	2.32	81	A
	1.253 x 1.291 x 0.634	6.461	100	0.9863	0.0100	0.69	81	B
	1.262 x 1.327 x 0.237	4.576	100	0.4123	0.0075	1.11	81	C
			100	0.2722	0.0063	1.84	81	D
	1.276 x 1.321 x 0.156	4.181	100	0.2653	0.0063	2.39	81	E
Narmco "C" 7343-7139 Polyurethane Adhesive Narmco Industries	1.466 x 1.422 x 0.056	4.492	50	0.1182	0.0008	0.68	82	A
			100	0.2085	0.0025	1.21	83	A
	1.268 x 1.326 x 0.038	3.560	100	2.3757	0.0260	1.11	83	B
	1.381 x 1.405 x 1.166	10.378	100	0.0677	0.0011	1.64	83	C
	1.290 x 1.308 x 0.670	6.856	100	1.2086	0.0131	1.09	83	D
	1.243 x 1.321 x 0.674	6.740	100	0.1811	0.0021	1.18	83	E
	1.692 x 1.445 x 0.053	5.223	100	0.1218	0.0018	1.48	83	F

TABLE II. - INTERMITTENT WEIGHING TEST (Continued)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature °C	Initial Weight g	Weight Loss Total, g	Weight Loss %	Figure No.	Run Designation
Aerobond 430	1.476 x 1.430 x 0.023	4.355	50	0.0604	0.0004	0.67	84	A
Epoxy-phenolic Adhesive	1.430 x 1.720 x 0.030	5.108	100	0.0706	0.0003	0.46	85	A
Adhesive Engineering Company	1.775 x 1.374 x 0.028	5.054	100	0.0774	0.0006	0.86	85	B
			100	0.2135	0.0020	0.94	85	C
FM-1000	1.473 x 1.493 x 0.025	4.546	50	0.0657	0.0015	2.29	86	A
Epoxy-nylon Adhesive	1.361 x 1.220 x 0.027	3.460	50	0.0504	0.0011	2.19	86	B
Bloomingdale Division,	2.070 x 3.825 x 0.066	16.614	50	0.0377	0.0006	1.60	86	C
American Cyanamid Company	1.727 x 1.334 x 0.038	4.841	100	0.0678	0.0011	1.69	87	A
	2.388 x 3.607 x 0.066	18.018	100	0.0397	0.0008	2.02	87	C
Narmco 302A	1.483 x 1.443 x 0.018	5.322	50	0.0455	0.0002	0.44	88	A
Epoxy-phenolic Adhesive	2.699 x 2.159 x 0.206	13.655	100	0.1389	0.0012	0.87	89	A
Narmco Industries								
AF-6	1.504 x 1.410 x 0.015	4.328	50	0.0355	0.0010	2.92	90	A
Nitrile-phenolic Adhesive	3.635 x 2.159 x 0.015	15.870	100	0.1375	0.0070	5.10	91	A
Minnesota Mining & Manufacturing Company								
AF-40	1.483 x 1.476 x 0.030	4.585	50	0.0535	0.0012	2.63	92	A
Epoxy-nylon Adhesive	1.412 x 1.311 x 0.033	3.892	100	0.0458	0.0016	3.52	93	A
Minnesota Mining &	3.571 x 2.699 x 0.034	19.602	100	0.2259	0.0090	3.99	93	B
Manufacturing Company								
Narmco 4021	1.445 x 1.496 x 0.030	4.529	50	0.0608	0.0013	2.19	94	A
Nitrile-phenolic Adhesive	2.380 x 3.016 x 0.030	14.980	100	0.2211	0.0093	4.21	95	A
Narmco Industries	1.397 x 1.750 x 0.023	5.035	100	0.0581	0.0020	3.46	95	B
	1.410 x 1.717 x 0.028	5.016	100	0.0595	0.0024	4.08	95	C
Narmco 408	1.445 x 1.453 x 0.018	4.303	50	0.0419	0.0007	1.70	96	A
Modified Epoxy	2.707 x 2.065 x 0.170	12.801	100	0.1749	0.0038	2.18	97	A
Narmco Industries								

TABLE II. - INTERMITTENT WEIGHING TEST (Continued)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature °C	Initial Weight g	Weight Loss, Total, g	Weight Loss, %	Figure No.	Run Designation
Selectron 5003 Polyester Laminate Pittsburgh Plate Glass Company	1.306 x 1.778 x 0.257	6.229	50	1.0608	0.0023	0.23	98	A
	3.016 x 2.062 x 0.247	14.947	100	2.4658	0.0121	0.50	99	A
Kynar Fluoroethylene Dielectric Pennsalt Chemicals Corporation	1.471 x 1.461 x 0.015	4.386	50	0.0588	0.0001	0.21	100	A
	4.128 x 2.380 x 0.014	19.831	100	0.1720	0.0002	0.12	101	A
MB 302A Epoxy-phenolic Adhesive Narmco Industries	1.349 x 1.854 x 0.025	5.162	50	0.0594	0.0003	0.99	102	A
	1.859 x 1.326 x 0.025	5.089	100	0.0595	0.0004	0.68	103	A
MB 406 Epoxy-phenolic Adhesive Narmco Industries	1.872 x 1.641 x 0.025	6.320	50	0.0700	0.0012	1.72	104	A
	1.681 x 1.572 x 0.025	5.448	100	0.0564	0.0013	2.31	105	A
MB 4021 Nitrile-phenolic Adhesive Narmco Industries	1.791 x 1.651 x 0.023	6.072	50	0.0726	0.0021	2.90	106	A
	1.676 x 1.862 x 0.030	6.453	100	0.0760	0.0028	3.70	107	A
Scotchcast 212 Epoxy Potting Compound Minnesota Mining & Manufacturing Company	1.298 x 1.359 x 0.284	5.037	50	0.5873	0.0034	0.63	108	A
	1.364 x 1.488 x 0.290	5.713	100	0.6724	0.0117	1.75	109	A
EC 1949 Epoxy Potting Compound Minnesota Mining & Manufacturing Company	1.422 x 1.384 x 0.117	4.593	50	0.3041	0.0073	2.42	110	A
	1.367 x 1.740 x 0.157	5.733	100	0.4373	0.0151	3.49	111	A
EC 1663 Epoxy Potting Compound Minnesota Mining & Manufacturing Company	1.290 x 1.247 x 0.178	4.120	50	0.4257	0.0031	0.74	112	A
	1.488 x 1.311 x 0.175	4.882	100	0.4801	0.0049	1.03	113	A

TABLE II. - INTERMITTENT WEIGHING TEST (Concluded)

Material	Sample Dimensions cm	Surface Area cm^2	Temperature °C	Initial Weight g	Weight Loss Total, g	Weight Loss %	Figure No.	Run Designation
PR-1538	1.369 x 1.234 x 0.282	4.847	50	0.5655	0.0036	0.66	114	A
Polyurethane Potting Compound	1.245 x 1.506 x 0.284	5.313	100	0.6178	0.0054	0.88	115	A
Products Research Company								
Molykote X-15			50	0.0322	0.0004	1.25	116	A
MoS_2 Lubricant			100	0.0363	0.0002	0.88	117	A
Alpha Molykote Corporation								
Electrofilm 66-C			50	0.0304	0.0003	0.99	118	A
MoS_2 Lubricant			100	0.0225	0.0002	0.89	119	A
Electrofilm Corporation								
MLF-5	1.760 (Dia.) x 0.163	5.761	50	1.0749	0.0001	0.02	120	A
MoS_2 Lubricant	1.758 (Dia.) x 0.163	5.754	100	1.0630	0.0002	0.02	121	A
Midwest Research, Incorporated								
ETR-H			50	0.0540	0.0030	5.56	122	A
Silicone Lubricant			100	0.0236	0.0019	8.06	123	A
General Electric Company								
Epoxy Coating (on Al)	2.421 (Dia.)	4.615	50	1.3755	0.0009	0.07	124	A
Thermal Control Coating	2.405 (Dial)	4.555	100	1.3641	0.0022	0.17	125	A
Andrew Brown Company								
Epoxy Coating (off Glass)	0.983 x 0.792 x 0.028	1.656	50	0.0314	0.0004	1.30	126	A
Thermal Control Coating	1.293 x 1.140 x 0.036	3.123	100	0.0646	0.0031	4.81	127	A
Andrew Brown Company								

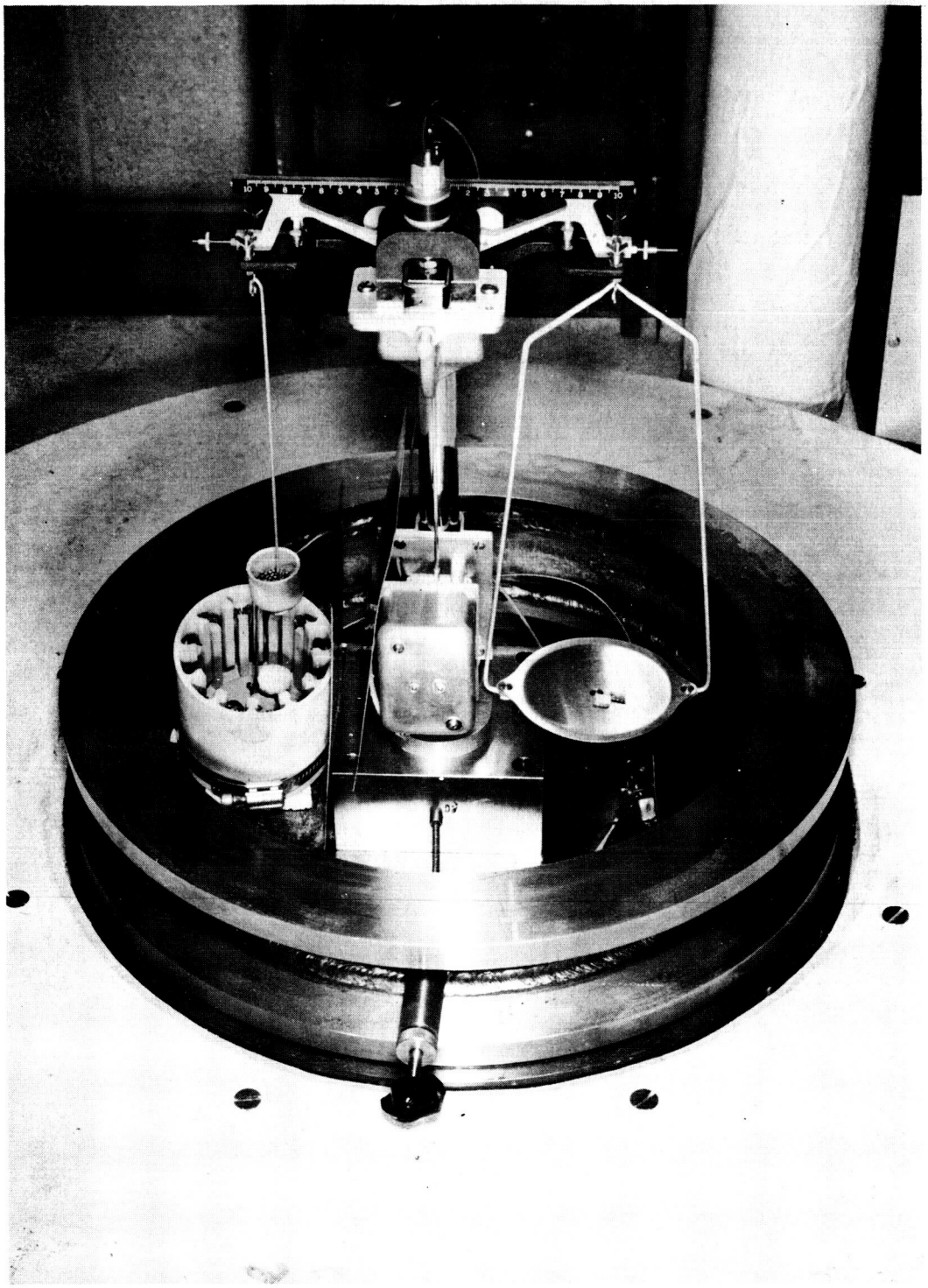

FIGURE 1. - CONTINUOUS RECORDING AUTOMATIC ELECTROBALANCE

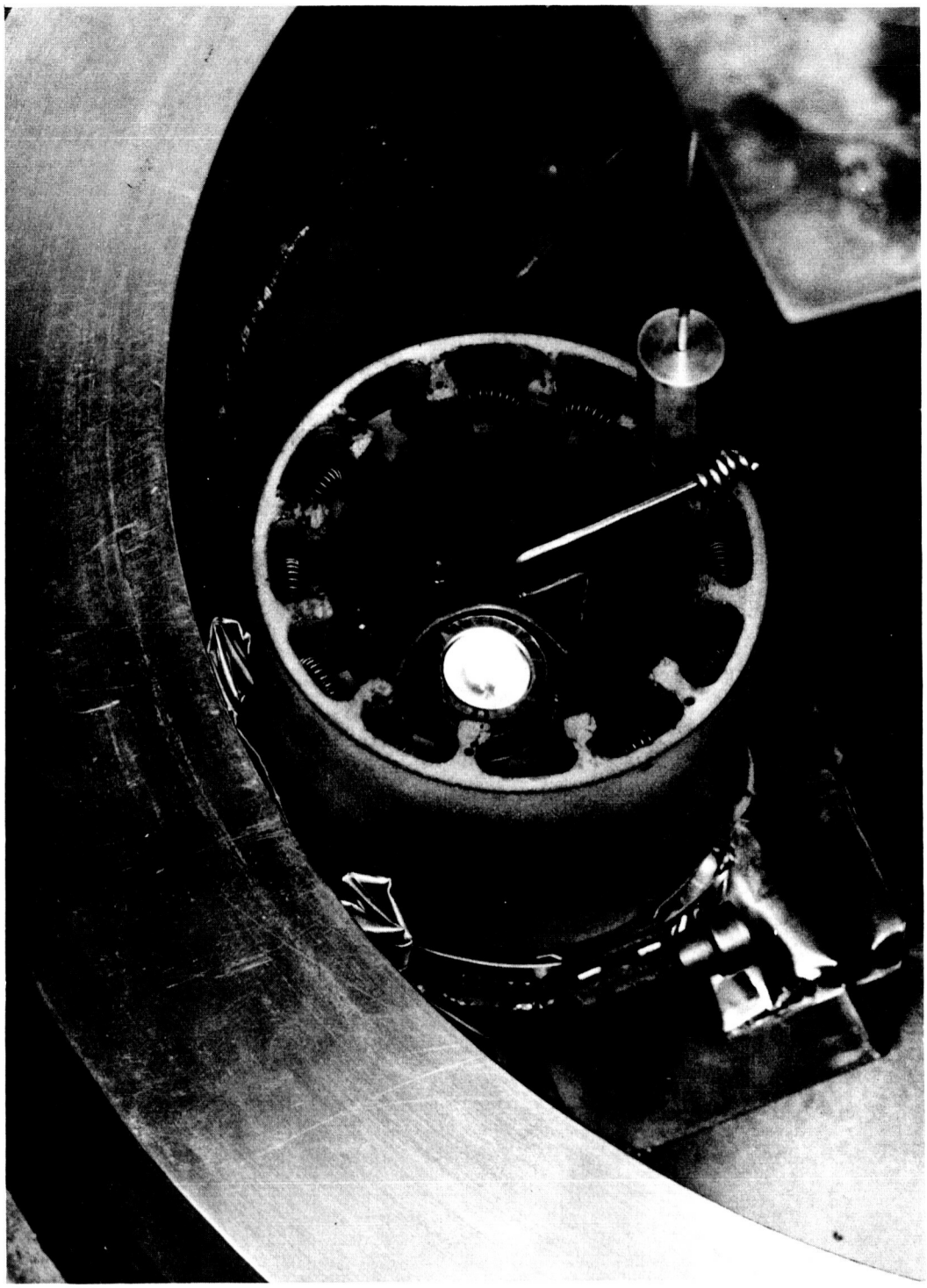

FIGURE 2. - CERAMIC OVEN FOR HEATING TEST SPECIMENS IN VACUUM

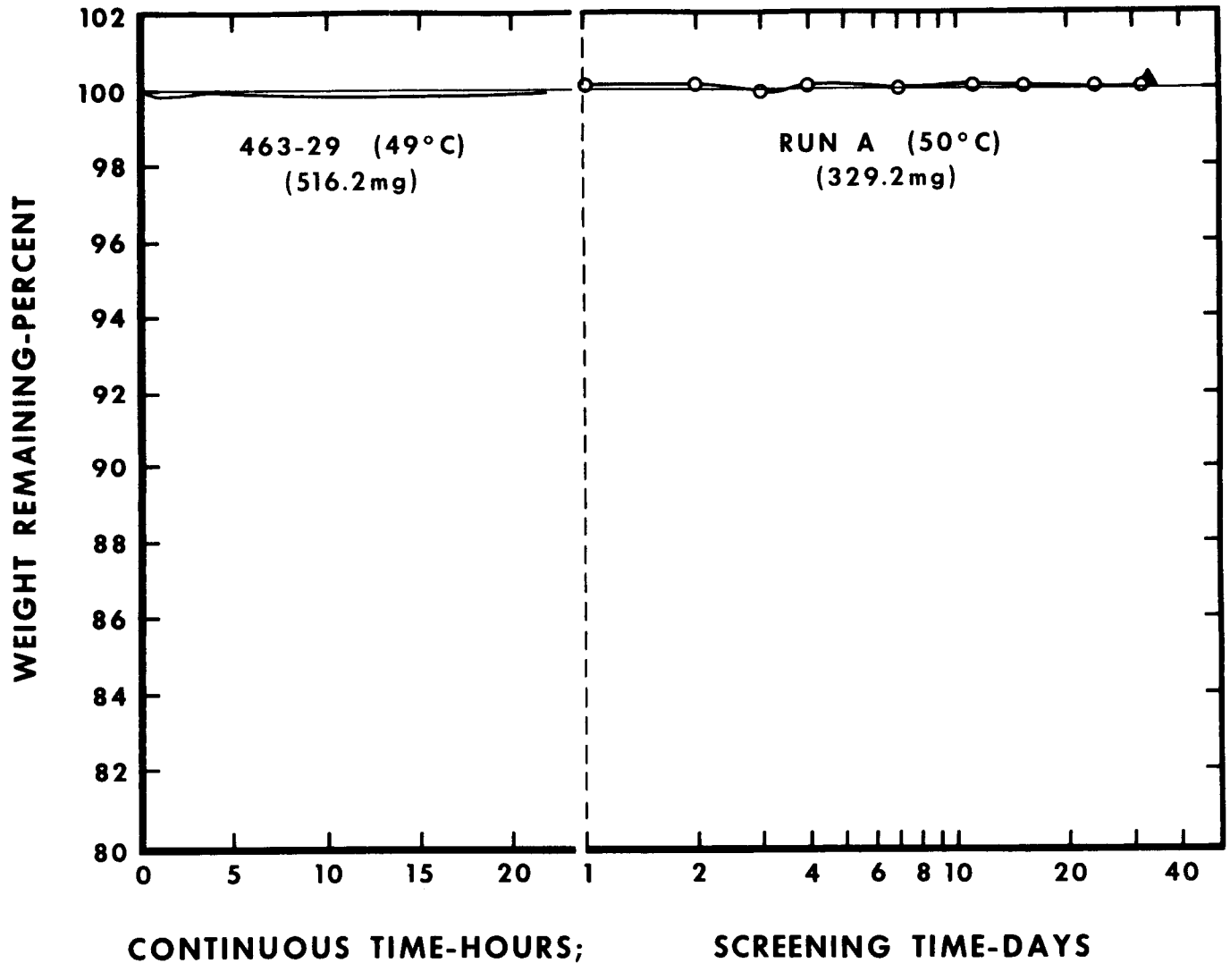

FIGURE 3. - TIME-WEIGHT HISTORIES FOR DC 7170 DURING EXPOSURE TO VACUUM AT 49°C AND 50°C

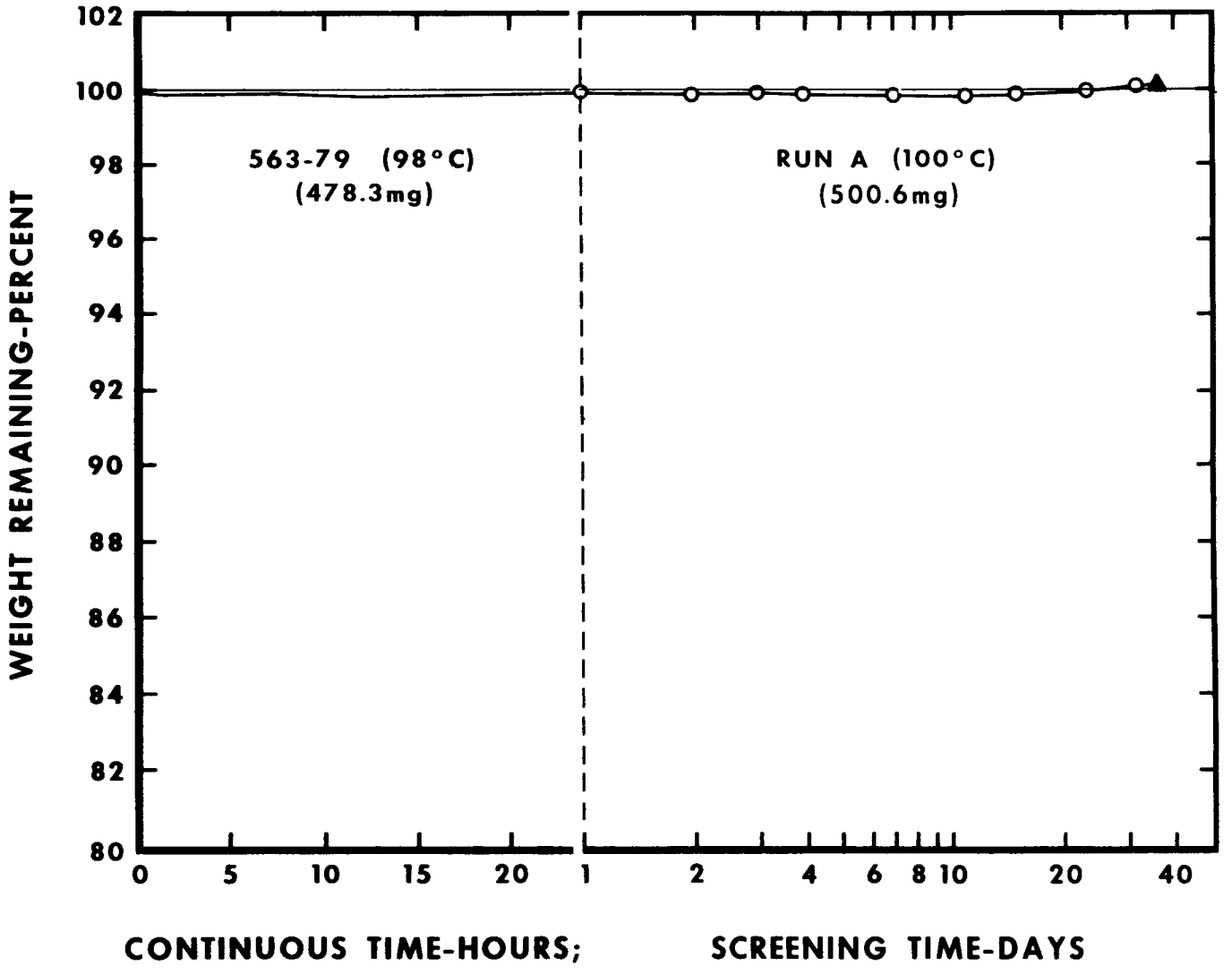

FIGURE 4. - TIME-WEIGHT HISTORIES FOR DC 7170 DURING EXPOSURE TO VACUUM AT 98°C AND 100°C

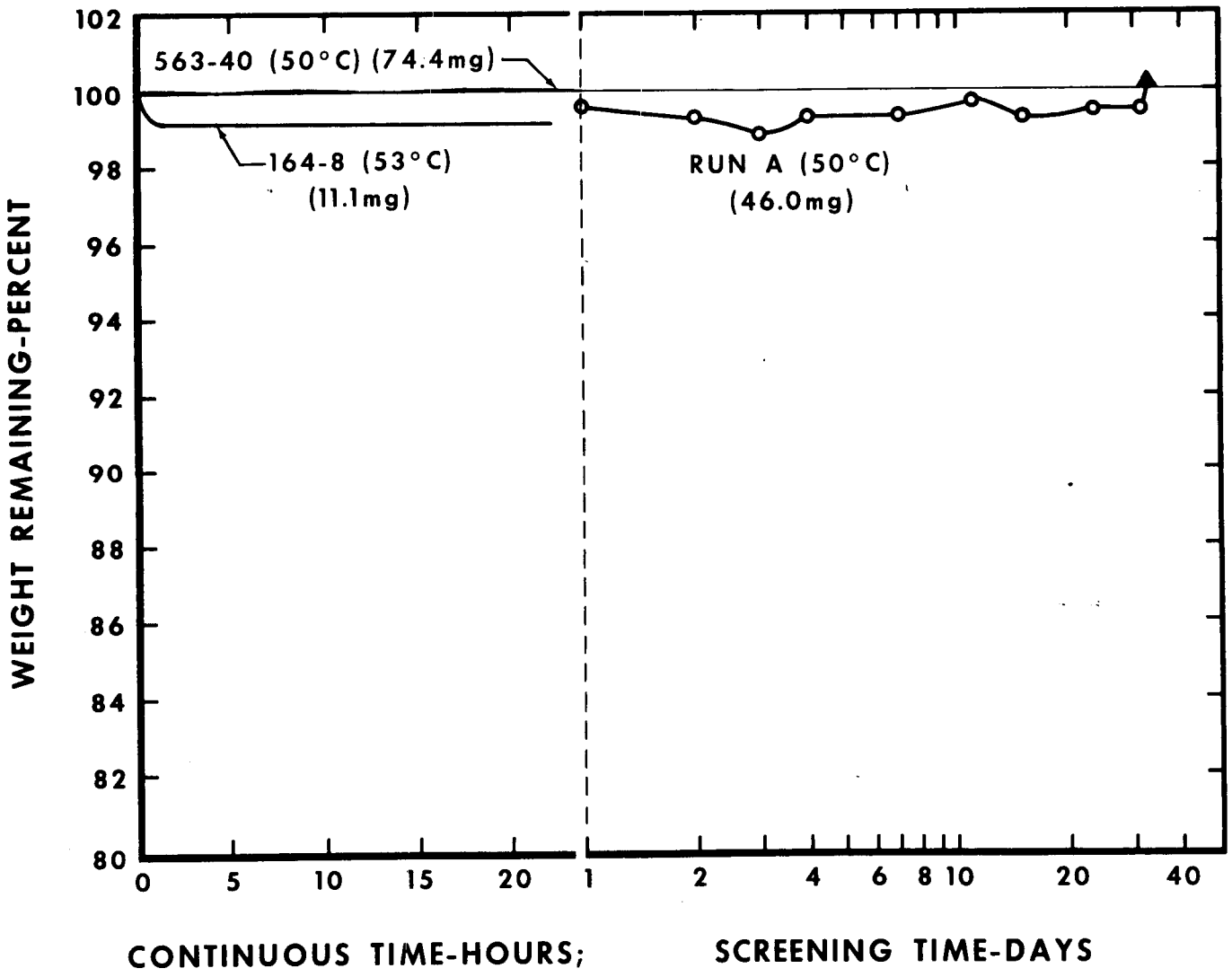

FIGURE 5. - TIME-WEIGHT HISTORIES FOR MARLEX 6002 DURING EXPOSURE TO VACUUM AT 50°C AND 53°C

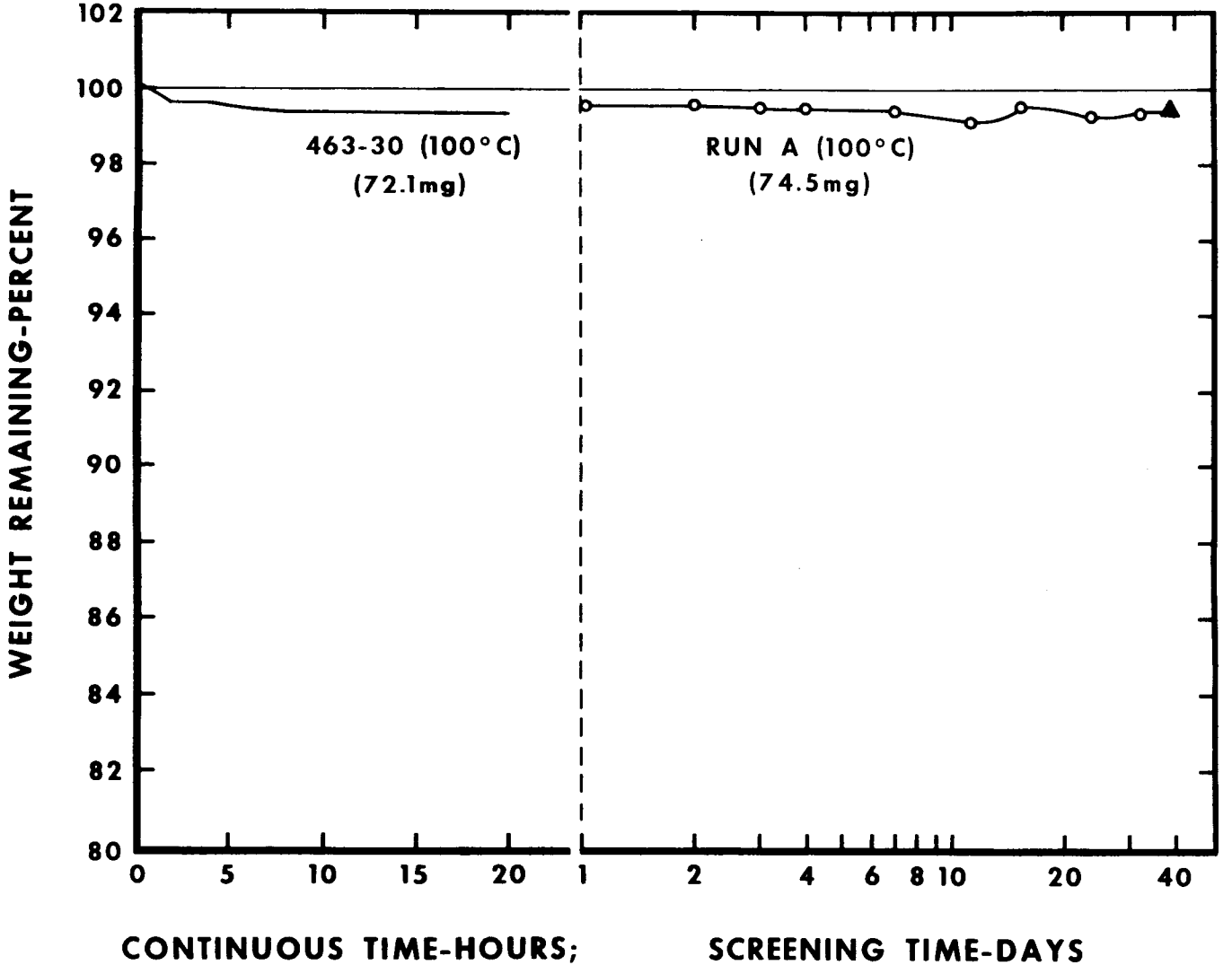

FIGURE 6. - TIME-WEIGHT HISTORIES FOR MARLEX 6002 DURING EXPOSURE TO VACUUM AT 100°C

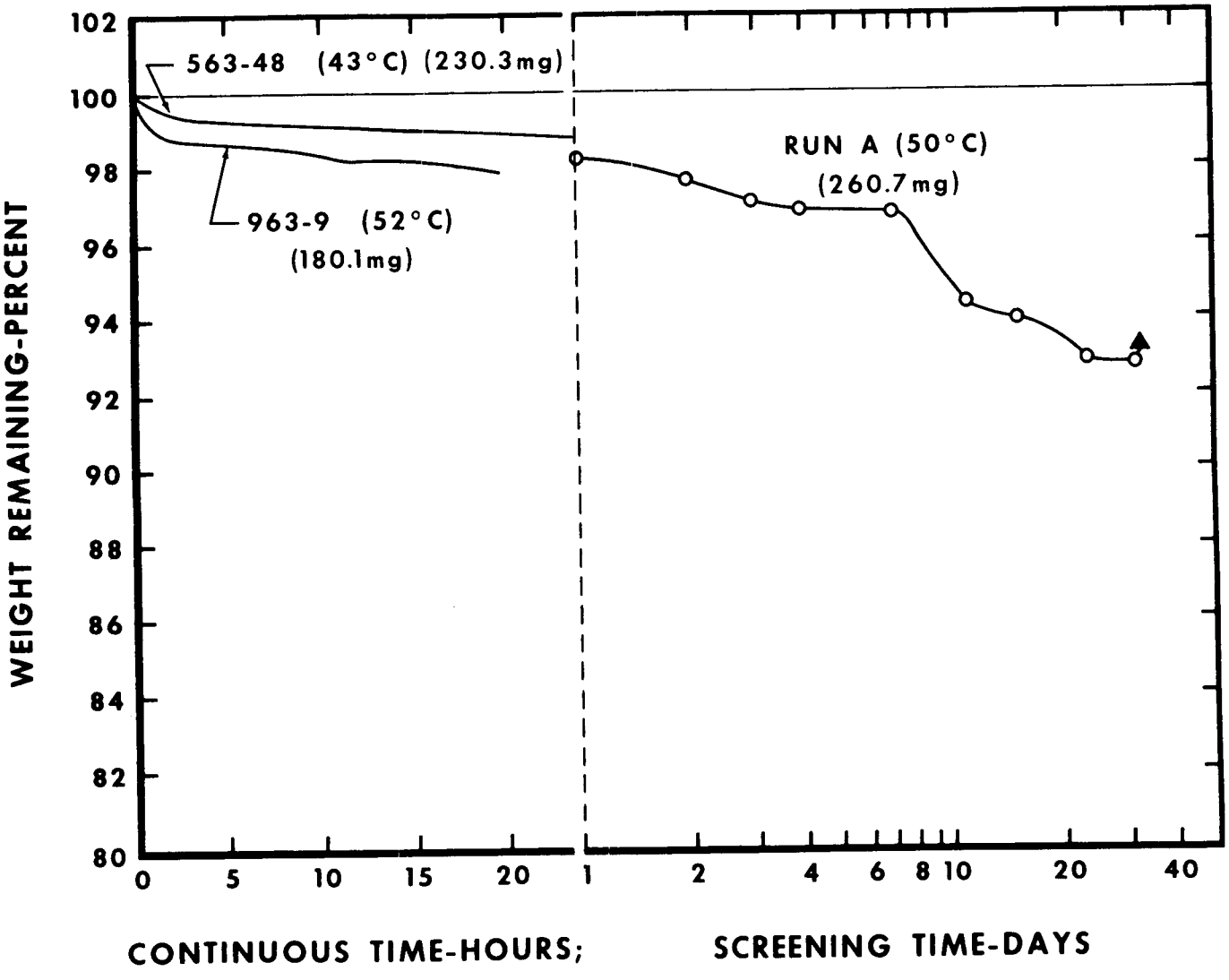

FIGURE 7. - TIME-WEIGHT HISTORIES FOR GEON 2046 DURING EXPOSURE TO VACUUM AT 43°C, 50°C, AND 52°C

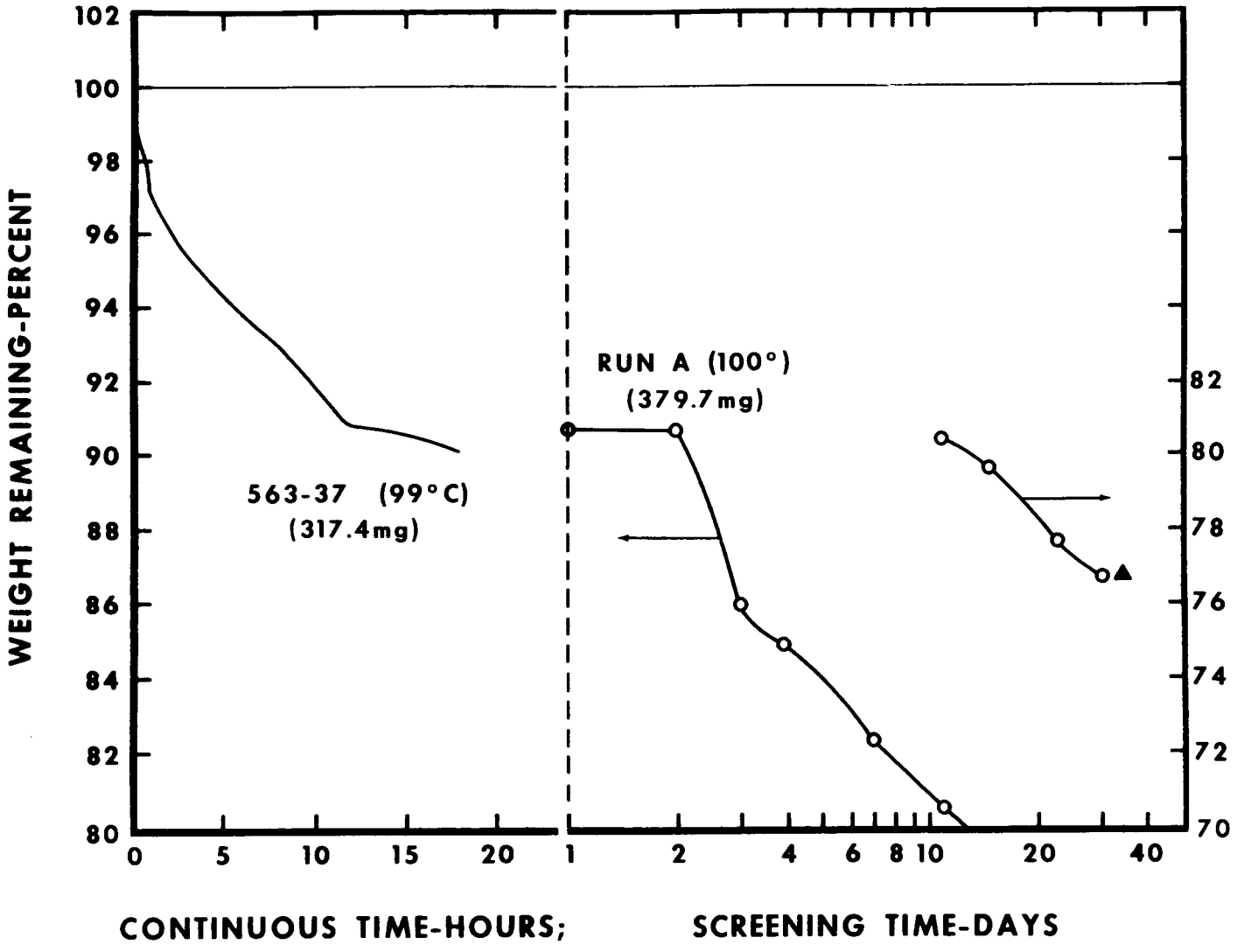

FIGURE 8. - TIME-WEIGHT HISTORIES FOR GEON 2046 DURING EXPOSURE TO VACUUM AT 99°C AND 100°C

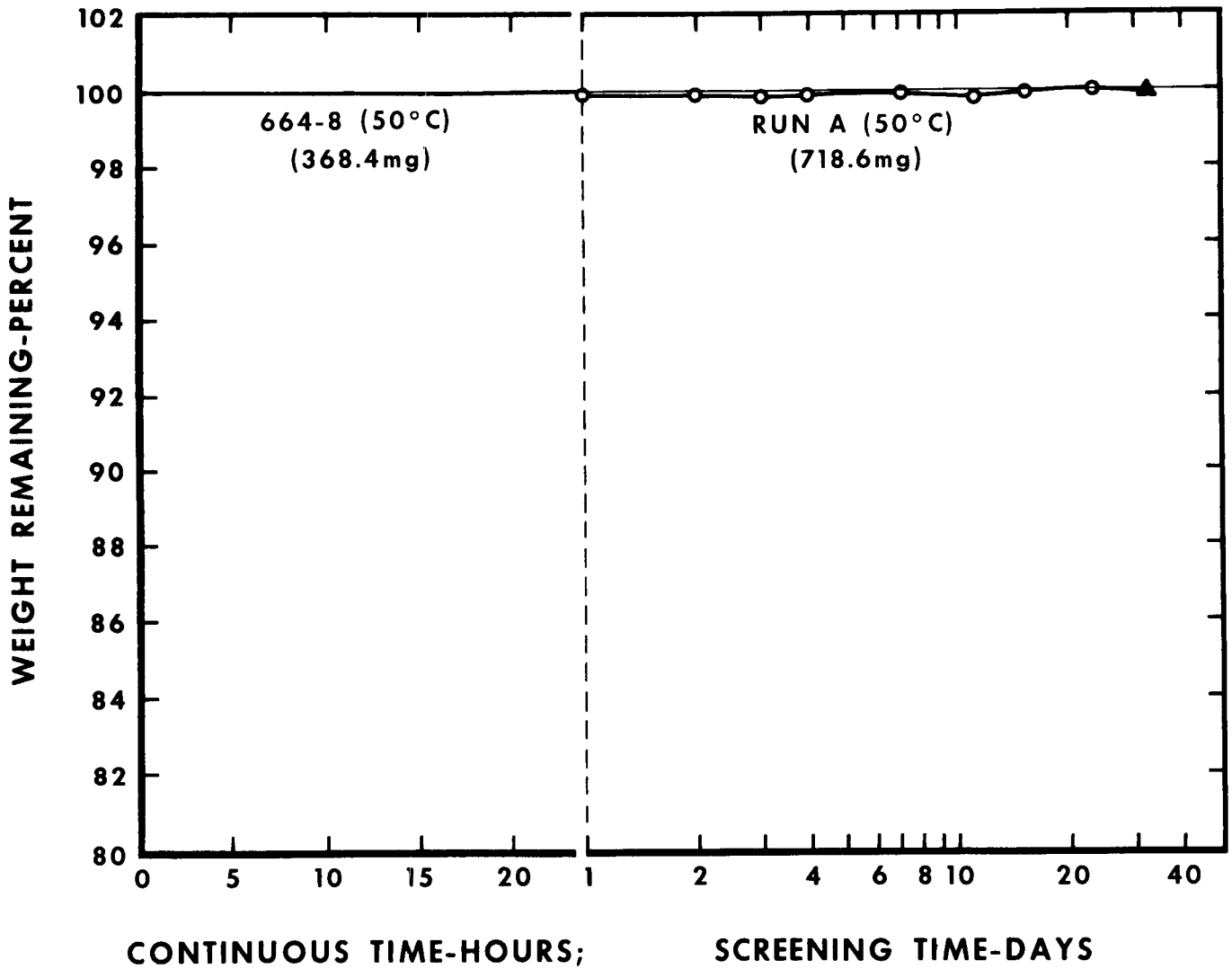

FIGURE 9. - TIME-WEIGHT HISTORIES FOR GEON 8800 DURING EXPOSURE TO VACUUM AT 50°C

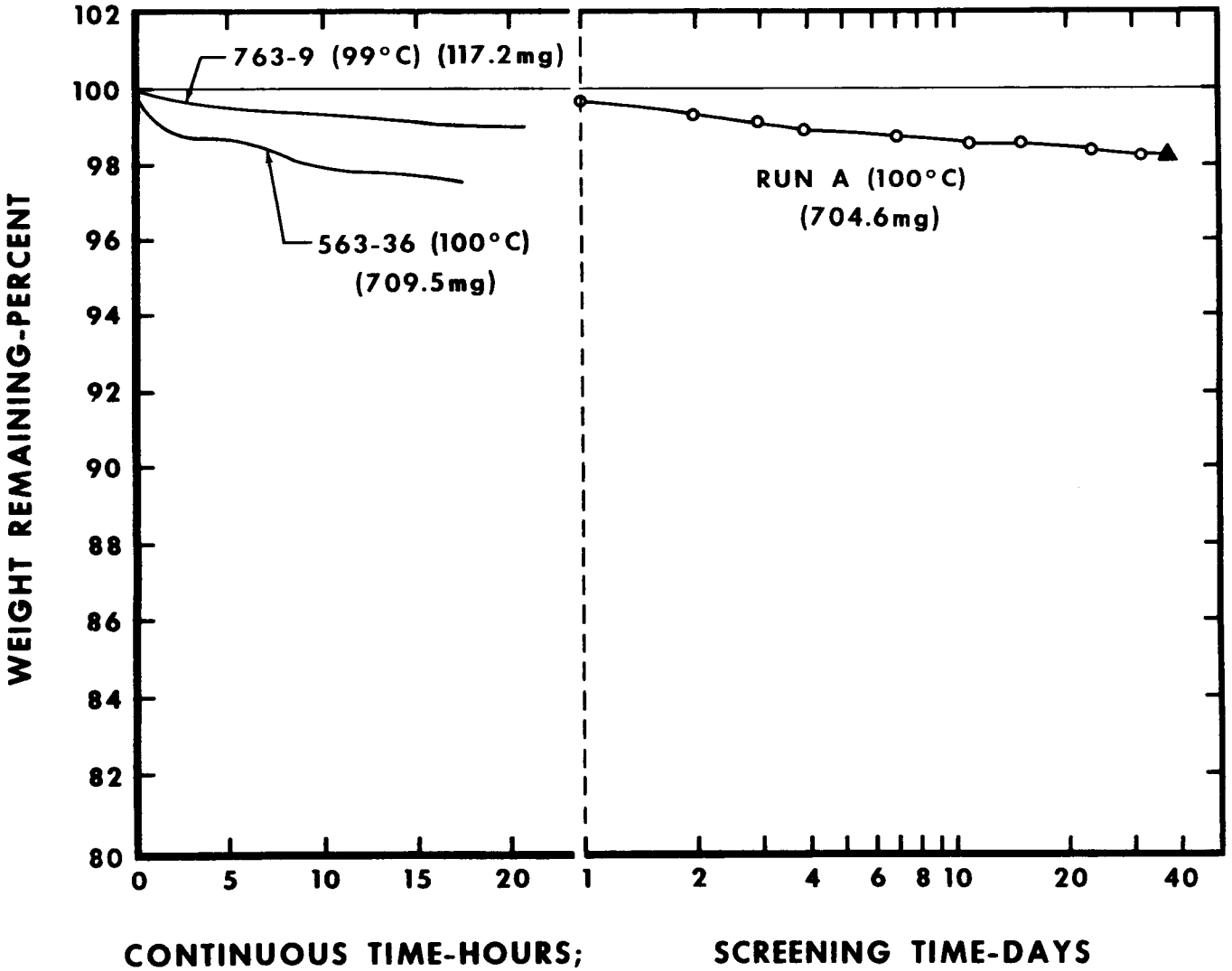

FIGURE 10. - TIME-WEIGHT HISTORIES FOR GEON 8800 DURING EXPOSURE TO VACUUM AT 99°C AND 100°C

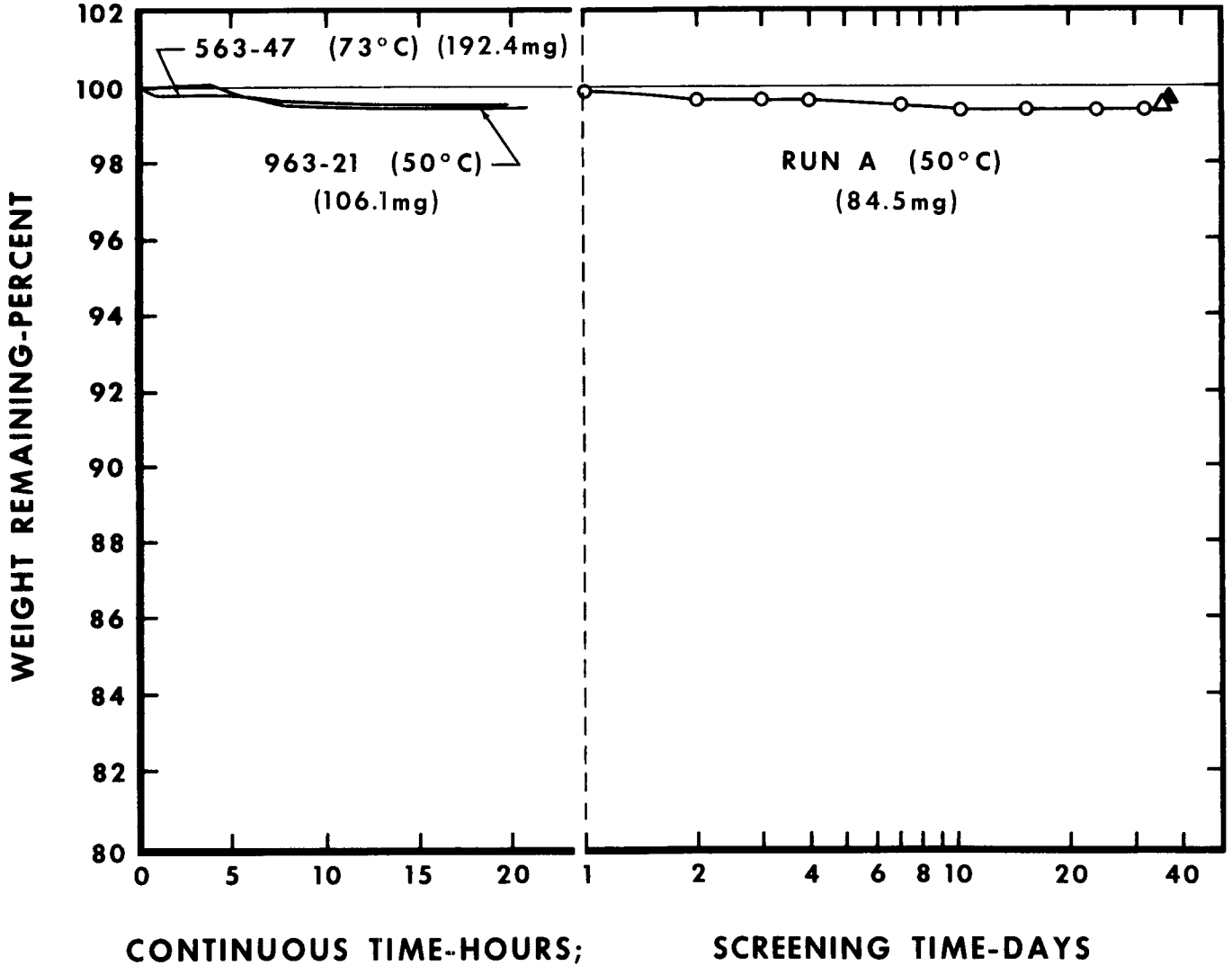

FIGURE 11. - TIME- WEIGHT HISTORIES FOR ESTANE 5740 DURING EXPOSURE TO VACUUM AT 50°C AND 73°C

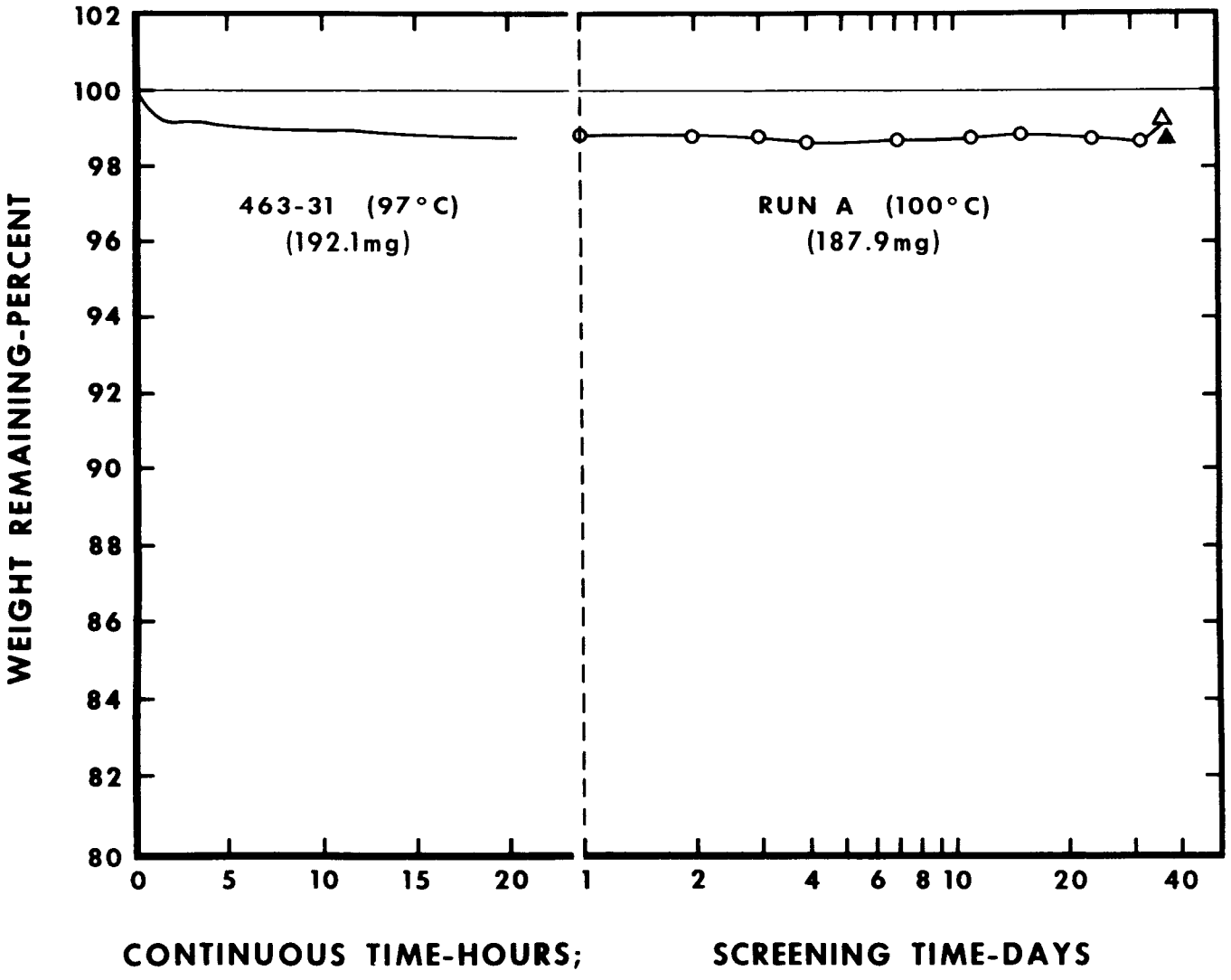

FIGURE 12. - TIME-WEIGHT HISTORIES FOR ESTANE 5740 DURING EXPOSURE TO VACUUM AT 97°C AND 100°C

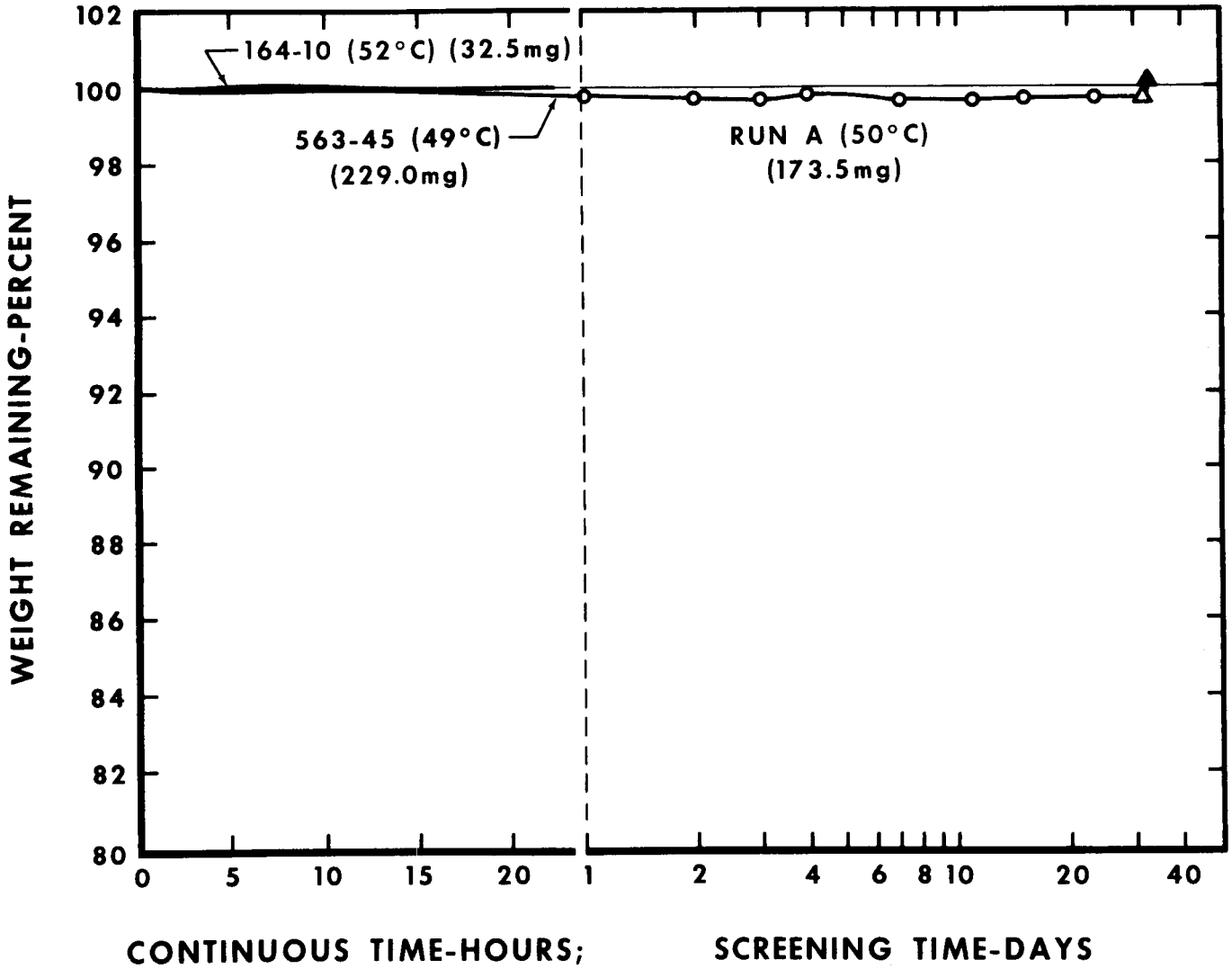

FIGURE 13. - TIME-WEIGHT HISTORIES FOR ROYALINE-R DURING EXPOSURE TO VACUUM AT 49°C, 50°C, AND 52°C

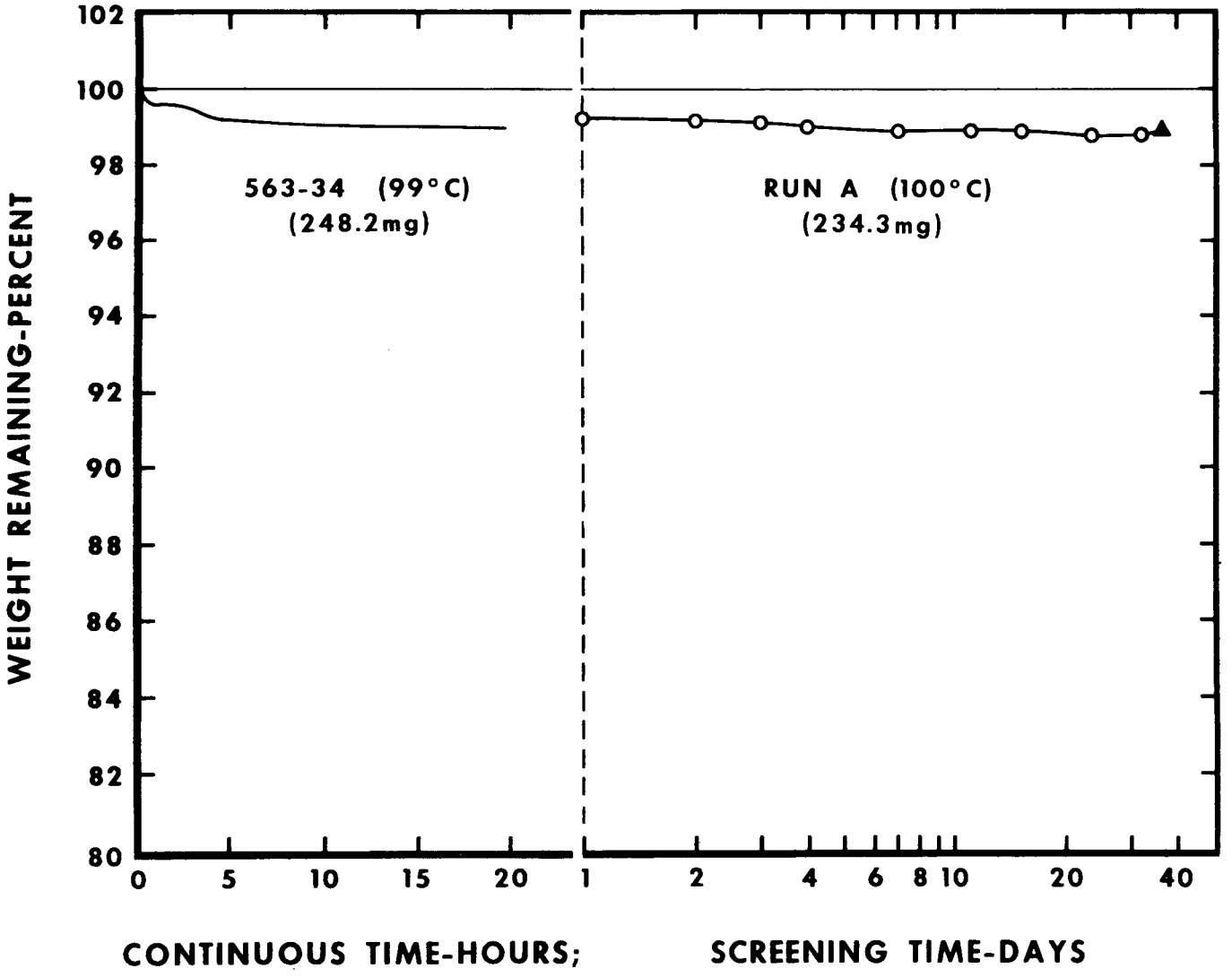

FIGURE 14. - TIME-WEIGHT HISTORIES FOR ROYALINE-R DURING EXPOSURE TO VACUUM AT 99°C AND 100°C

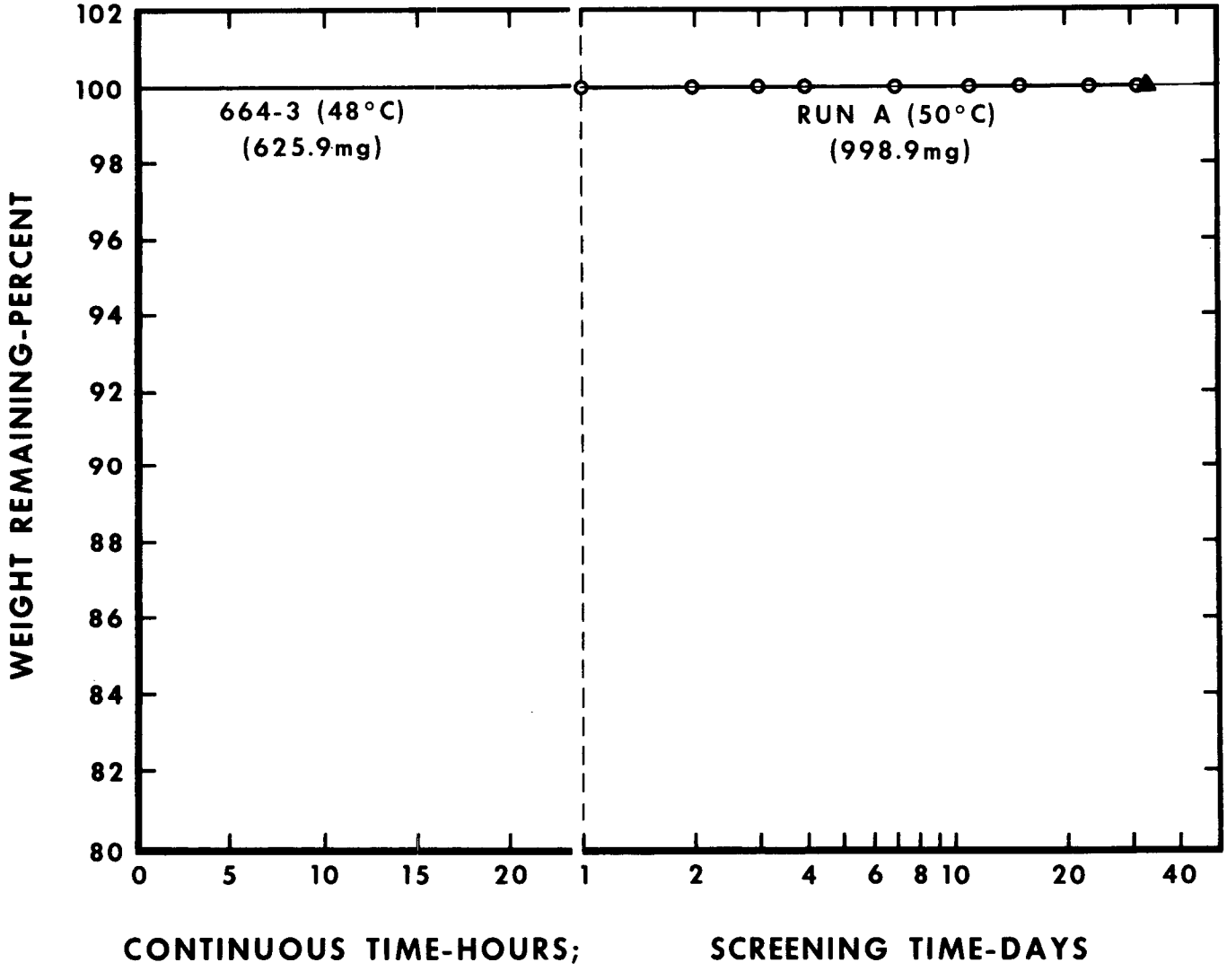

FIGURE 15. - TIME-WEIGHT HISTORIES FOR KEL-F 81 DURING EXPOSURE TO VACUUM AT 48°C AND 50°C

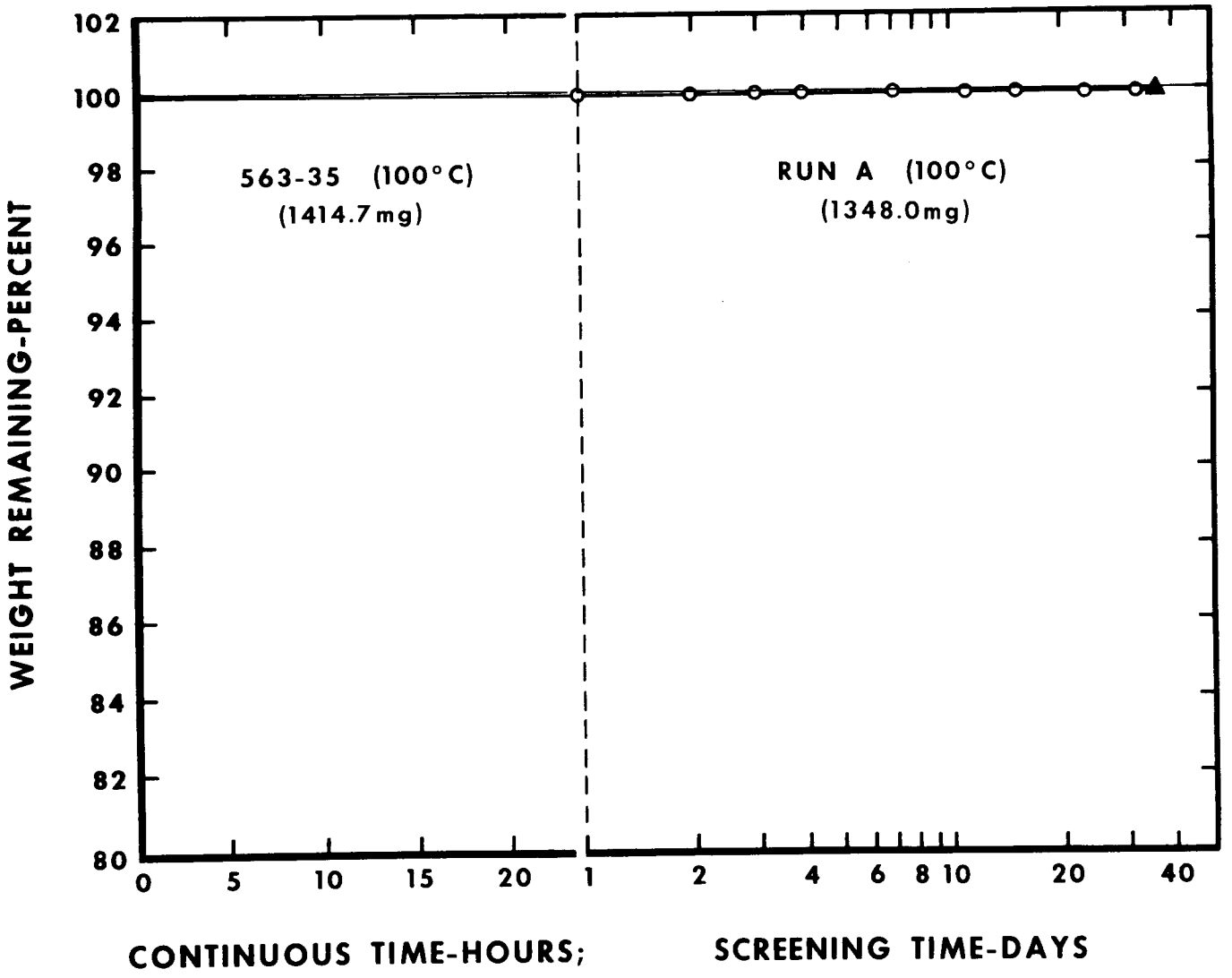

FIGURE 16. - TIME-WEIGHT HISTORIES FOR KEL-F 81 DURING EXPOSURE TO VACUUM AT 100°C

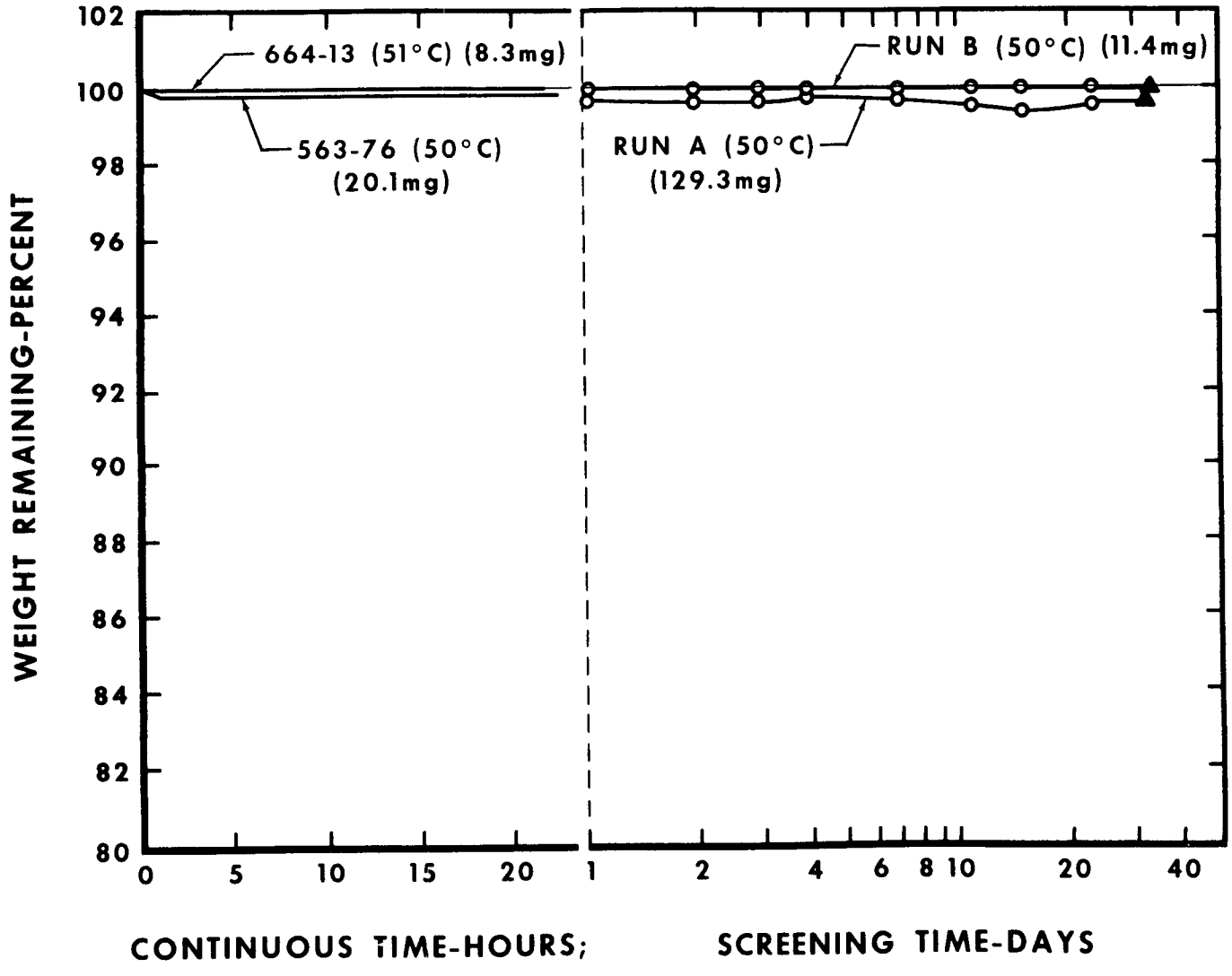

FIGURE 17. - TIME-WEIGHT HISTORIES FOR TEDLAR DURING EXPOSURE TO VACUUM AT 50°C AND 51°C

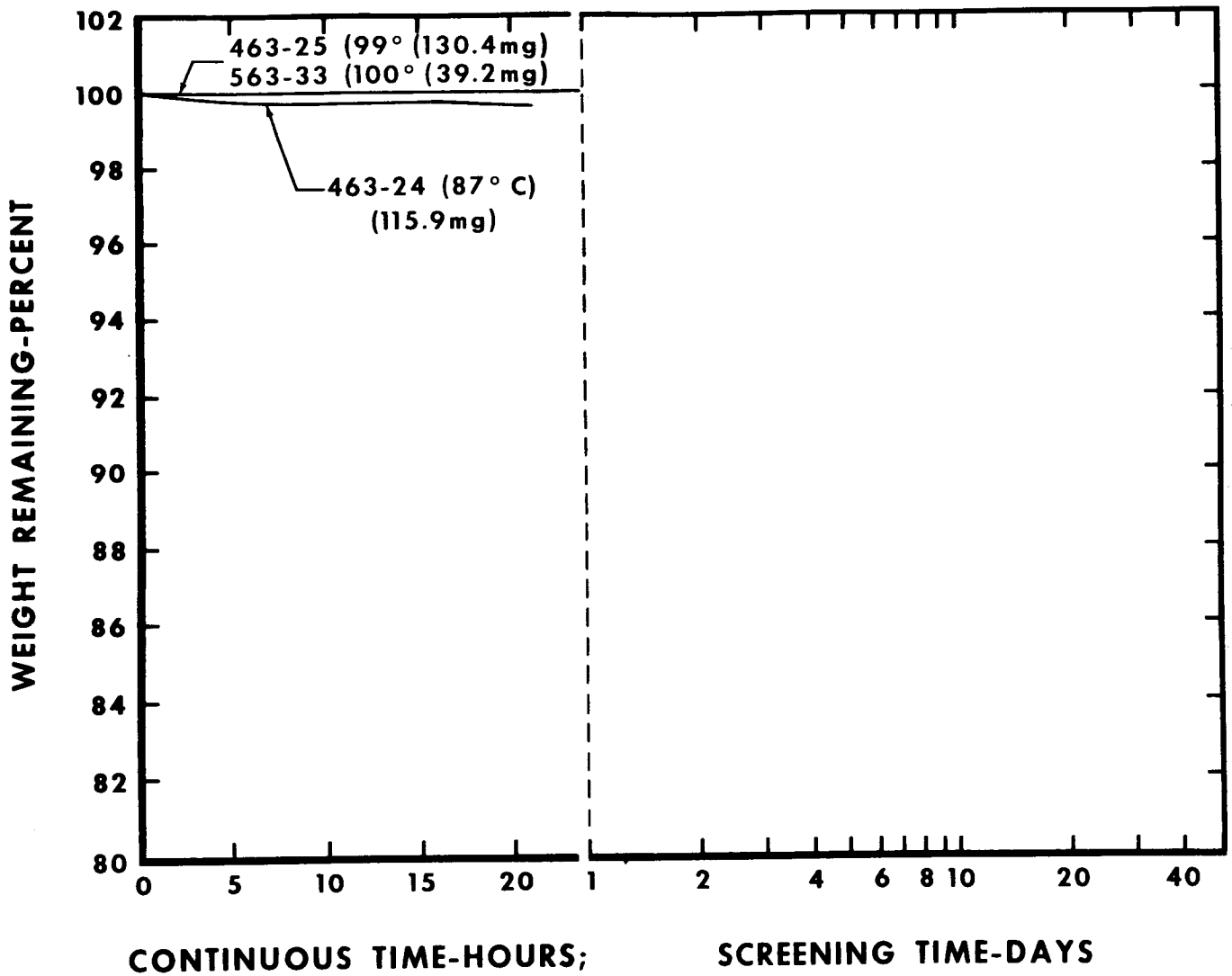

FIGURE 18. - TIME-WEIGHT HISTORIES FOR TEDLAR DURING EXPOSURE TO VACUUM AT 87°C, 99°C, AND 100°C

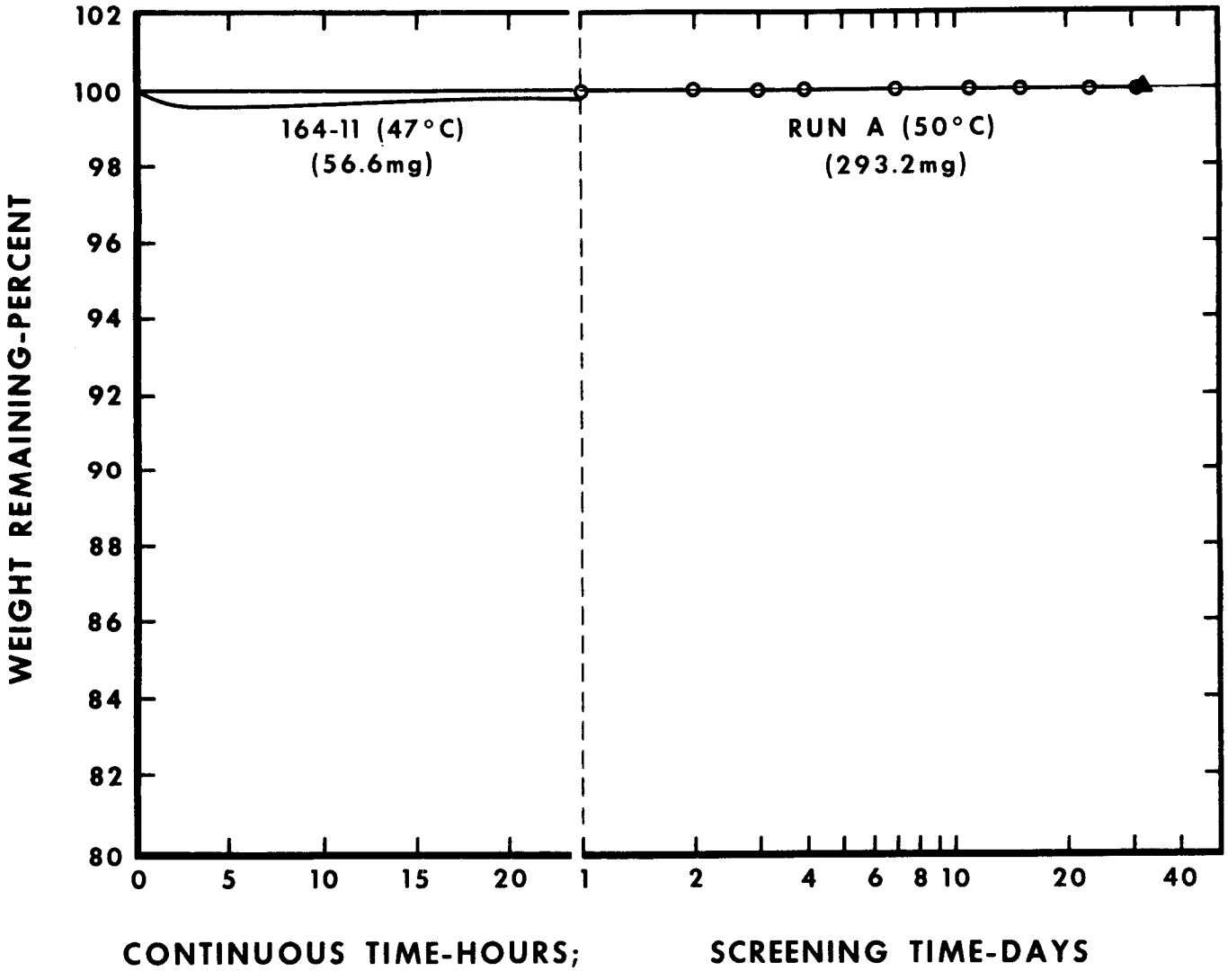

FIGURE 19. - TIME-WEIGHT HISTORIES FOR TEFLON FEP DURING EXPOSURE TO VACUUM AT 47°C AND 50°C

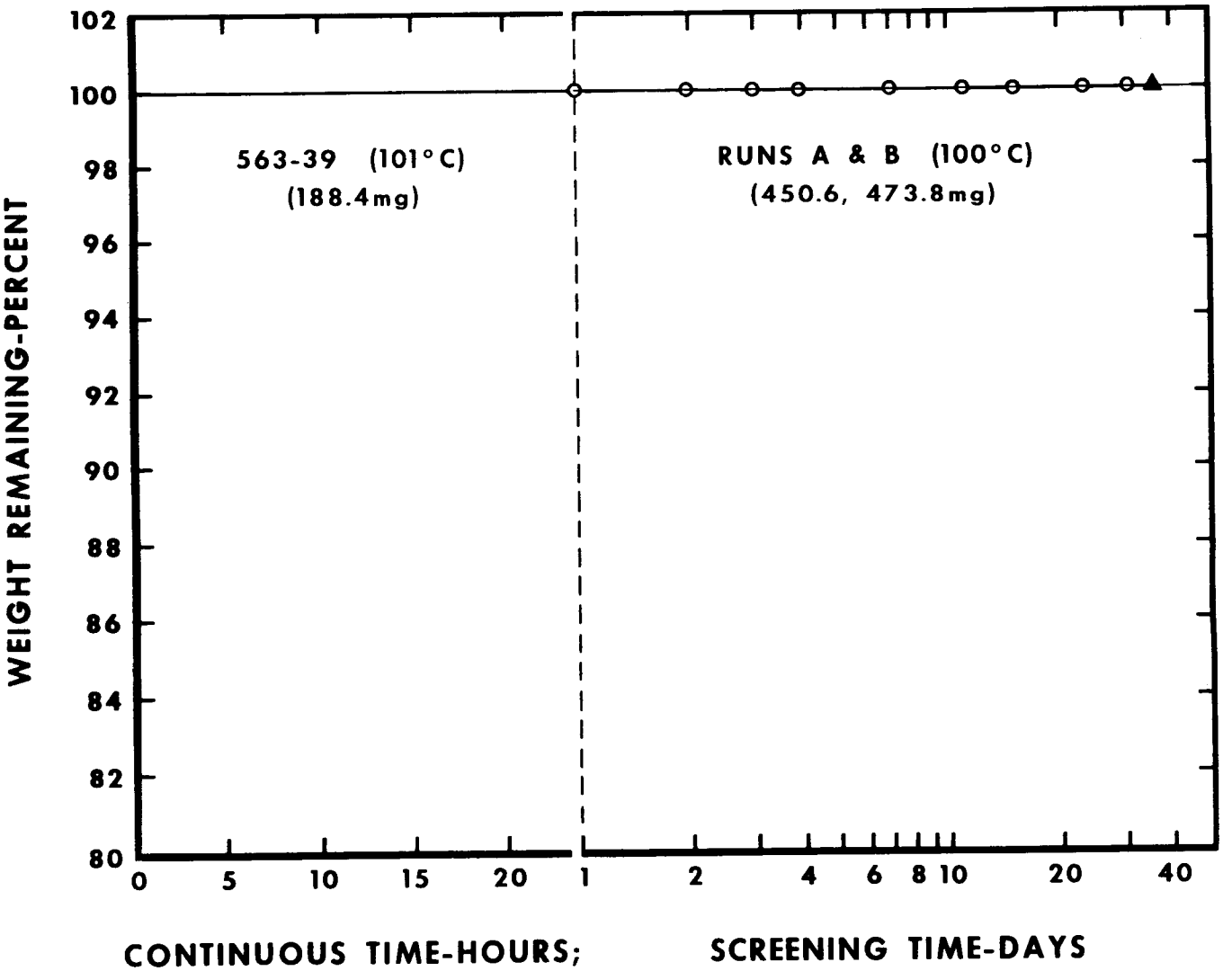

FIGURE 20. - TIME-WEIGHT HISTORIES FOR TEFLON FEP DURING EXPOSURE TO VACUUM AT 100°C AND 101°C

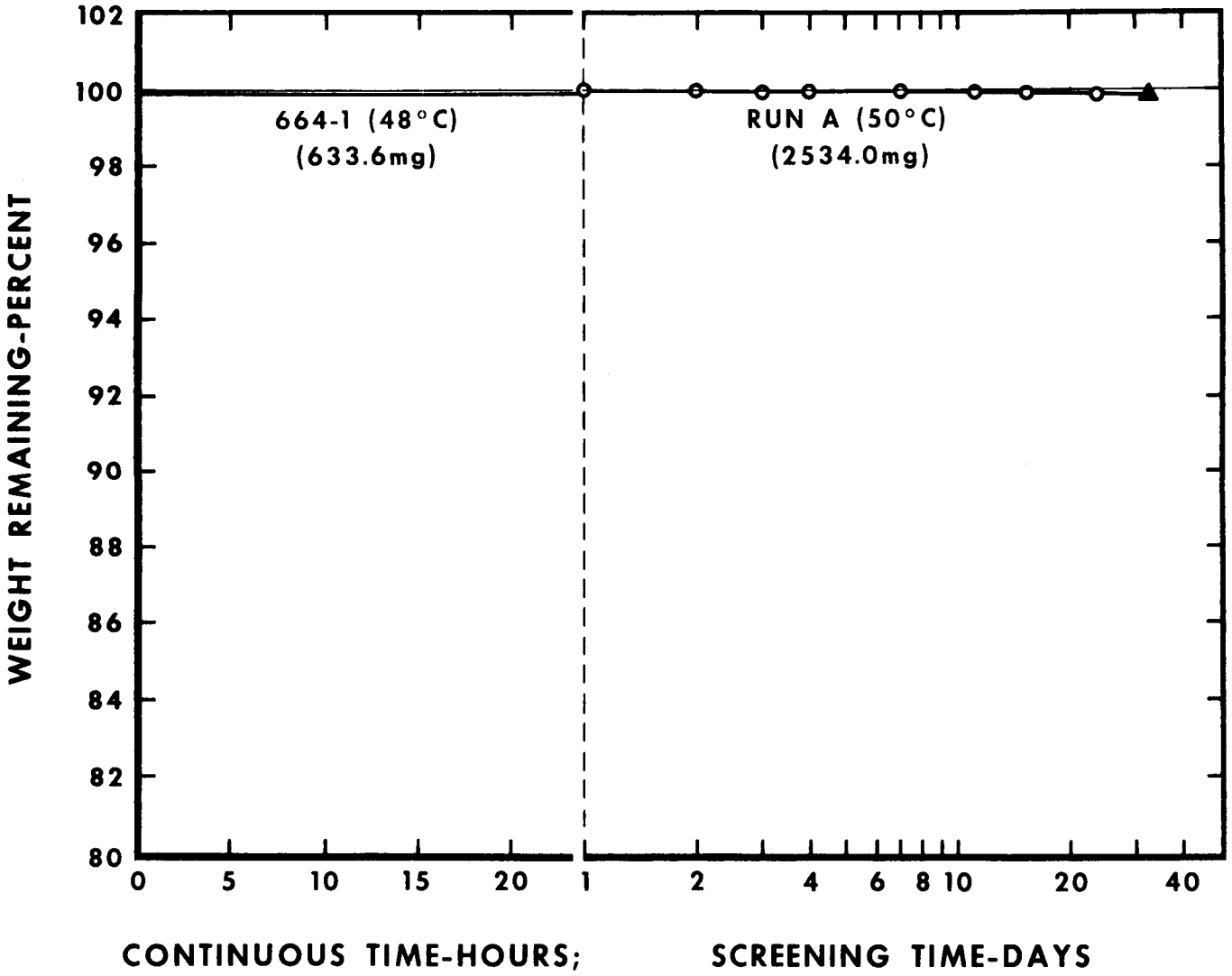

FIGURE 21. - TIME-WEIGHT HISTORIES FOR DUROID 5600 DURING EXPOSURE TO VACUUM AT 48°C AND 50°C

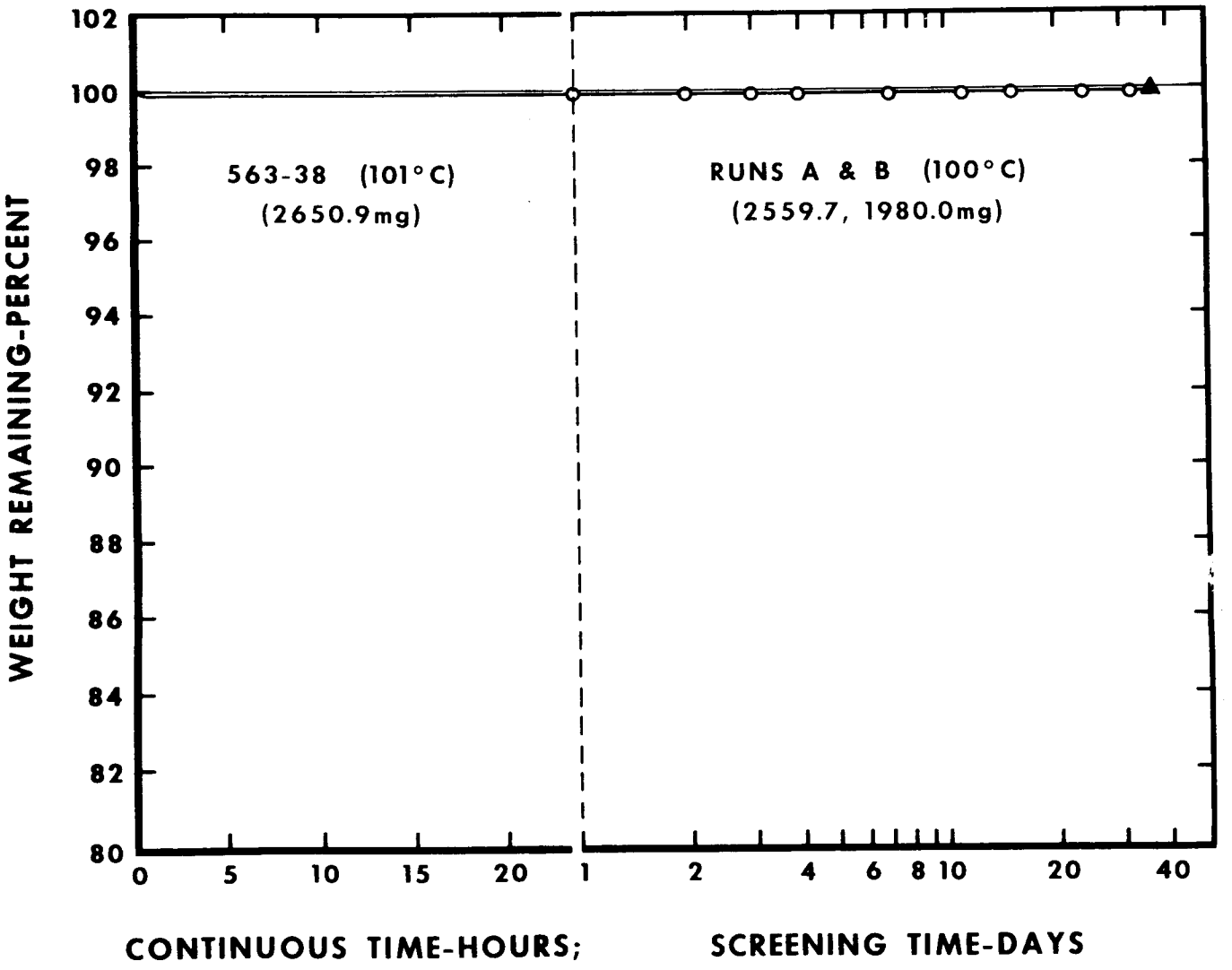

FIGURE 22. - TIME-WEIGHT HISTORIES FOR DUROID 5600 DURING EXPOSURE TO VACUUM AT 100°C AND 101°C

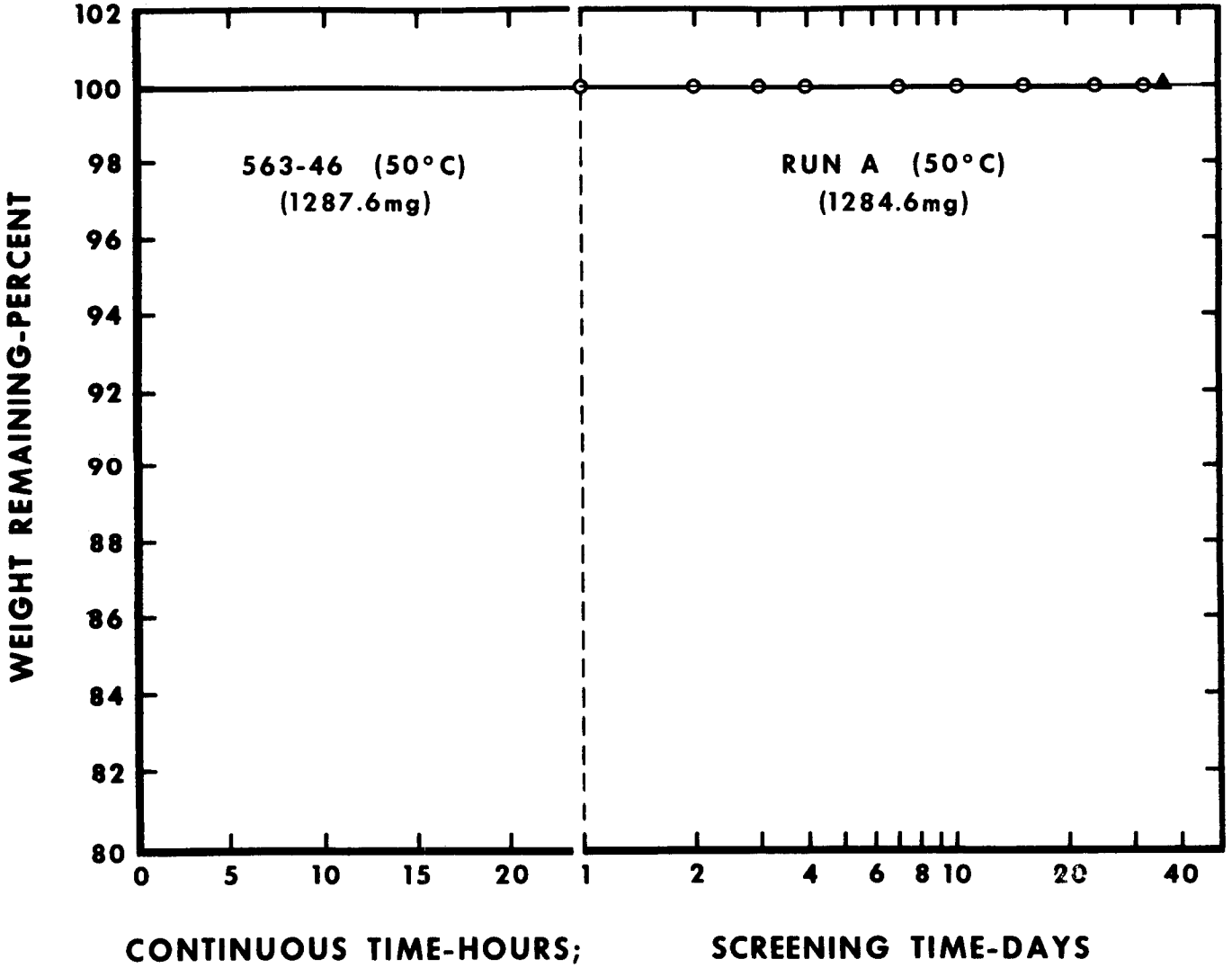

FIGURE 23. - TIME-WEIGHT HISTORIES FOR ACRYLIC COAT DURING EXPOSURE TO VACUUM AT 50°C

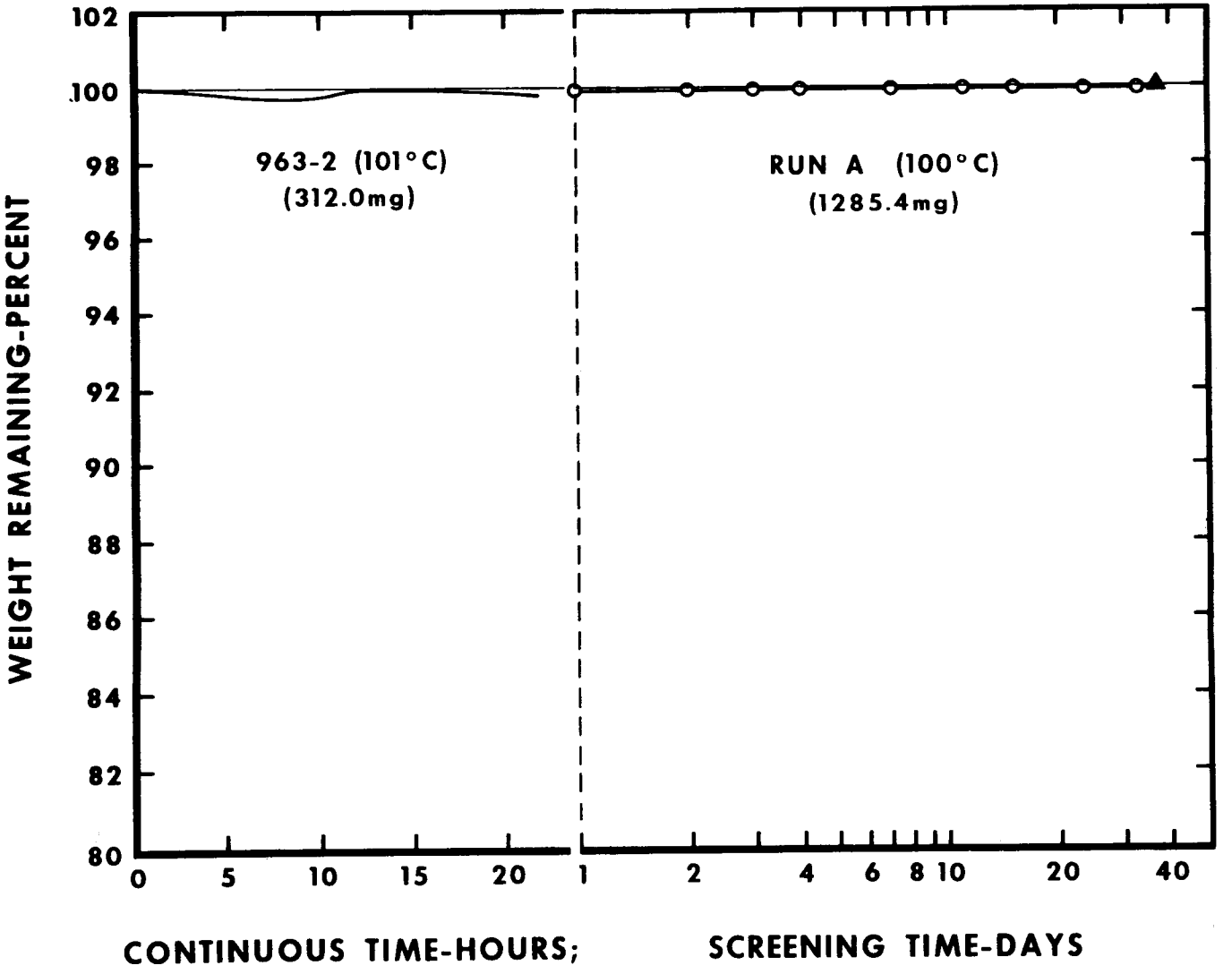

FIGURE 24. - TIME-WEIGHT HISTORIES FOR ACRYLIC COAT DURING EXPOSURE TO VACUUM AT 100°C AND 101°C

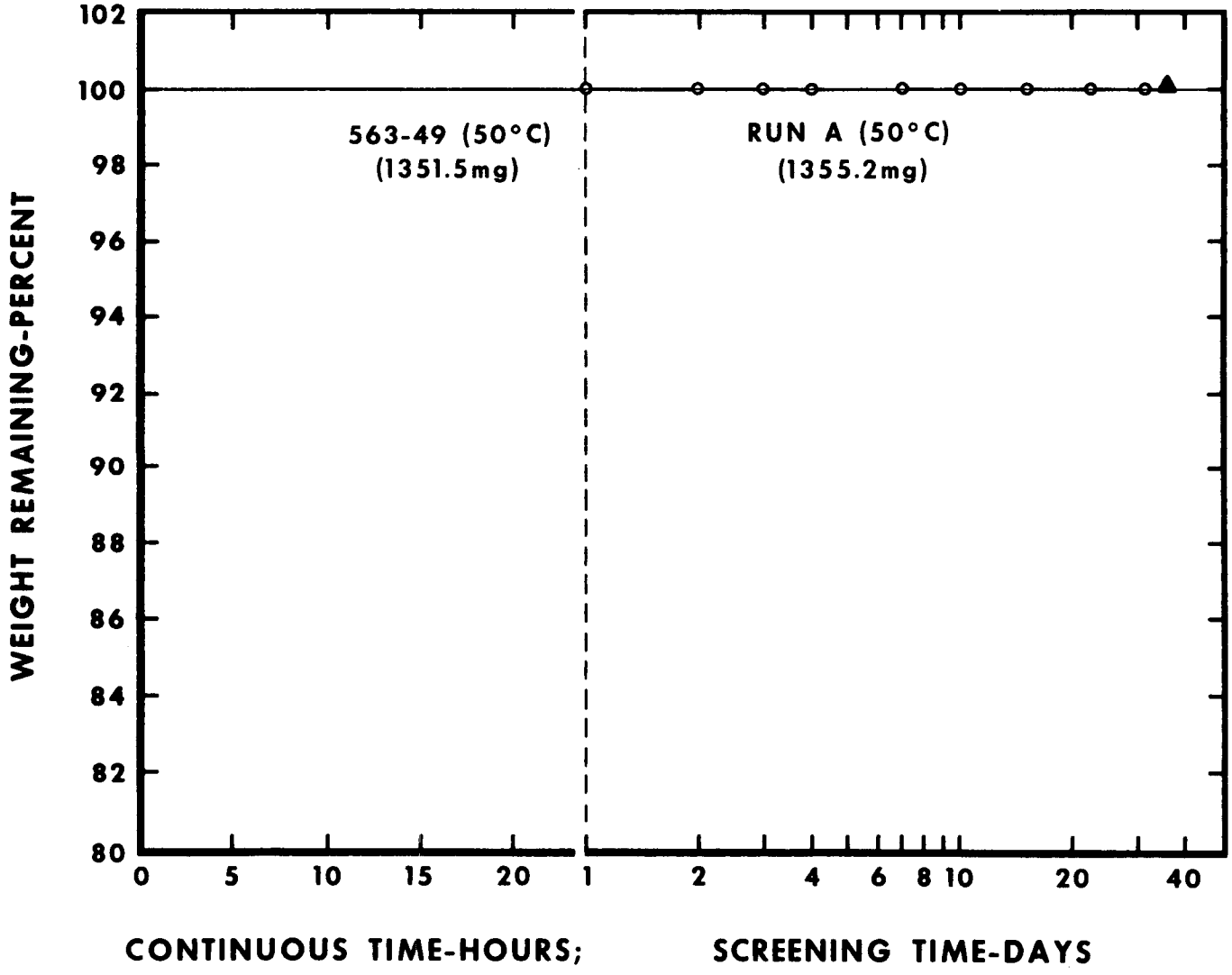

FIGURE 25. - TIME-WEIGHT HISTORIES FOR SILICONE THERMAL COATING DURING EXPOSURE TO VACUUM AT 50°C

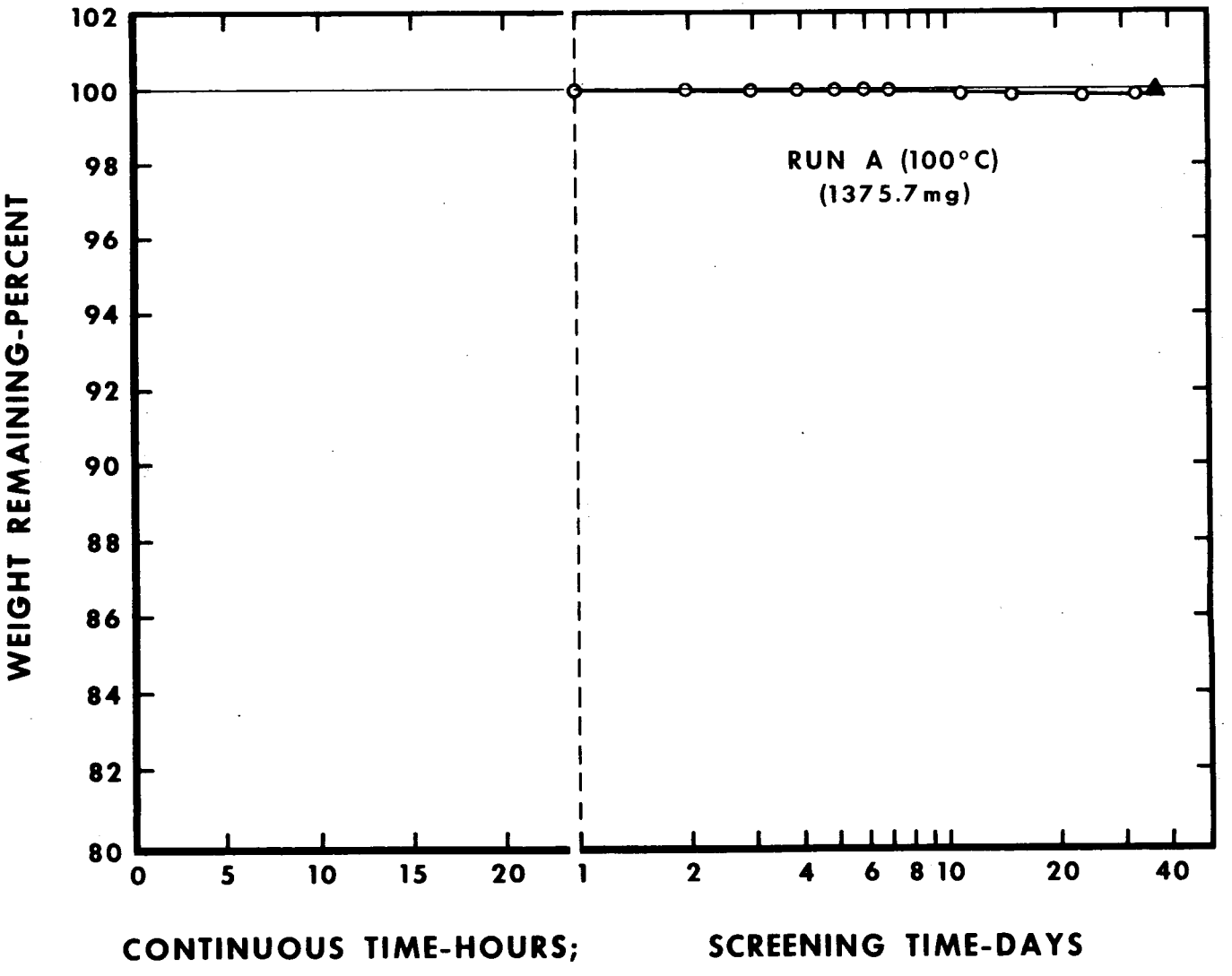

FIGURE 26. - TIME-WEIGHT HISTORIES FOR SILICONE THERMAL COATING DURING EXPOSURE TO VACUUM AT 100°C

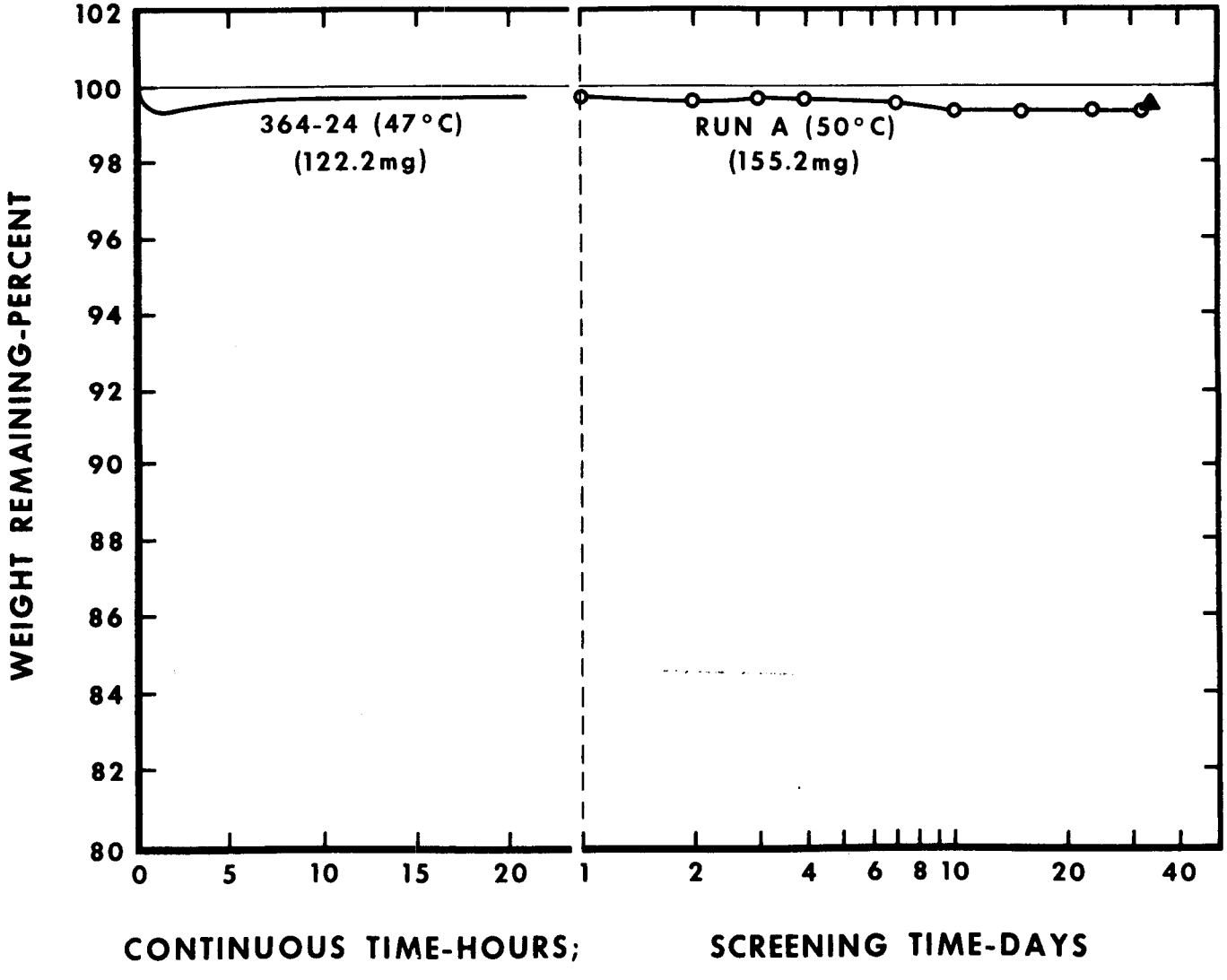

FIGURE 27. - TIME-WEIGHT HISTORIES FOR RTV-60 DURING EXPOSURE TO VACUUM AT 47°C AND 50°C

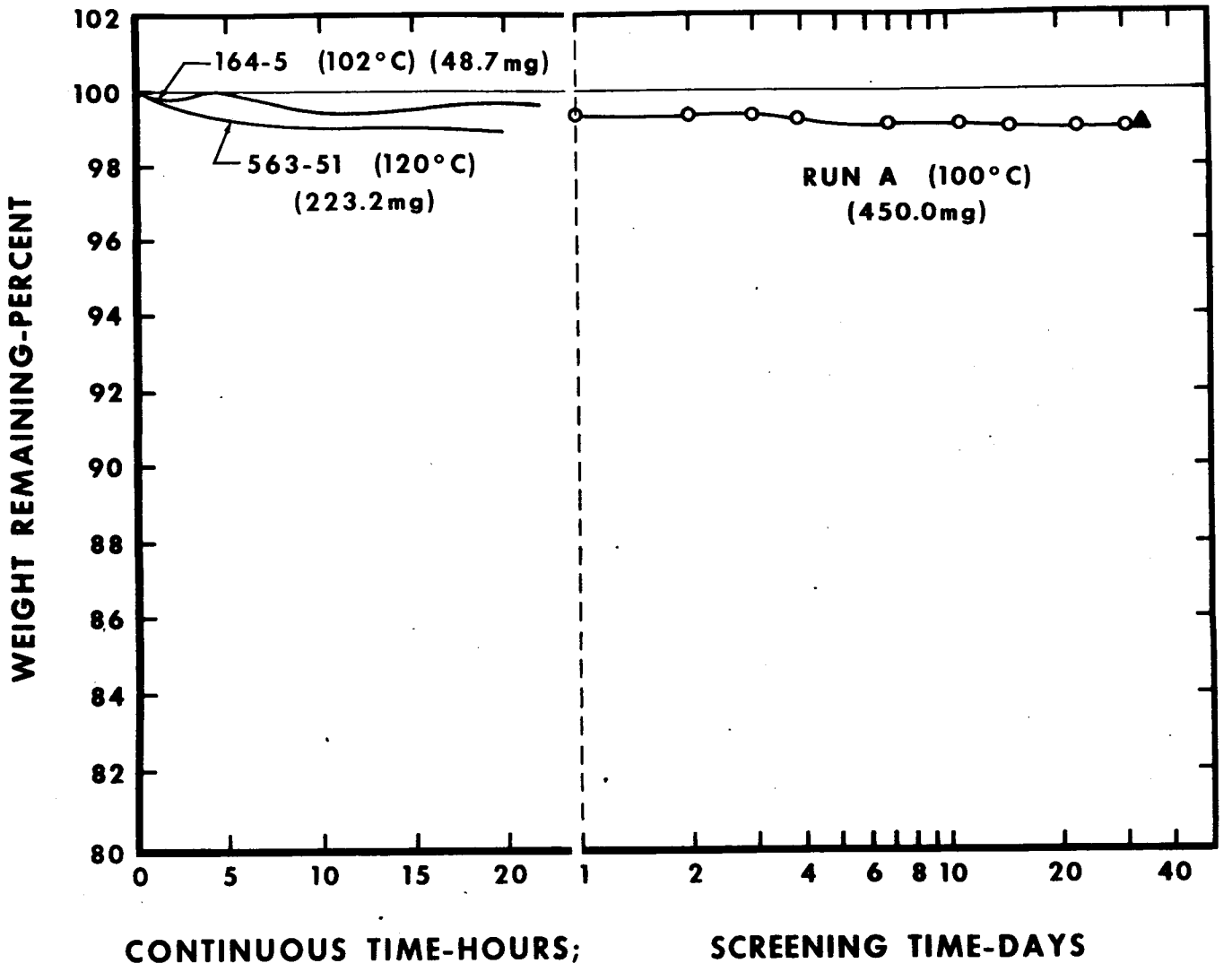

FIGURE 28. - TIME-WEIGHT HISTORIES FOR RTV-60 DURING EXPOSURE TO VACUUM AT 100°C, 102°C, AND 120°C

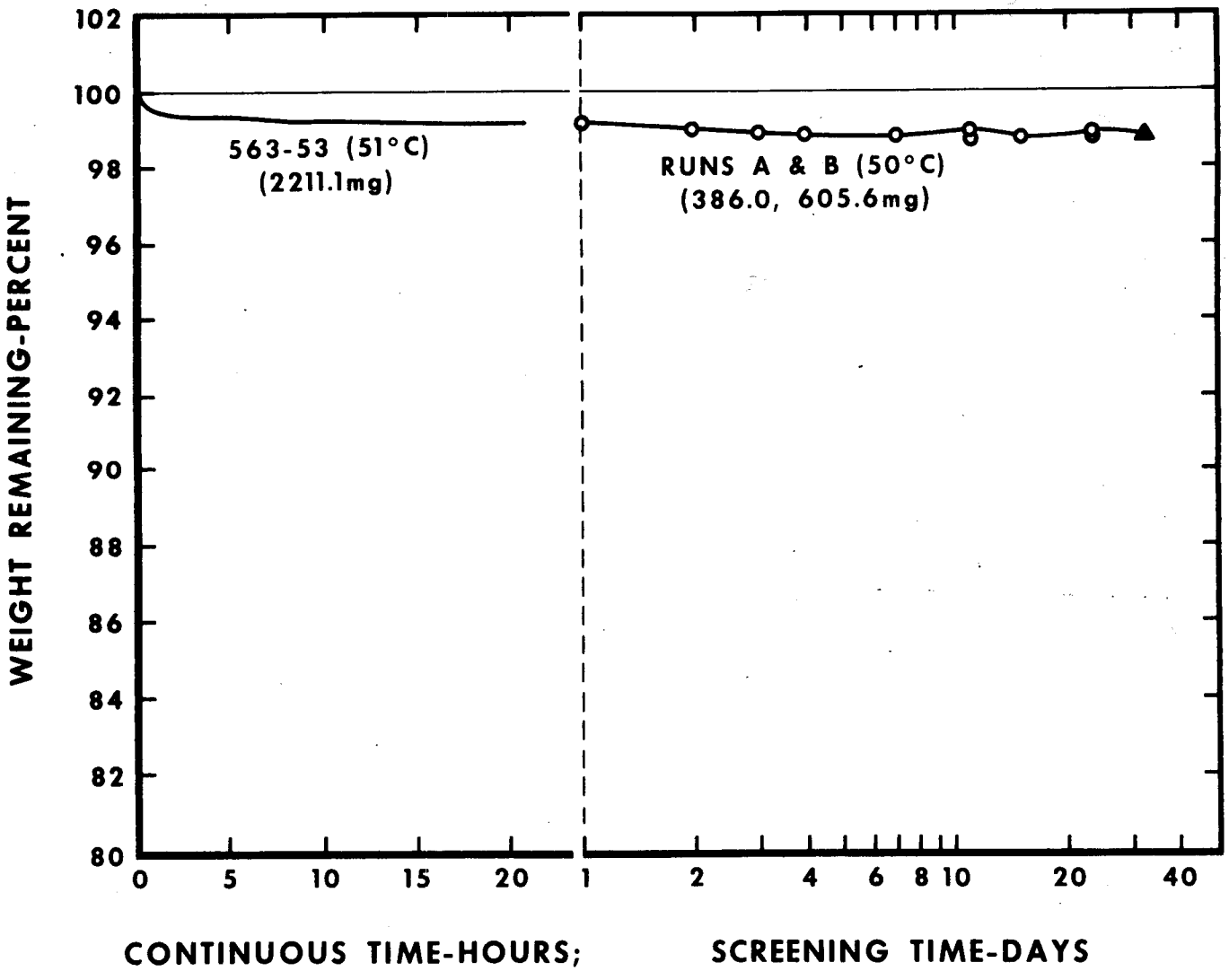

FIGURE 29. - TIME-WEIGHT HISTORIES FOR RTV-501 DURING EXPOSURE TO VACUUM AT 50°C AND 51°C

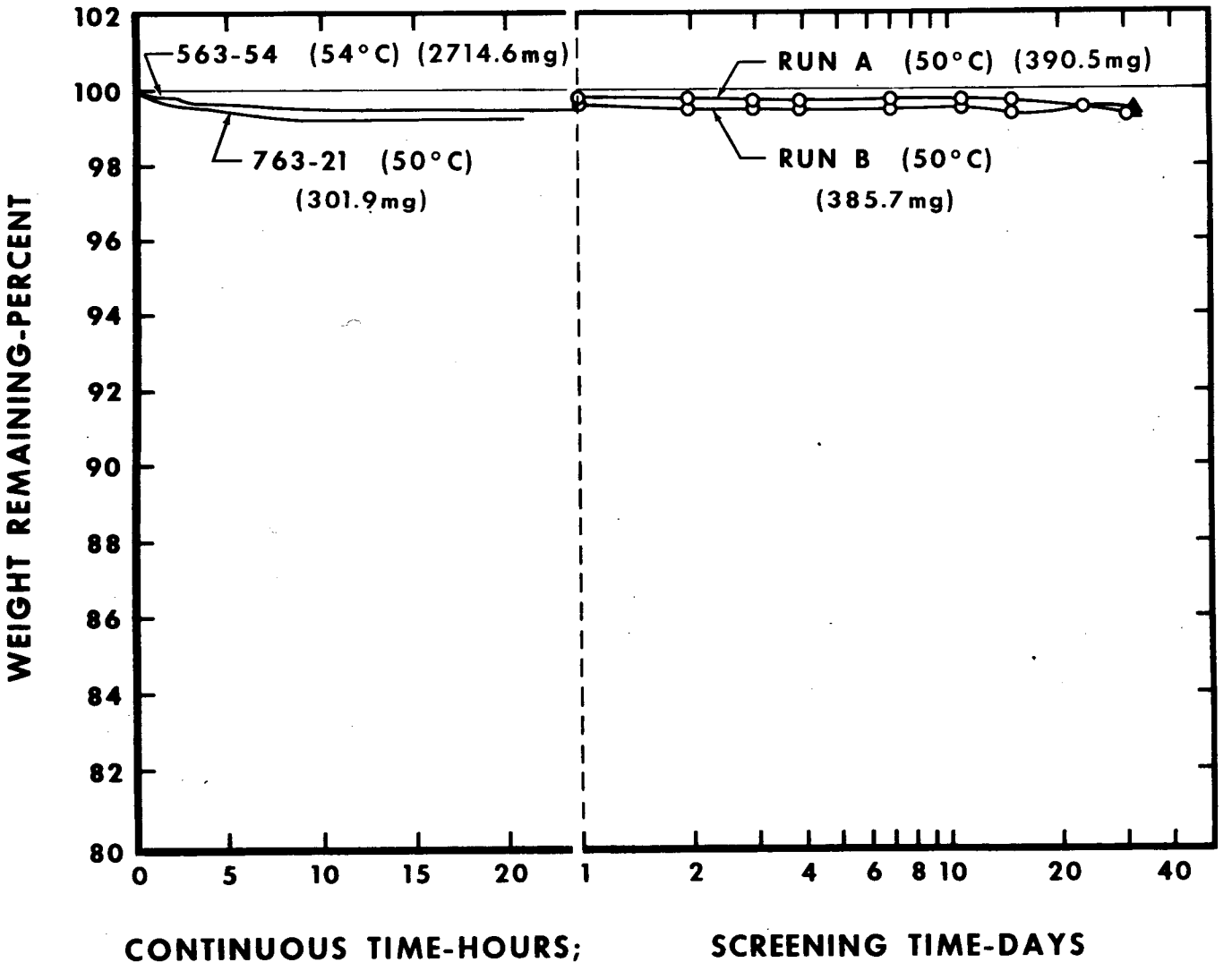

FIGURE 30. - TIME-WEIGHT HISTORIES FOR RTV-601 DURING EXPOSURE TO VACUUM AT 50°C AND 54°C

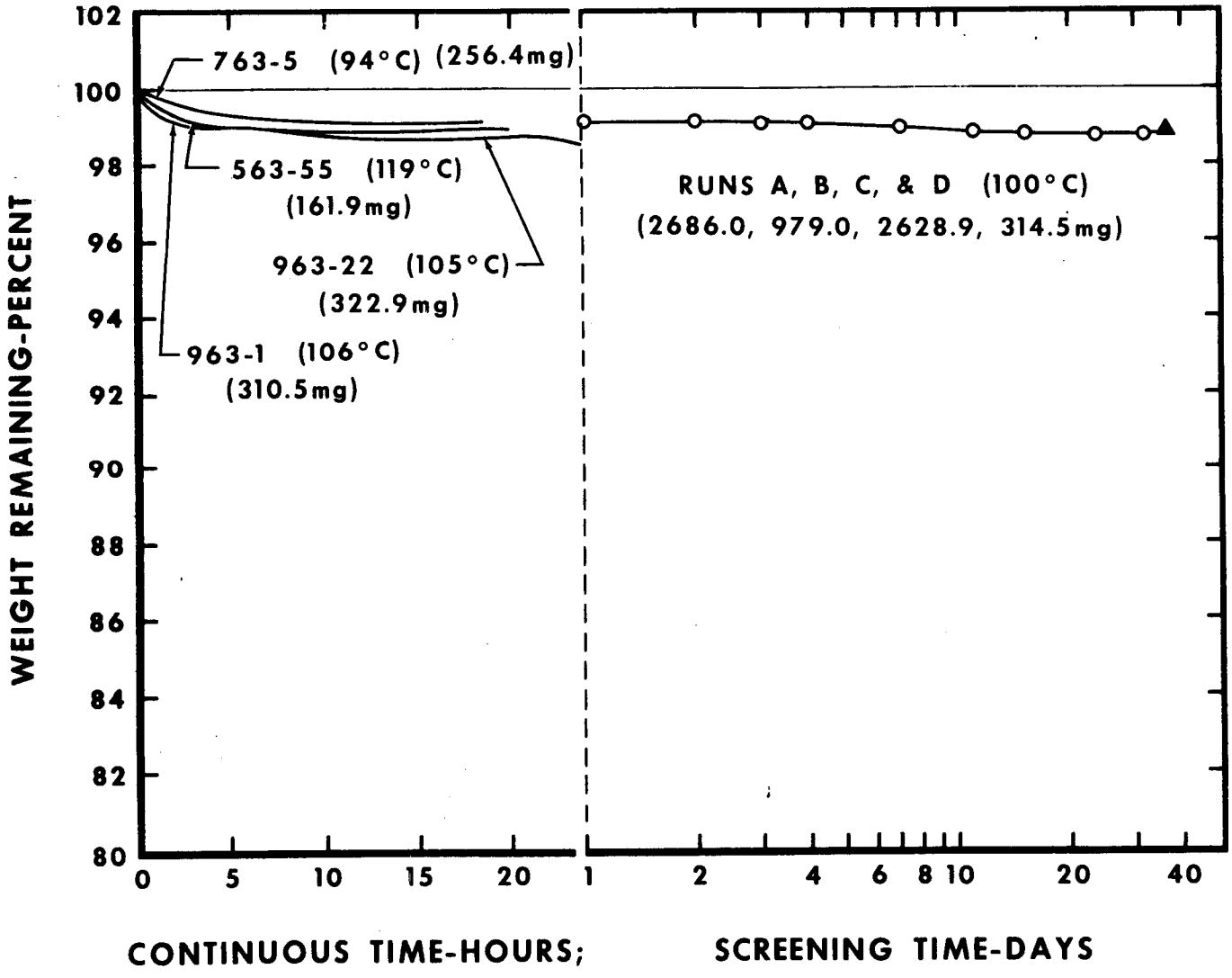

FIGURE 31. - TIME-WEIGHT HISTORIES FOR RTV-601 DURING EXPOSURE TO VACUUM AT 94°C, 100°C, 105°C, 106°C, AND 119°C

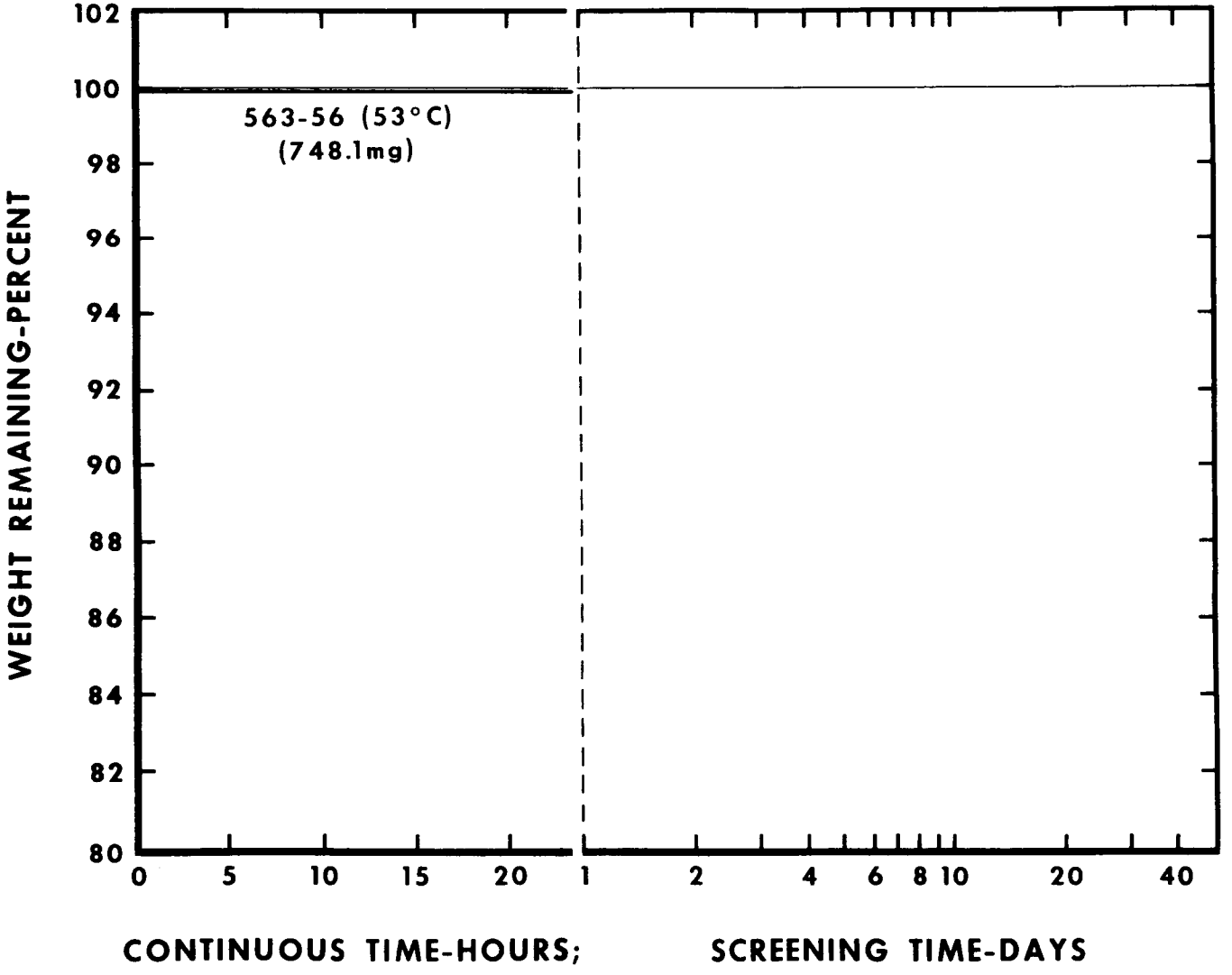

FIGURE 32. - TIME-WEIGHT HISTORIES FOR DCR-7521 DURING EXPOSURE TO VACUUM AT 53°C

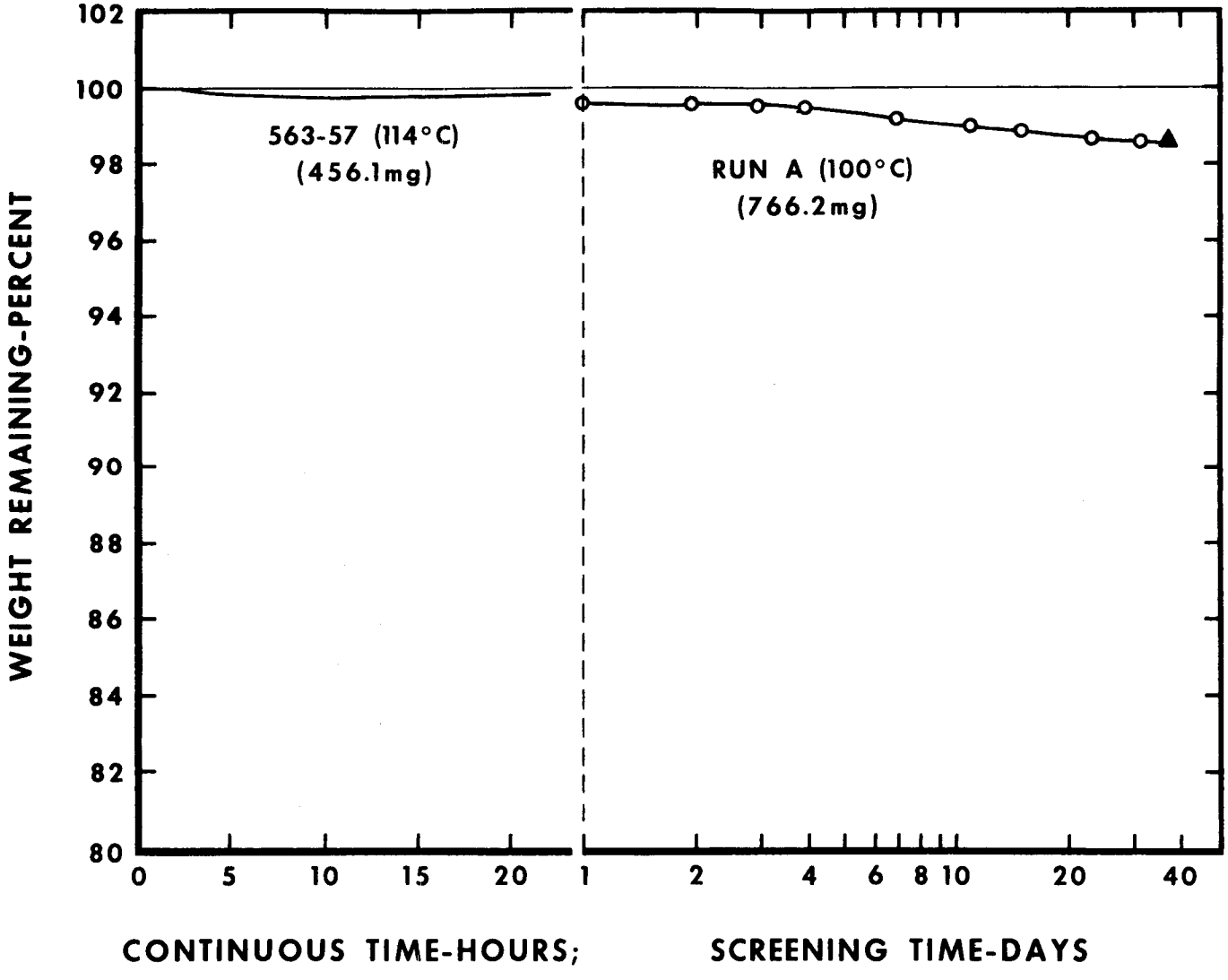

FIGURE 33. - TIME-WEIGHT HISTORIES FOR DCR-7521 DURING EXPOSURE TO VACUUM AT 100°C AND 114°C

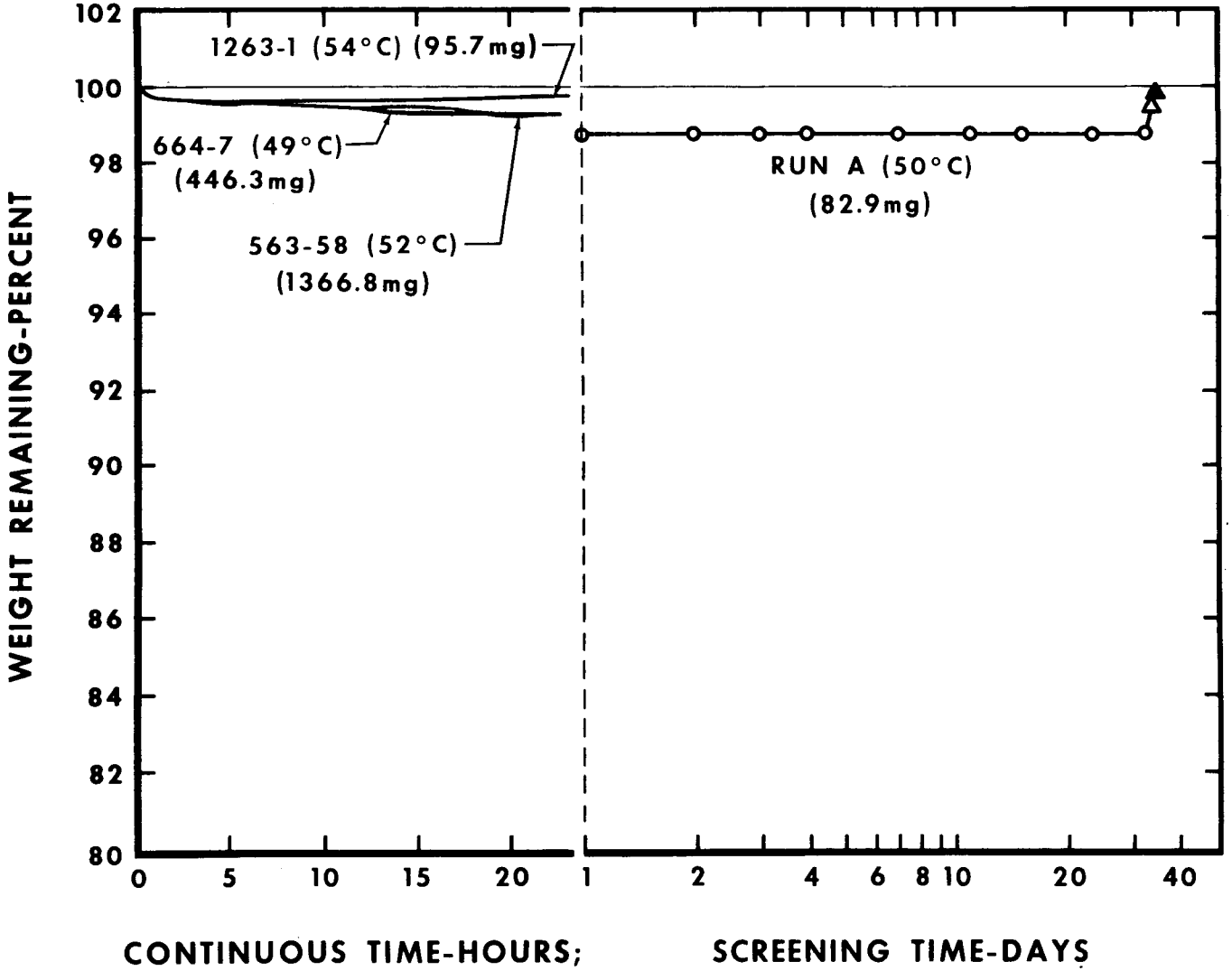

FIGURE 34. - TIME-WEIGHT HISTORIES FOR EC 2273 DURING EXPOSURE TO VACUUM AT 49°C, 50°C, 52°C, AND 54°C

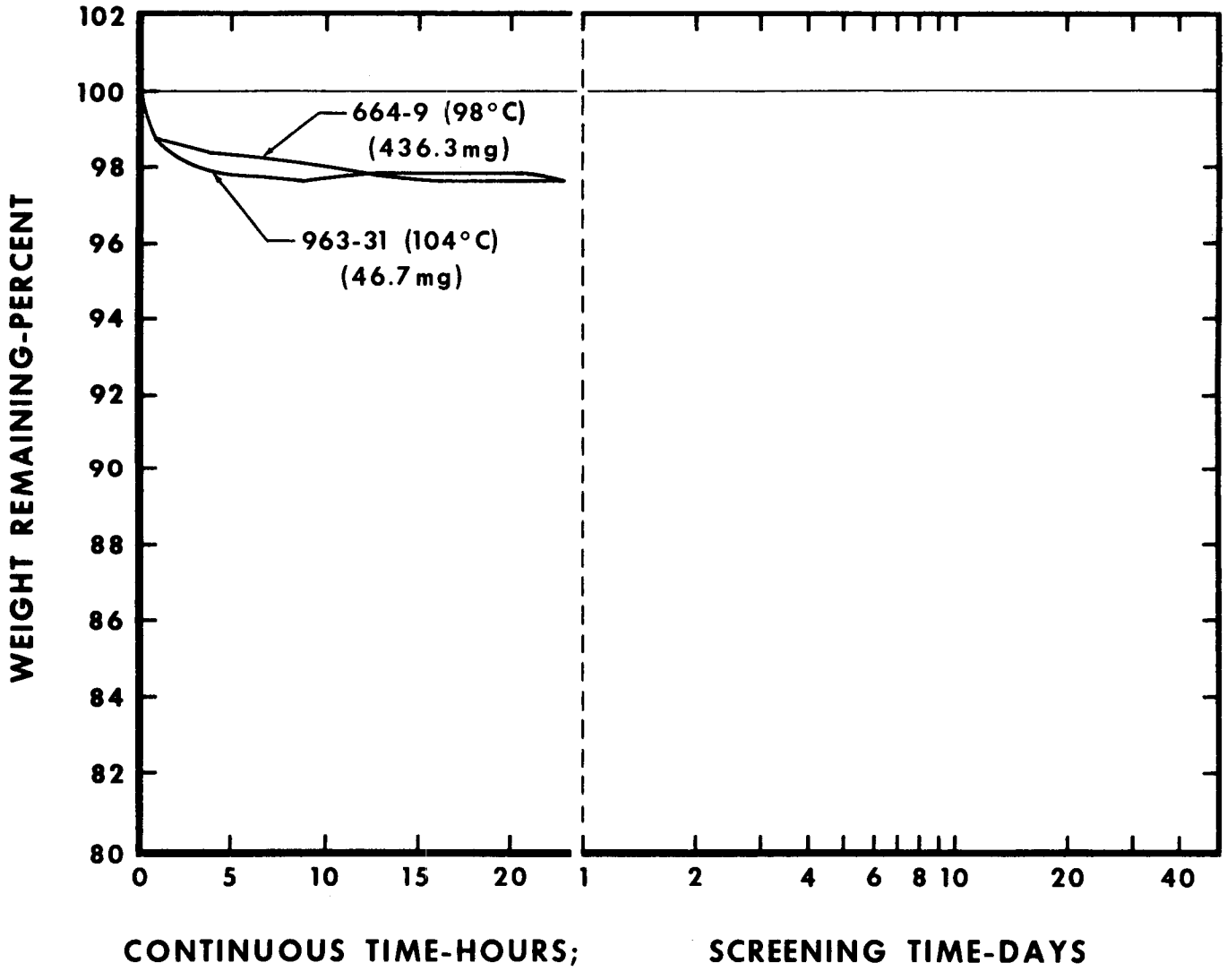

FIGURE 35. - TIME-WEIGHT HISTORIES FOR EC 2273 DURING EXPOSURE TO VACUUM AT 98°C AND 104°C

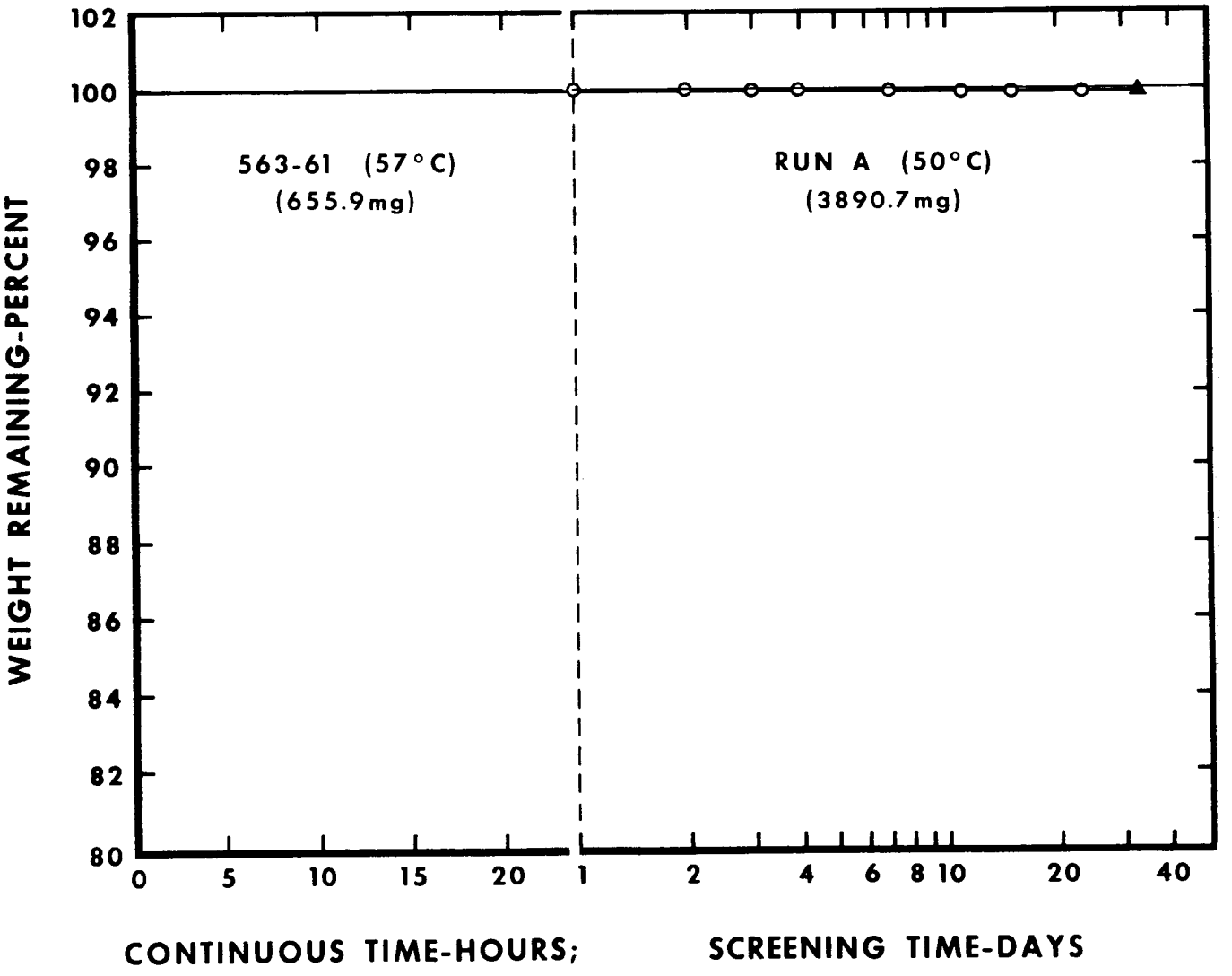

FIGURE 36. - TIME-WEIGHT HISTORIES FOR DUROCK D-133 DURING EXPOSURE TO VACUUM AT 50°C AND 57°C

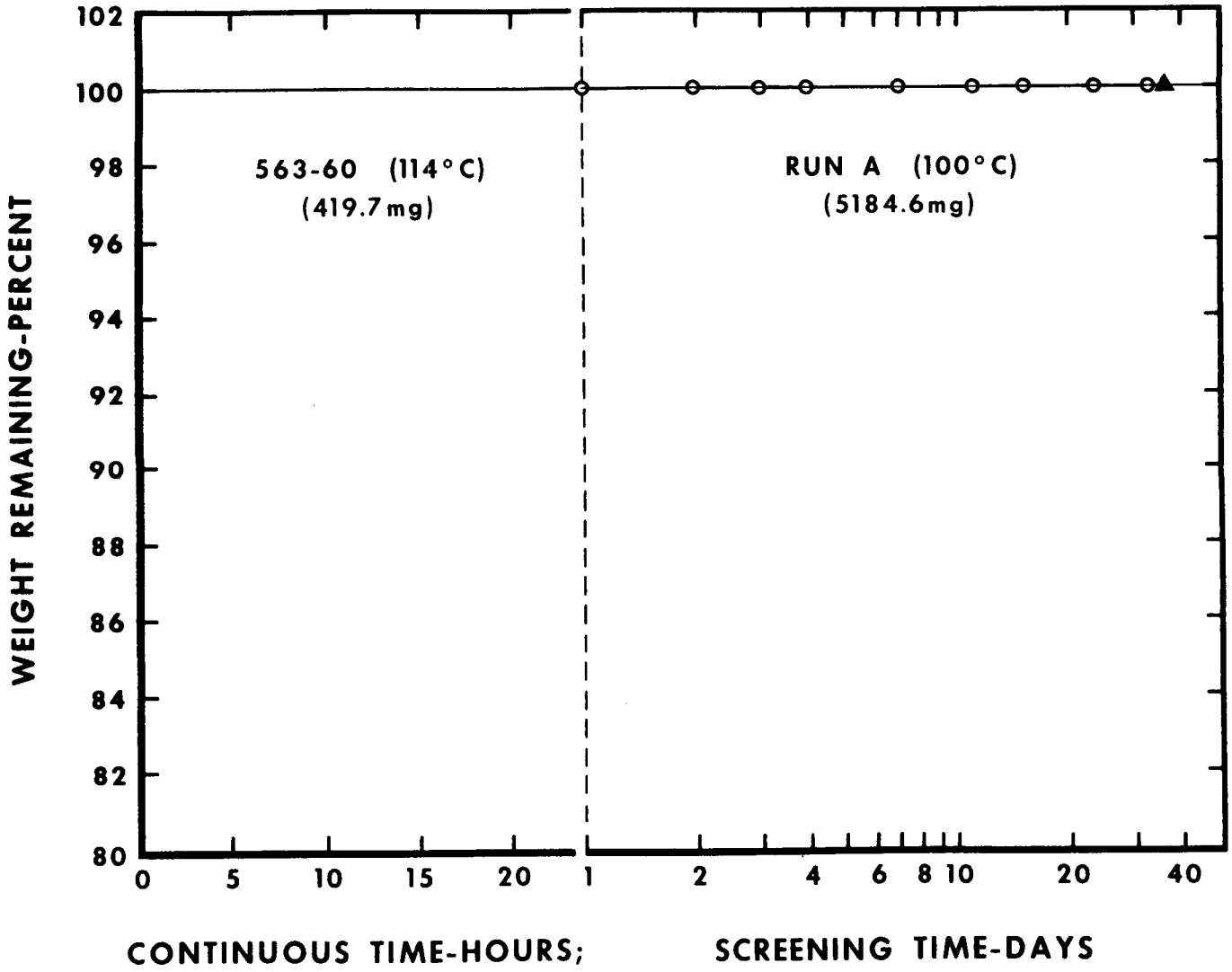

FIGURE 37. - TIME-WEIGHT HISTORIES FOR DUROCK D-133 DURING EXPOSURE TO VACUUM AT 100°C AND 114°C

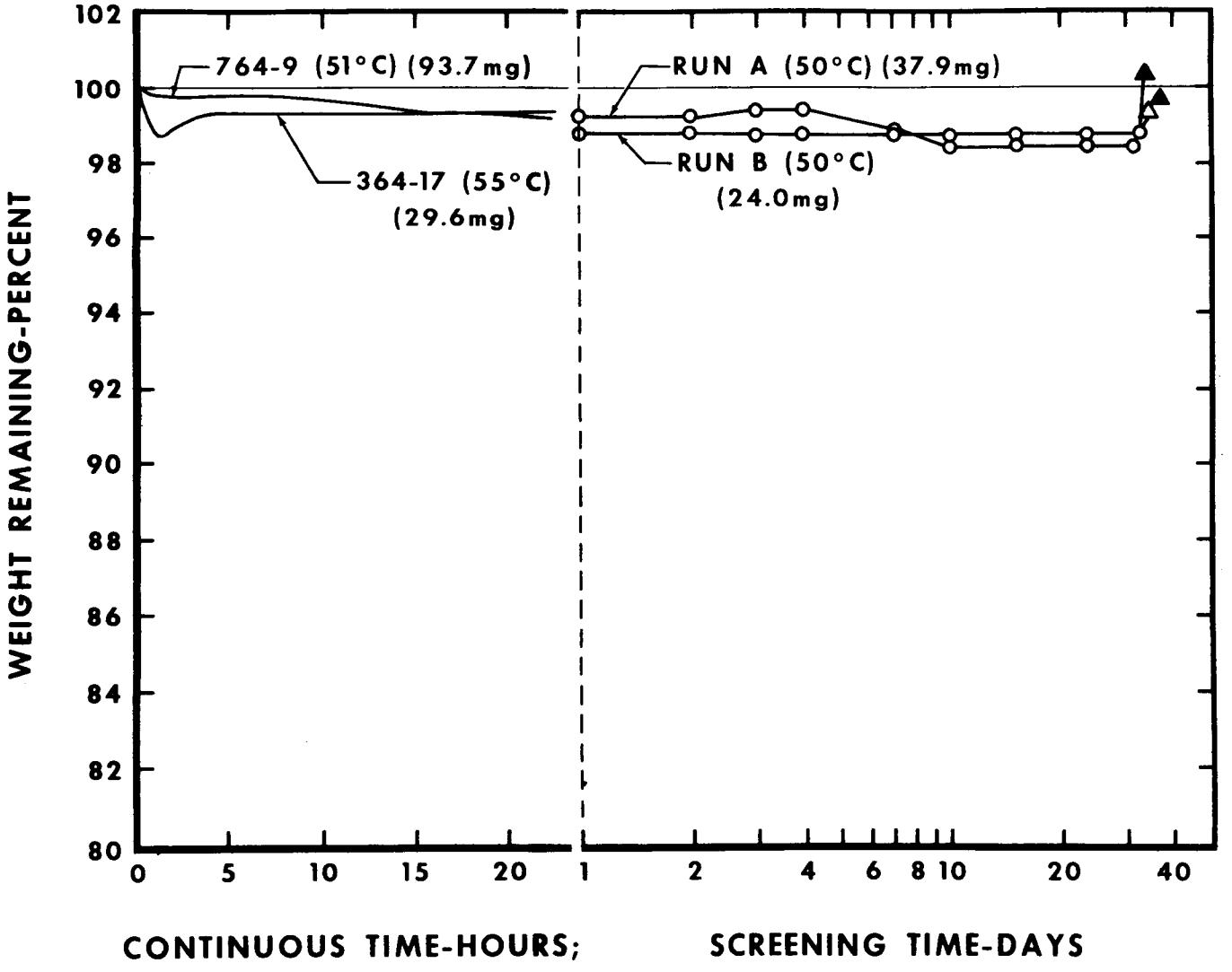

FIGURE 38. - TIME-WEIGHT HISTORIES FOR FM-47 DURING EXPOSURE TO VACUUM AT 50°C, 51°C, AND 55°C

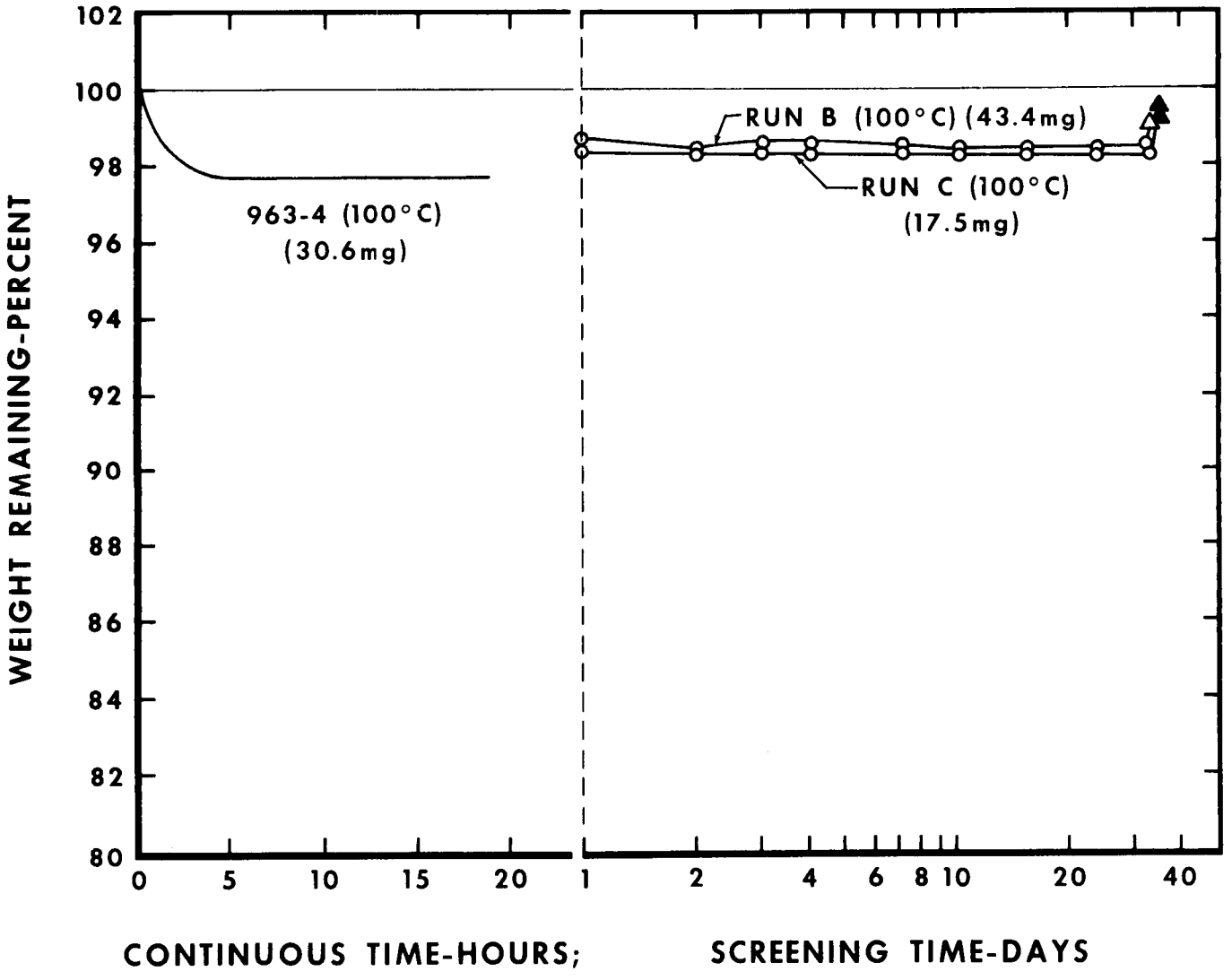

FIGURE 39. - TIME-WEIGHT HISTORIES FOR FM-47 DURING EXPOSURE TO VACUUM AT 100°C

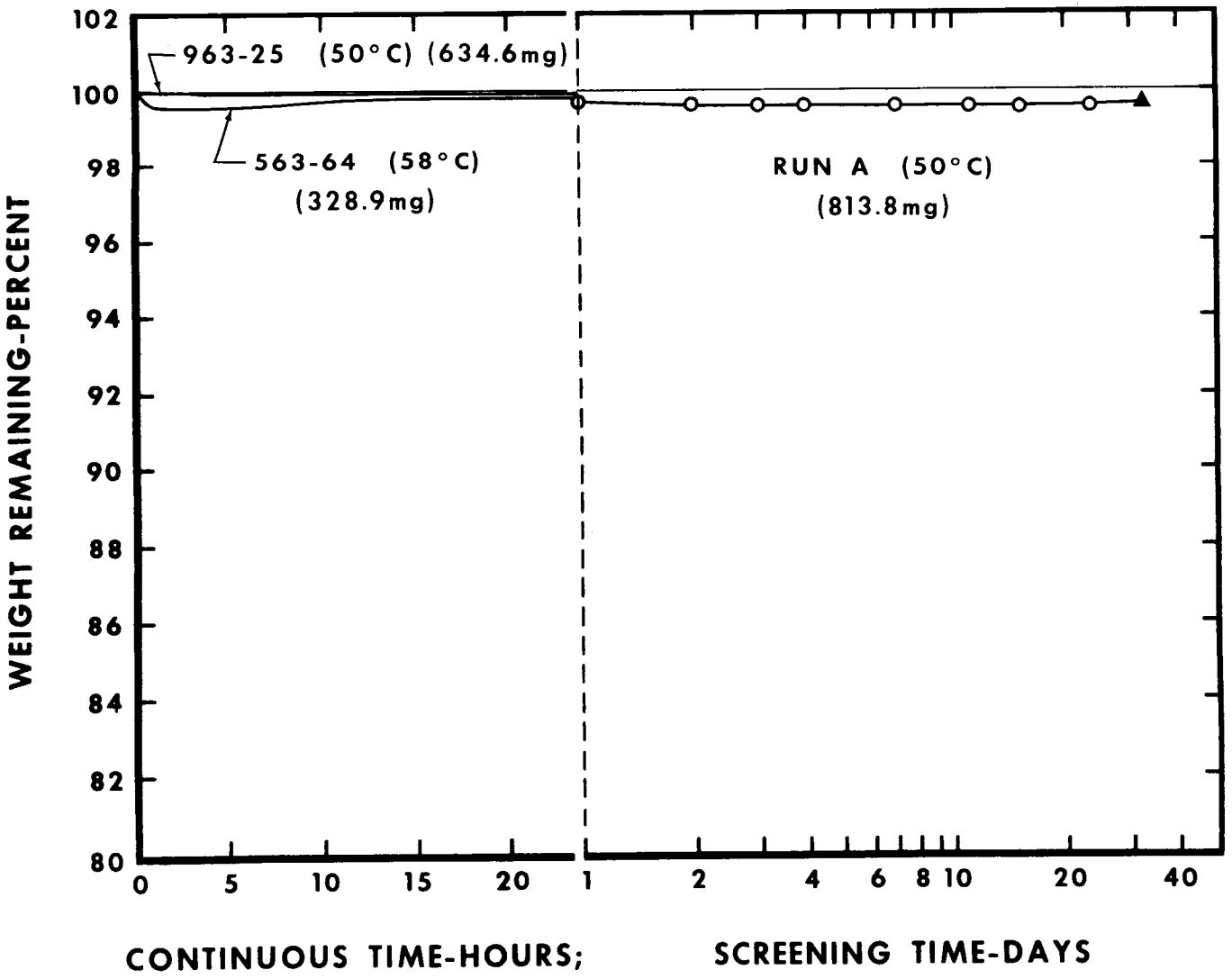

FIGURE 40. - TIME-WEIGHT HISTORIES FOR PARAPLEX P-43 DURING EXPOSURE TO VACUUM AT 50°C AND 58°C

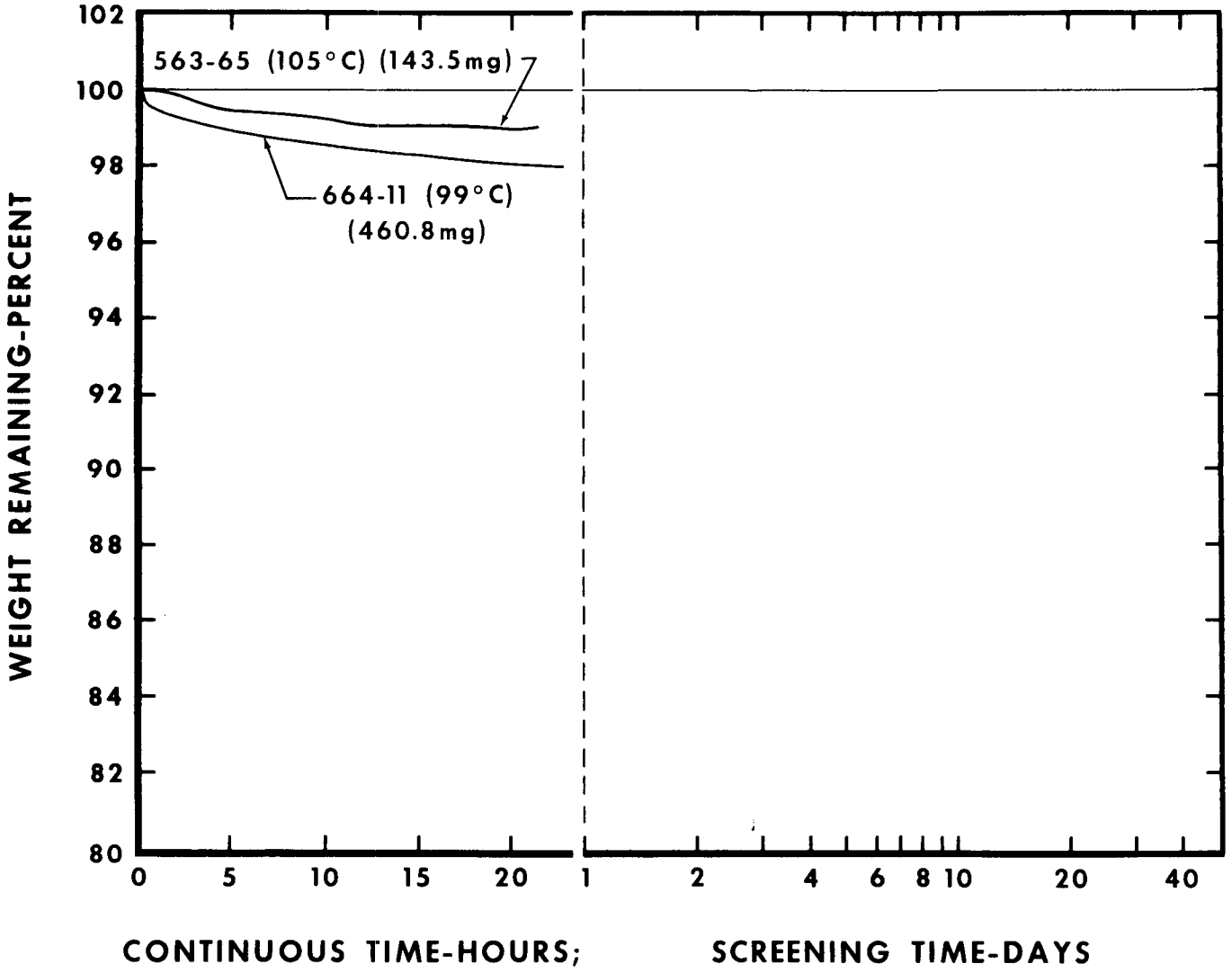

FIGURE 41. - TIME-WEIGHT HISTORIES FOR PARAPLEX P-43 DURING EXPOSURE TO VACUUM AT 99°C AND 105°C

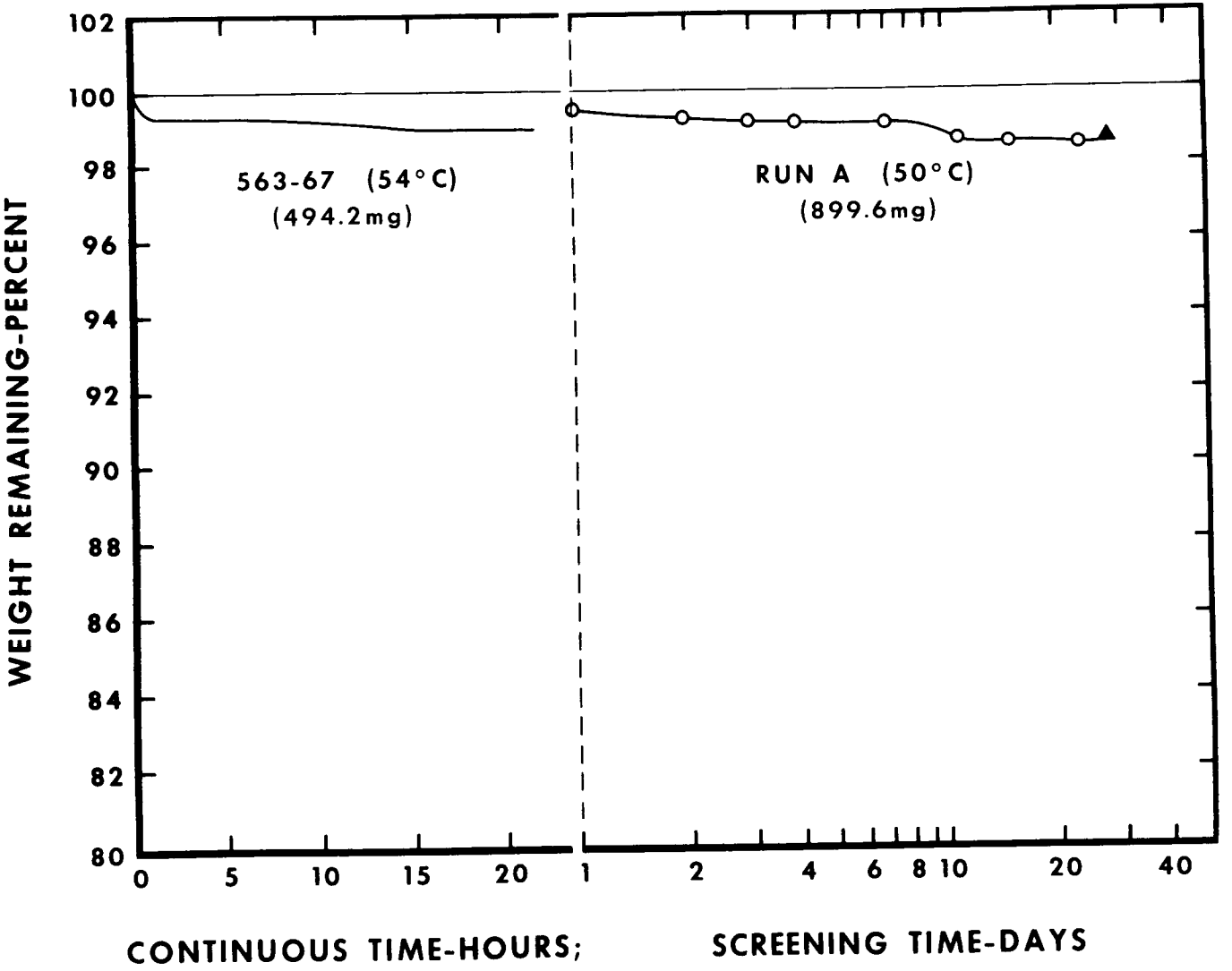

FIGURE 42. - TIME-WEIGHT HISTORIES FOR CTL-91-LD DURING EXPOSURE TO VACUUM AT 50°C AND 54°C

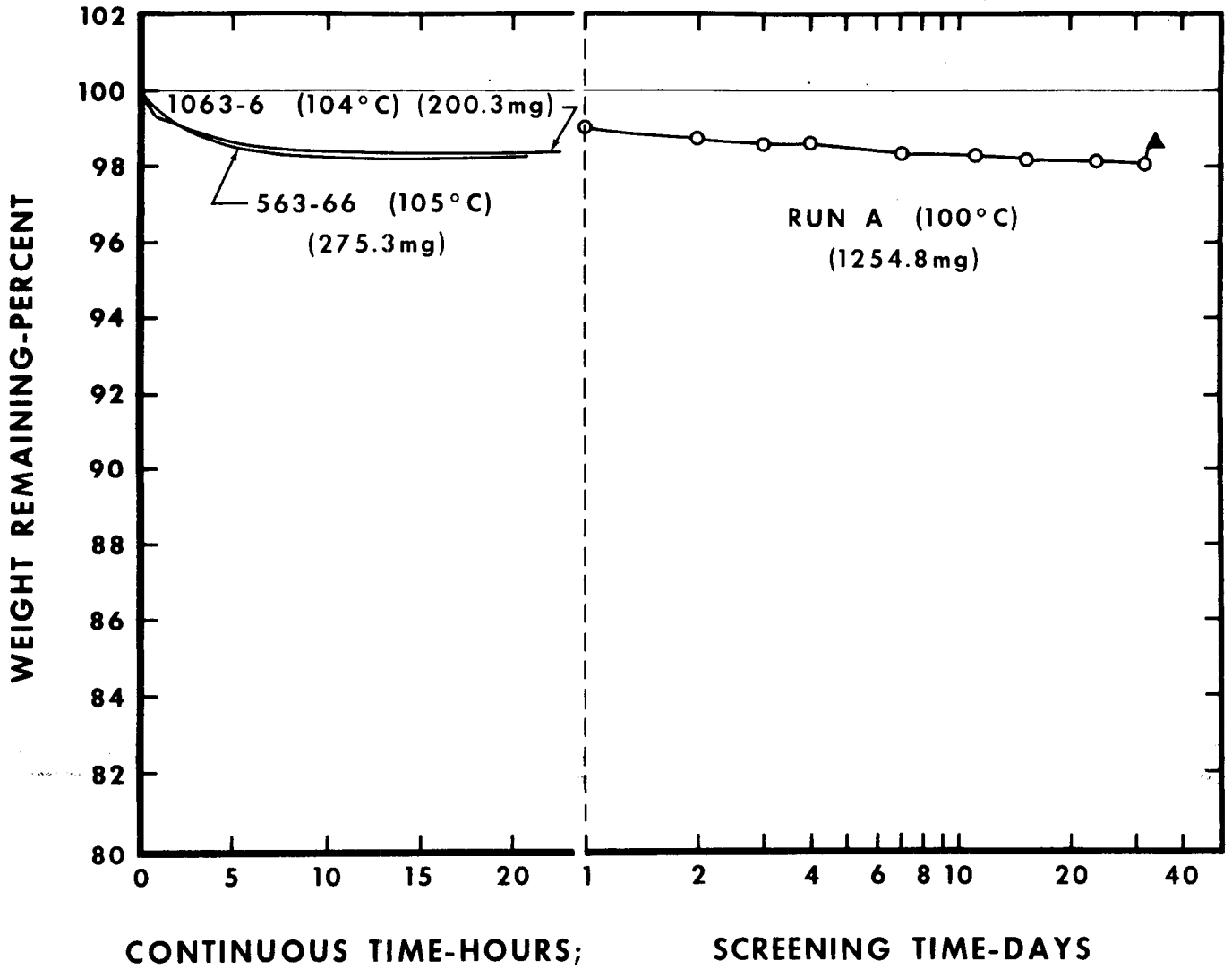

FIGURE 43. - TIME-WEIGHT HISTORIES FOR CTL-91-LD DURING EXPOSURE TO VACUUM AT 100°C, 104°C, AND 105°C

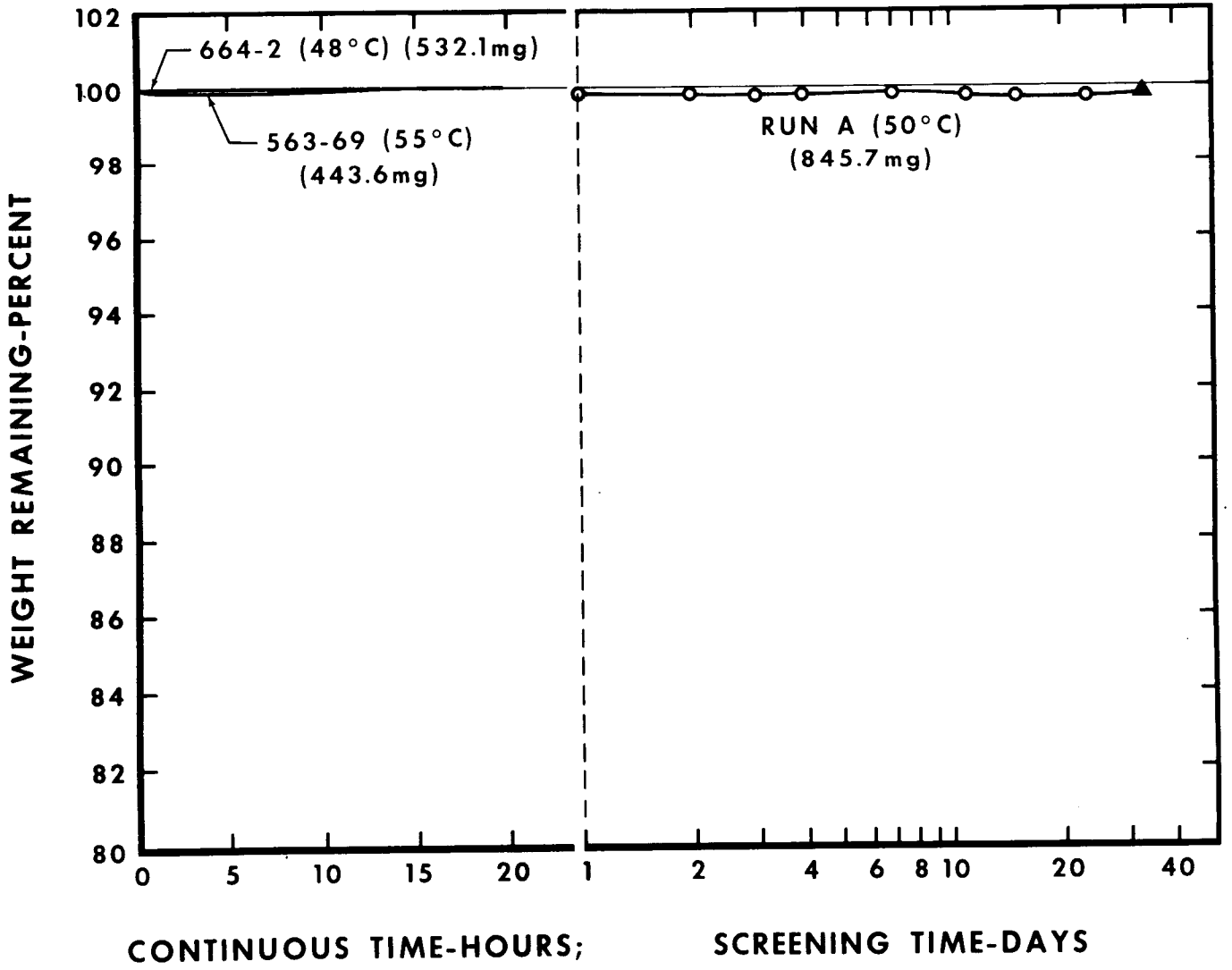

FIGURE 44. - TIME-WEIGHT HISTORIES FOR EPON 828 DURING EXPOSURE TO VACUUM AT 48°C, 50°C, AND 55°C

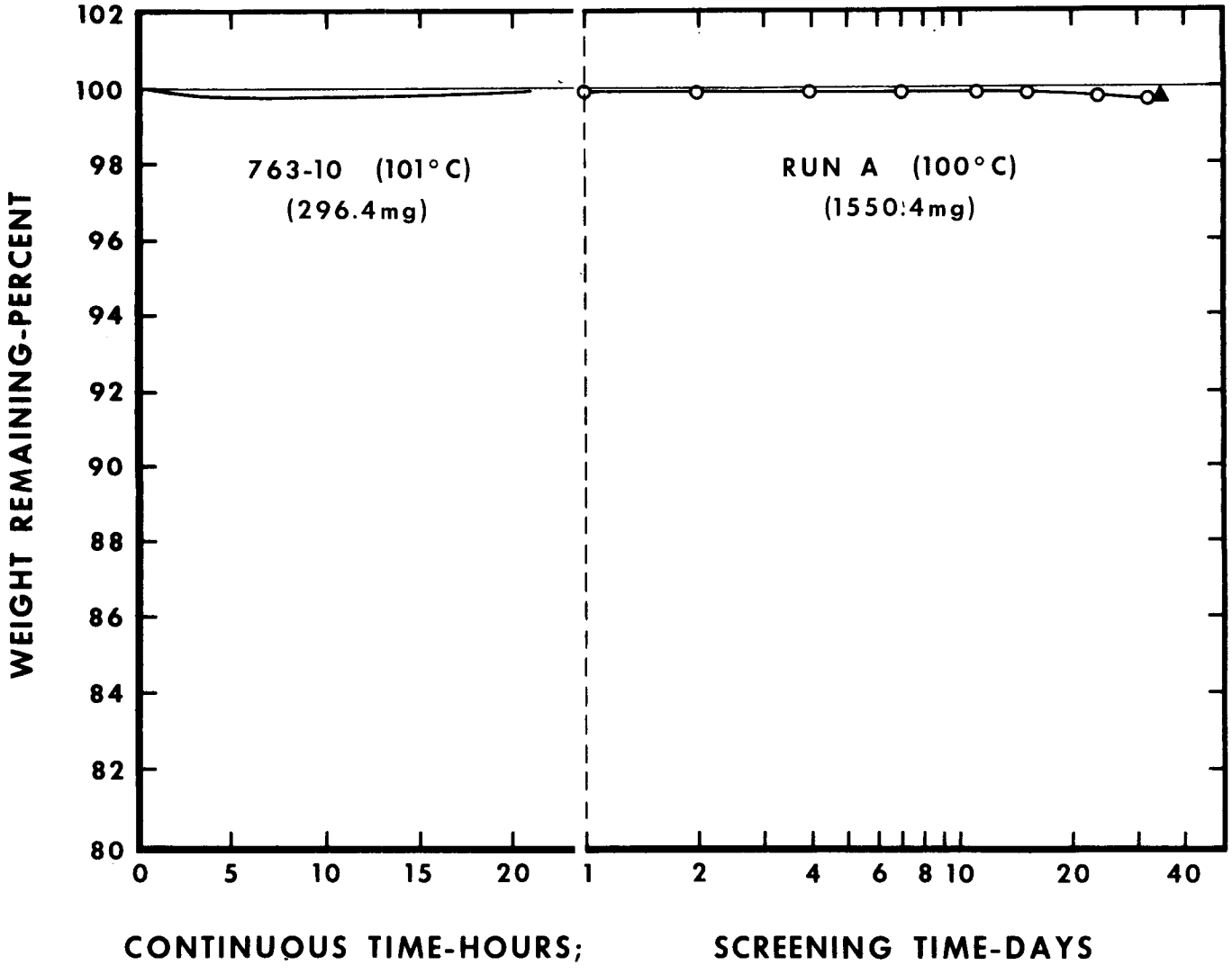

FIGURE 45. - TIME-WEIGHT HISTORIES FOR EPON 828 DURING EXPOSURE TO VACUUM AT 100°C AND 101°C

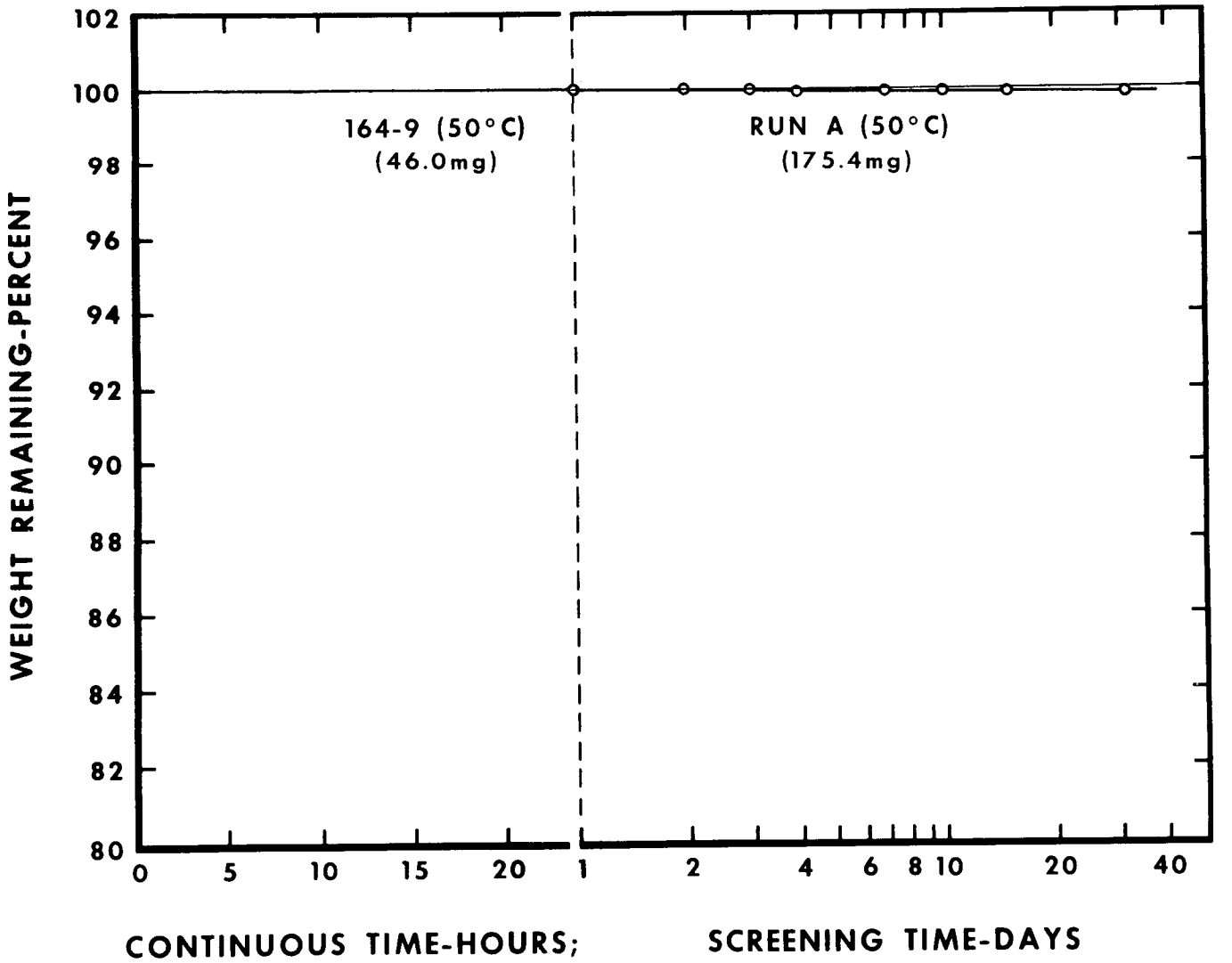

FIGURE 46. - TIME-WEIGHT HISTORIES FOR DC-2104 DURING EXPOSURE TO VACUUM AT 50°C

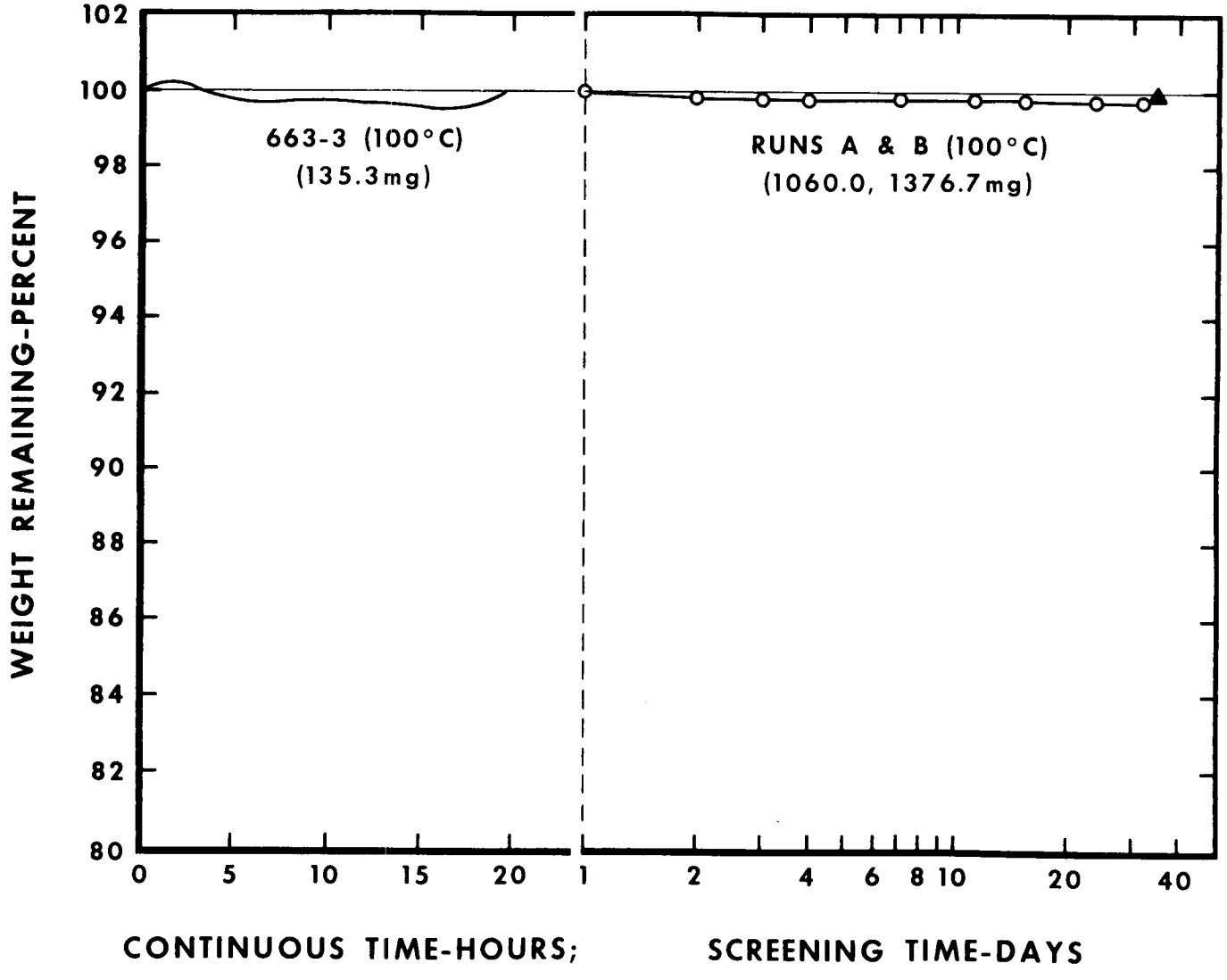

FIGURE 47. - TIME-WEIGHT HISTORIES FOR DC-2104 DURING EXPOSURE TO VACUUM AT 100°C

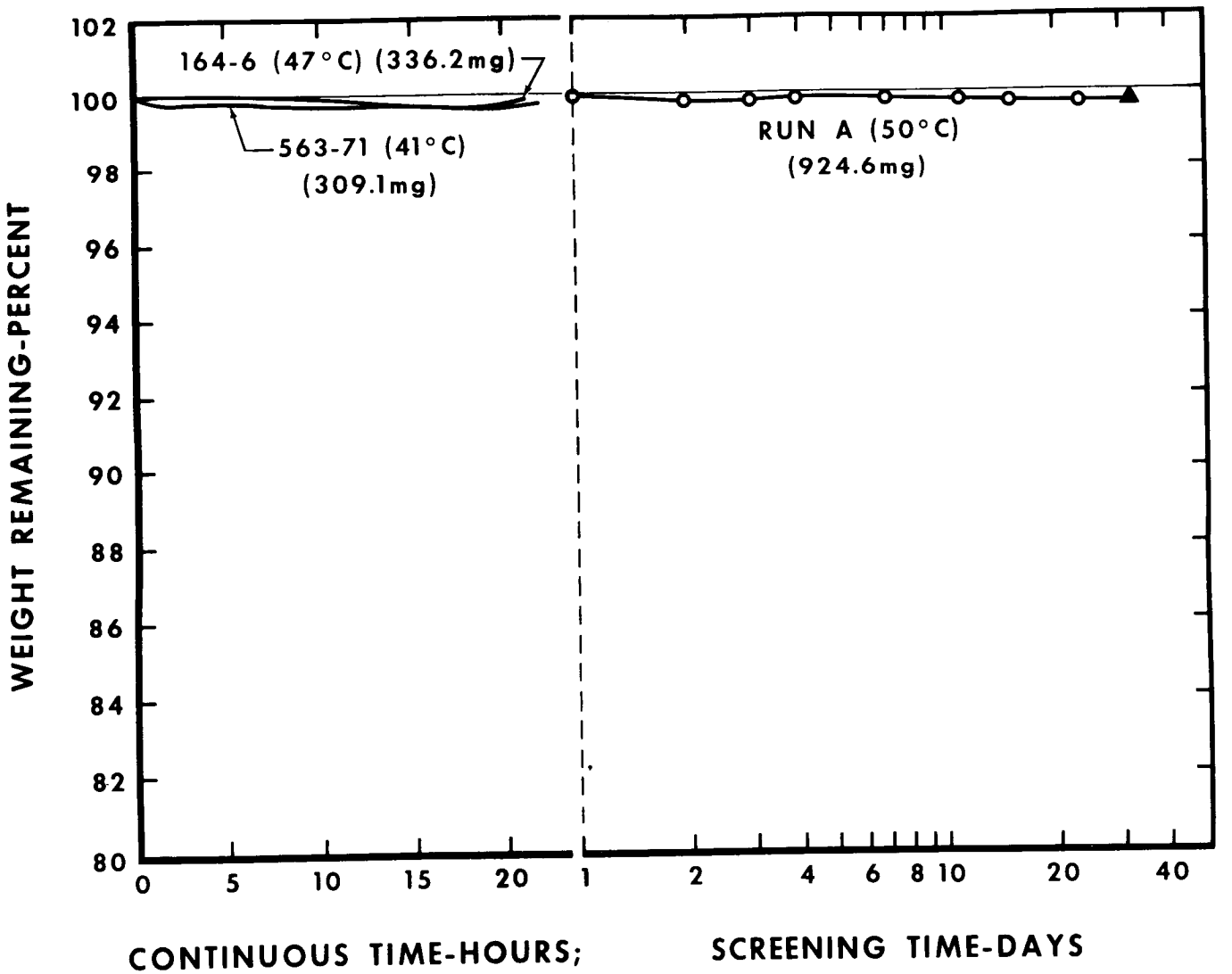

FIGURE 48. - TIME-WEIGHT HISTORIES FOR DC-2106 DURING EXPOSURE TO VACUUM AT 41°C, 47°C, AND 50°C

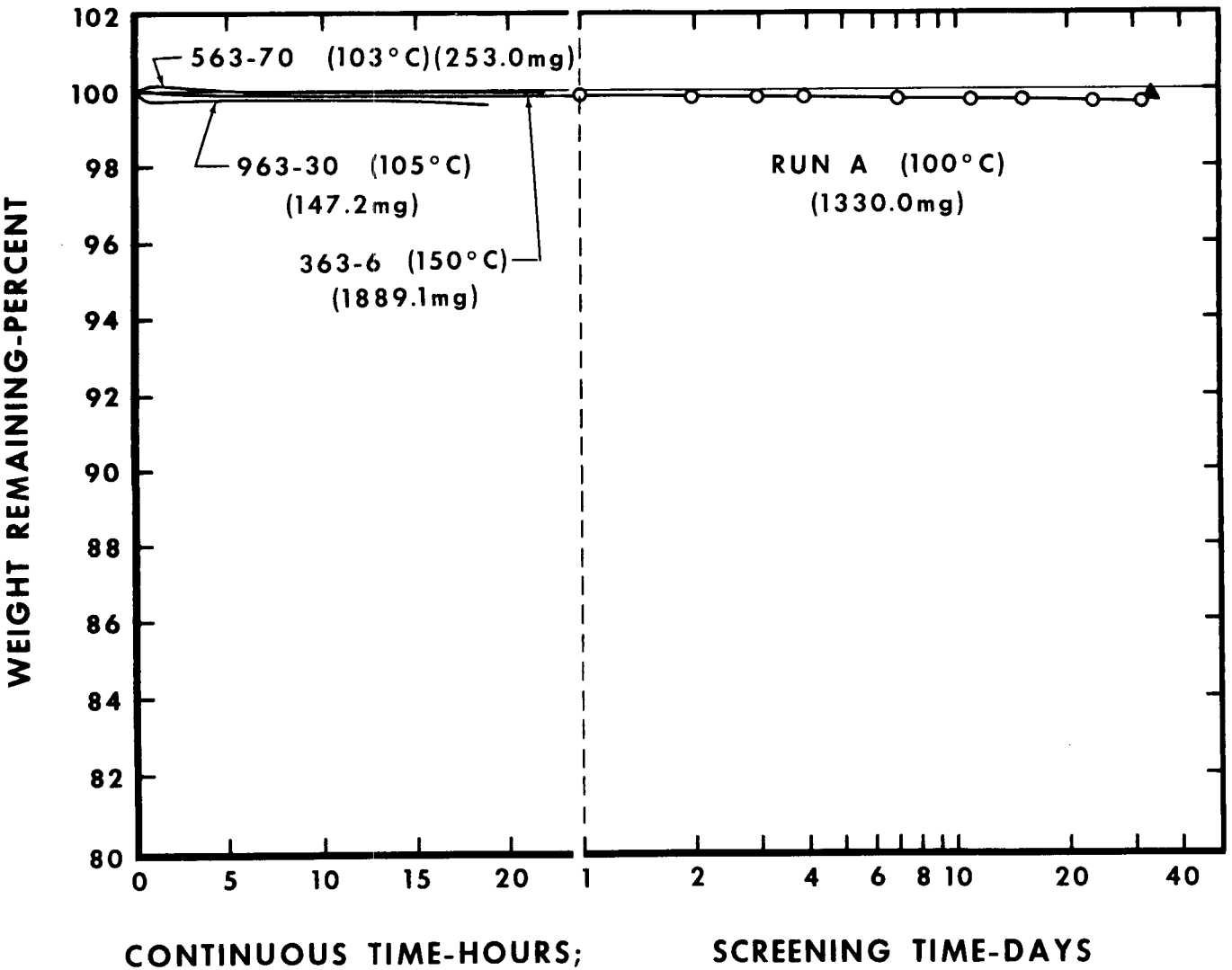

FIGURE 49. - TIME-WEIGHT HISTORIES FOR DC-2106 DURING EXPOSURE TO VACUUM AT 100°C, 103°C, 105°C, AND 150°C

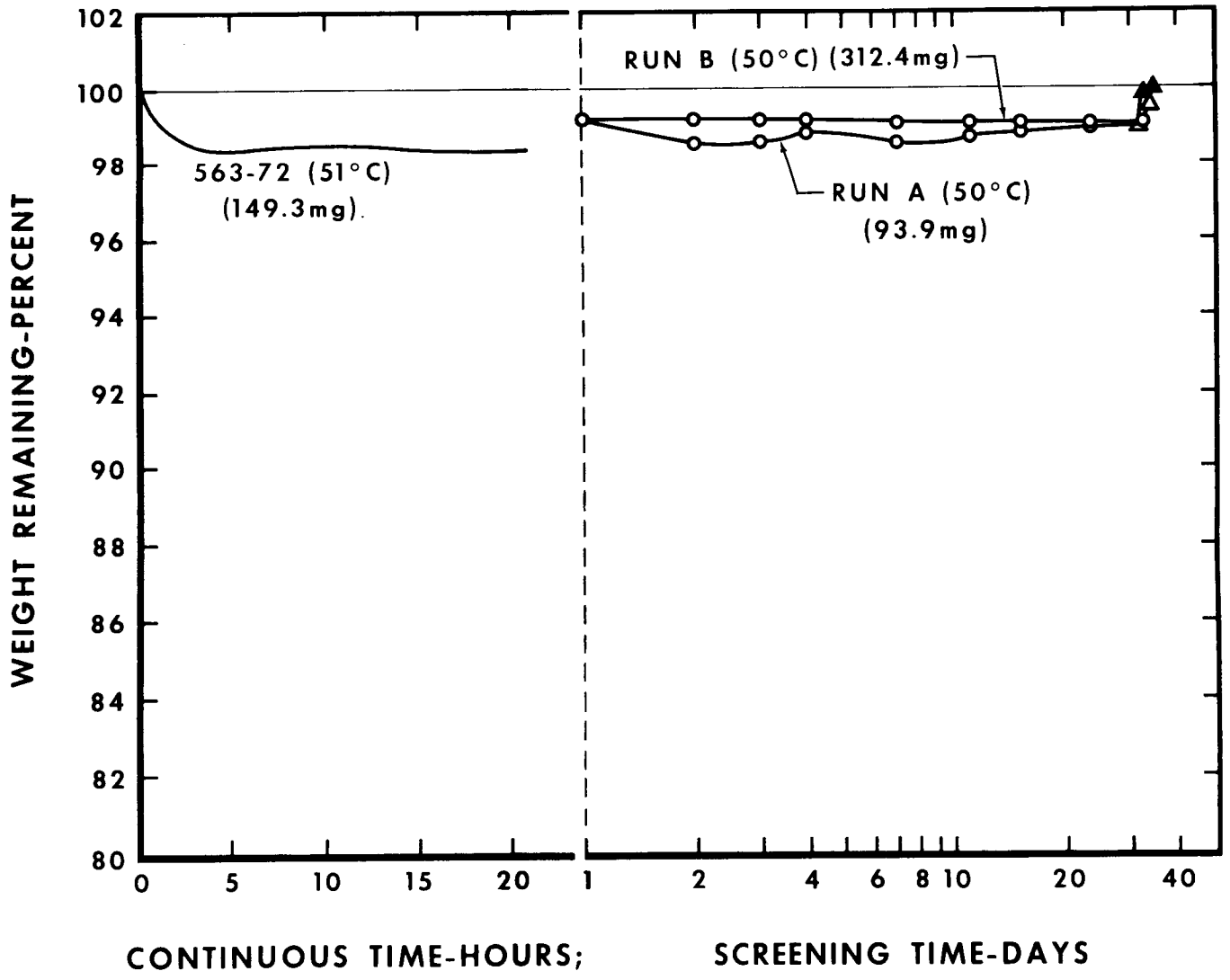

FIGURE 50. - TIME-WEIGHT HISTORIES FOR HRP HONEYCOMB DURING EXPOSURE TO VACUUM AT 50°C AND 51°C

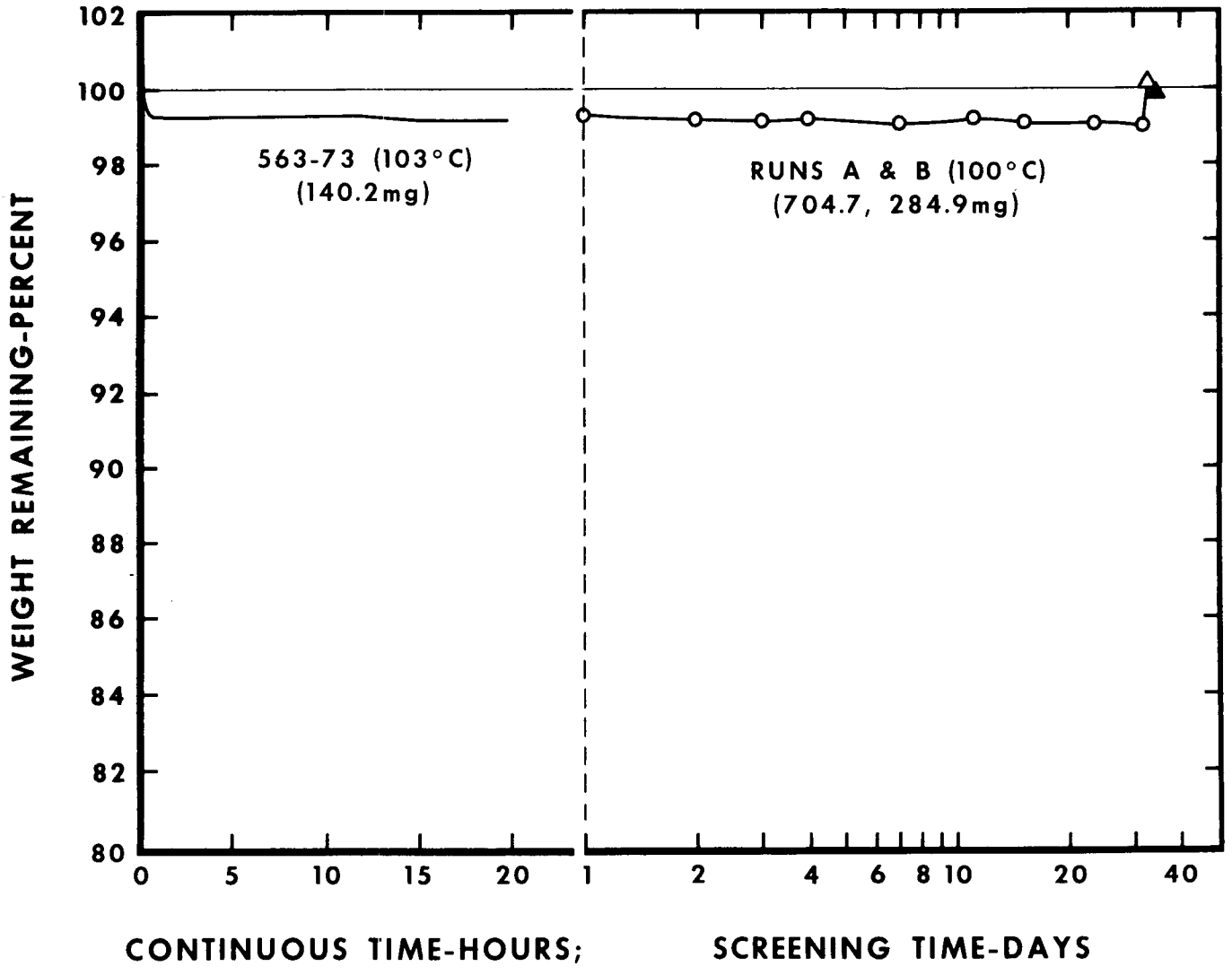

FIGURE 51. - TIME-WEIGHT HISTORIES FOR HRP HONEYCOMB DURING EXPOSURE TO VACUUM AT 100°C AND 103°C

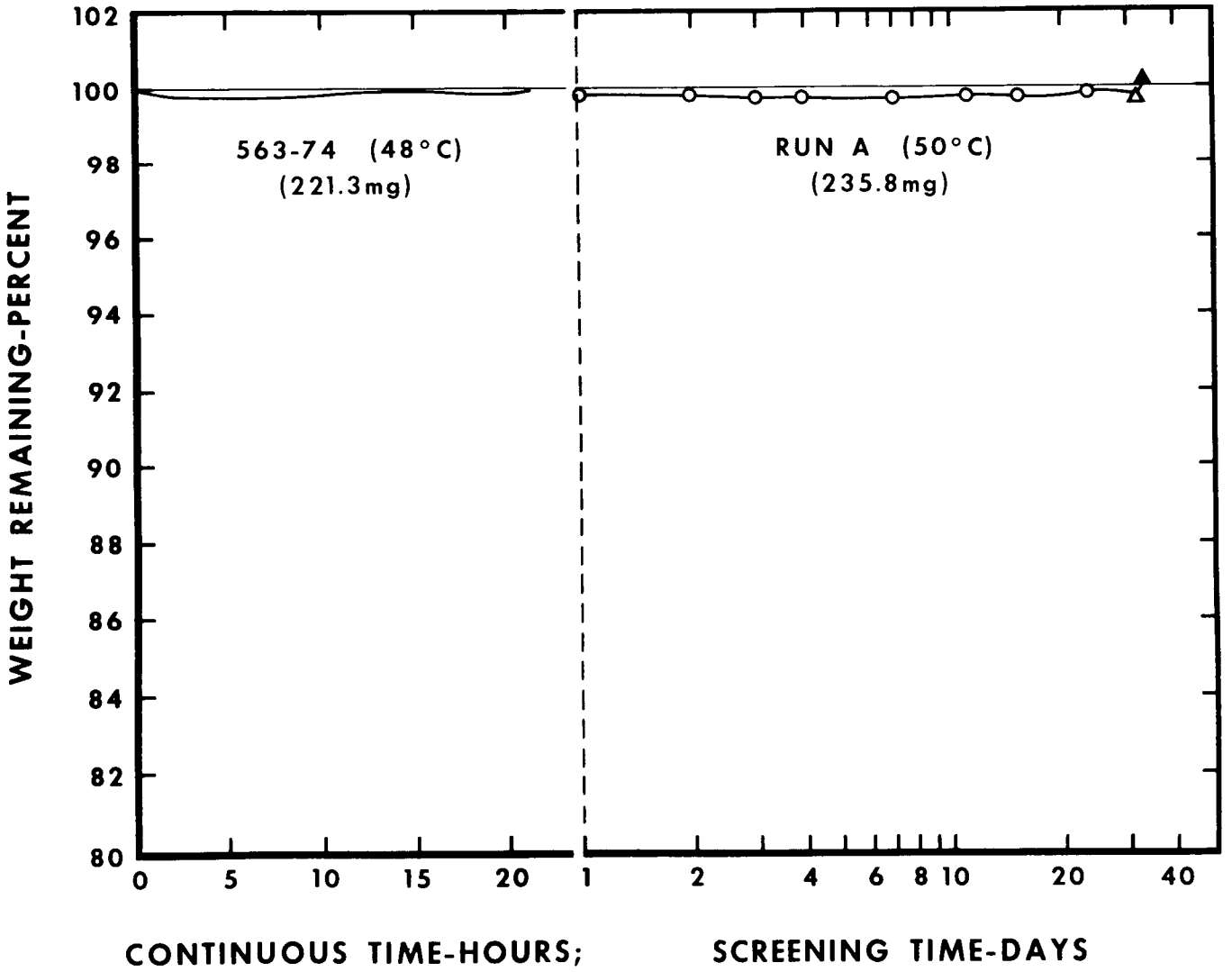

FIGURE 52. - TIME-WEIGHT HISTORIES FOR VITON B DURING EXPOSURE TO VACUUM AT 48°C AND 50°C

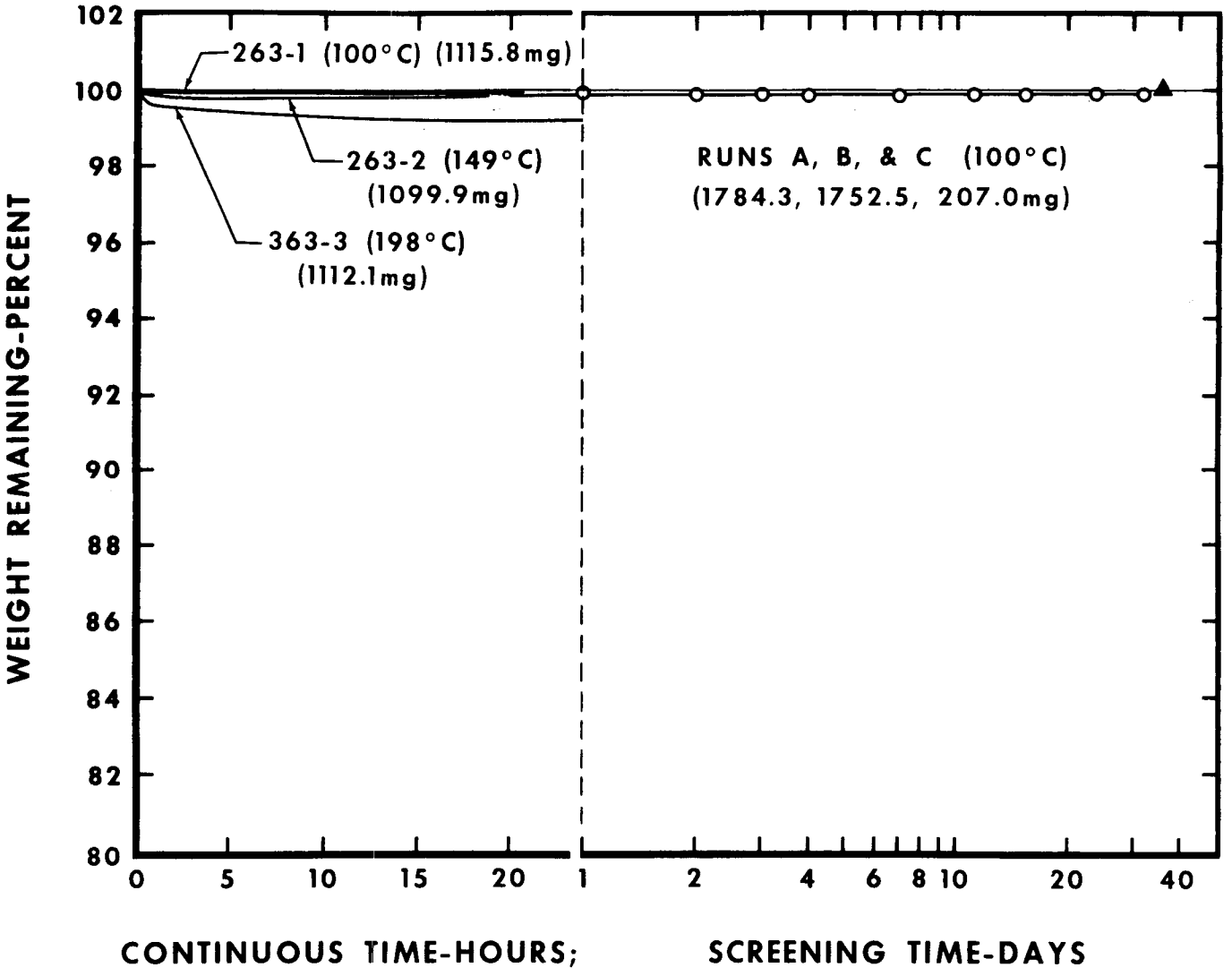

FIGURE 53. - TIME-WEIGHT HISTORIES FOR VITON B DURING EXPOSURE TO VACUUM AT 100°C, 149°C, AND 198°C

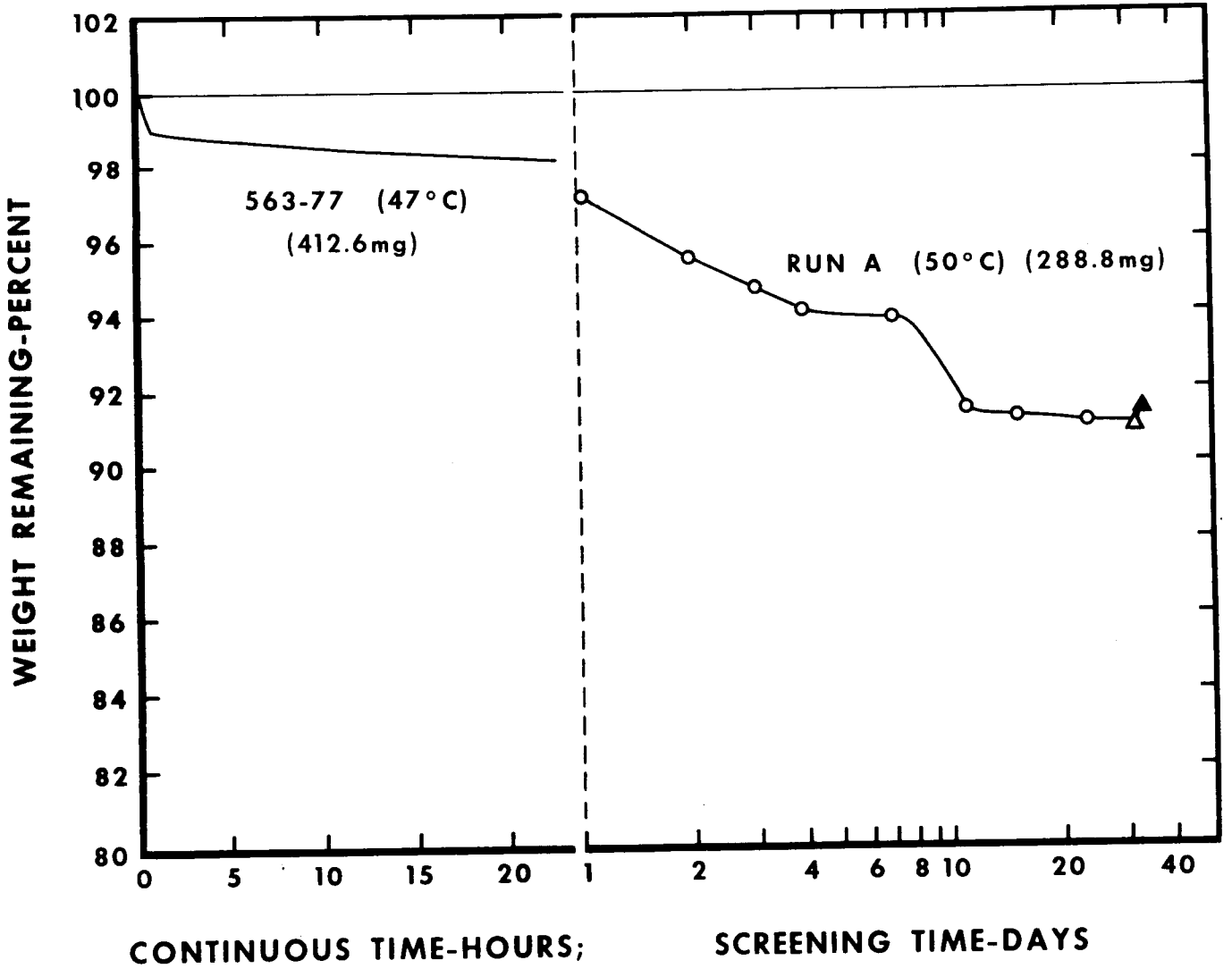

FIGURE 54. - TIME-WEIGHT HISTORIES FOR PRP 73770 DURING EXPOSURE TO VACUUM AT 47°C AND 50°C

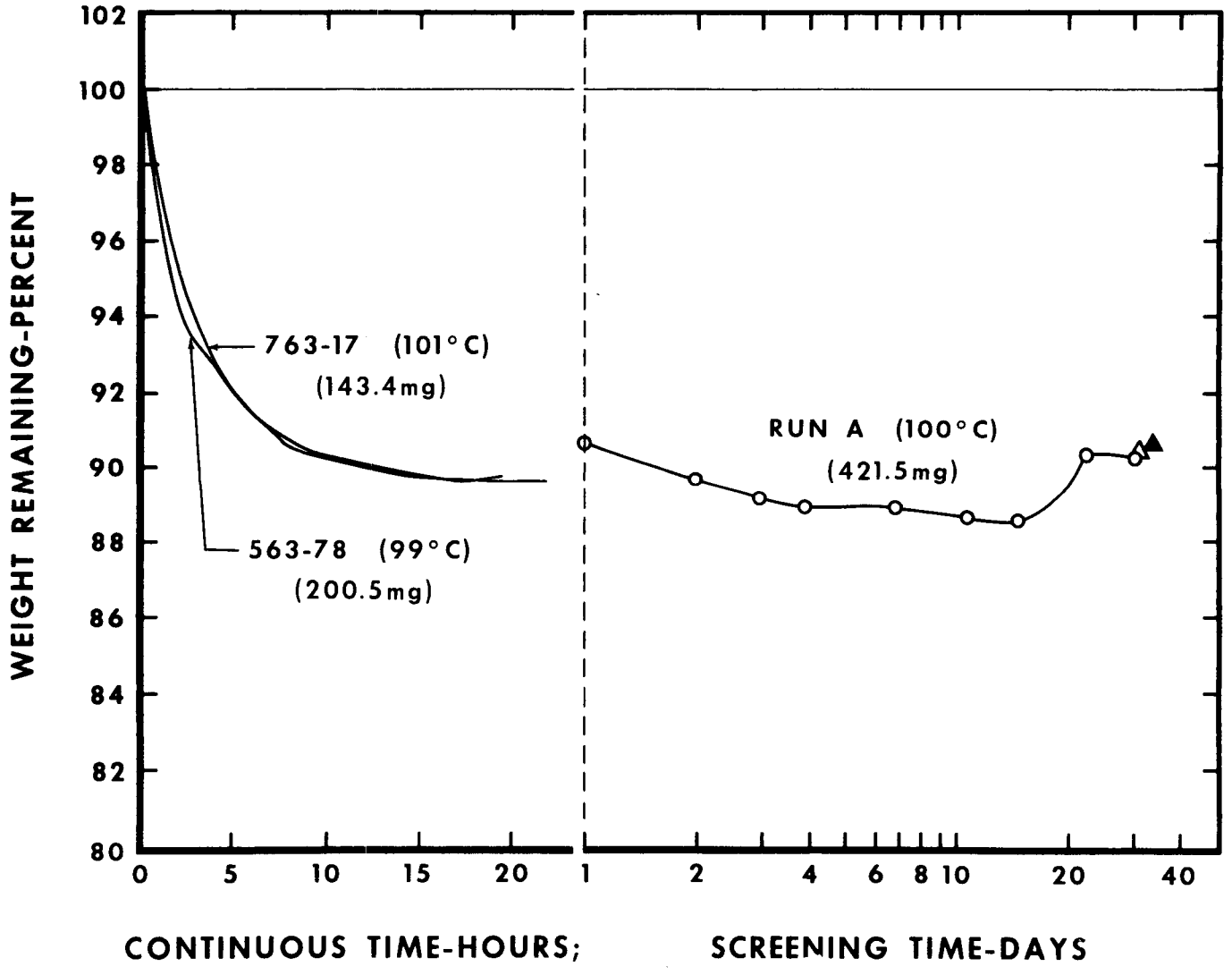

FIGURE 55. - TIME-WEIGHT HISTORIES FOR PRP 73770 DURING EXPOSURE TO VACUUM AT 99°C, 100°C, AND 101°C

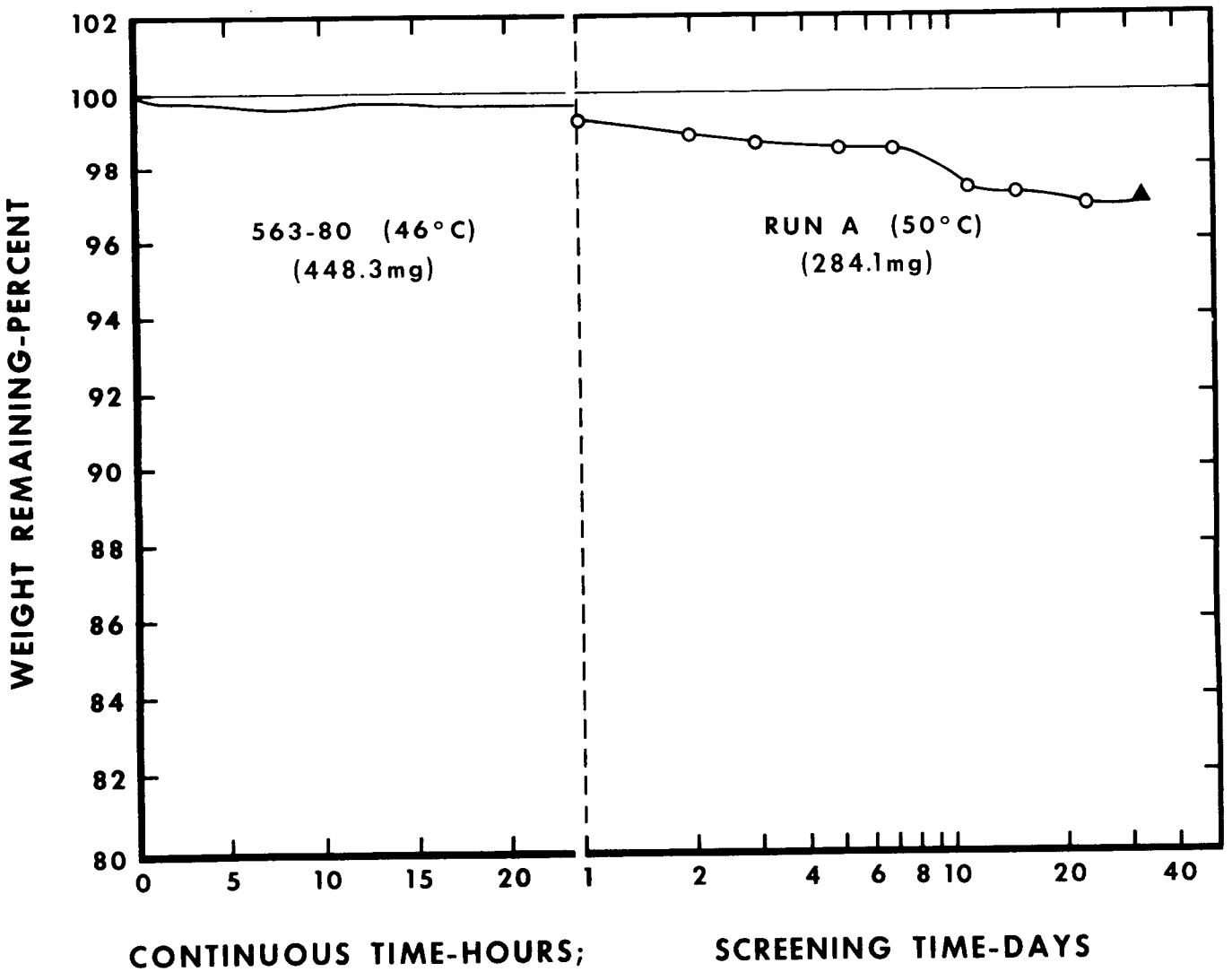

FIGURE 56. - TIME-WEIGHT HISTORIES FOR PRP 8187 DURING EXPOSURE TO VACUUM AT 46°C AND 50°C

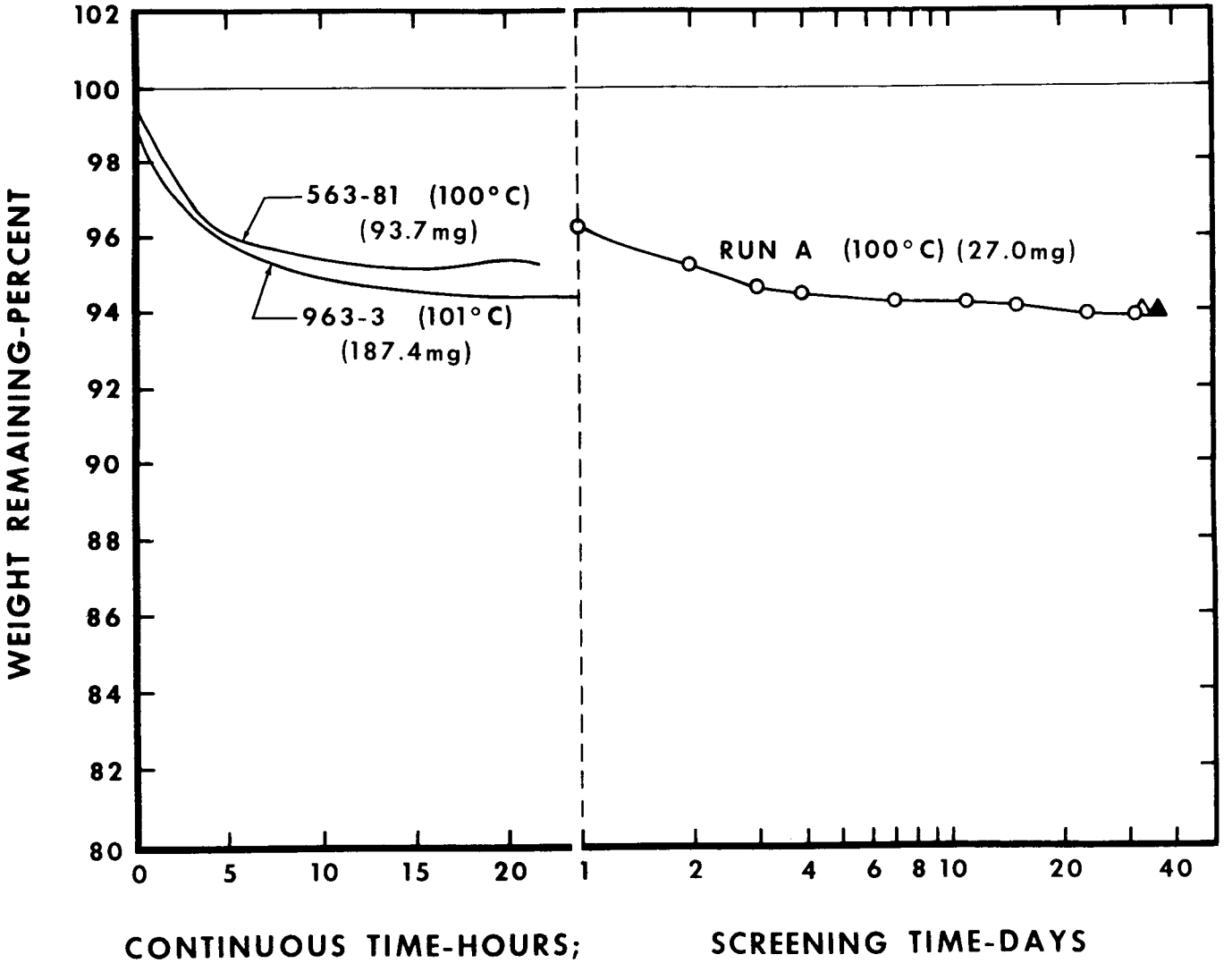

FIGURE 57. - TIME-WEIGHT HISTORIES FOR PRP 8187 DURING EXPOSURE TO VACUUM AT 100°C AND 101°C

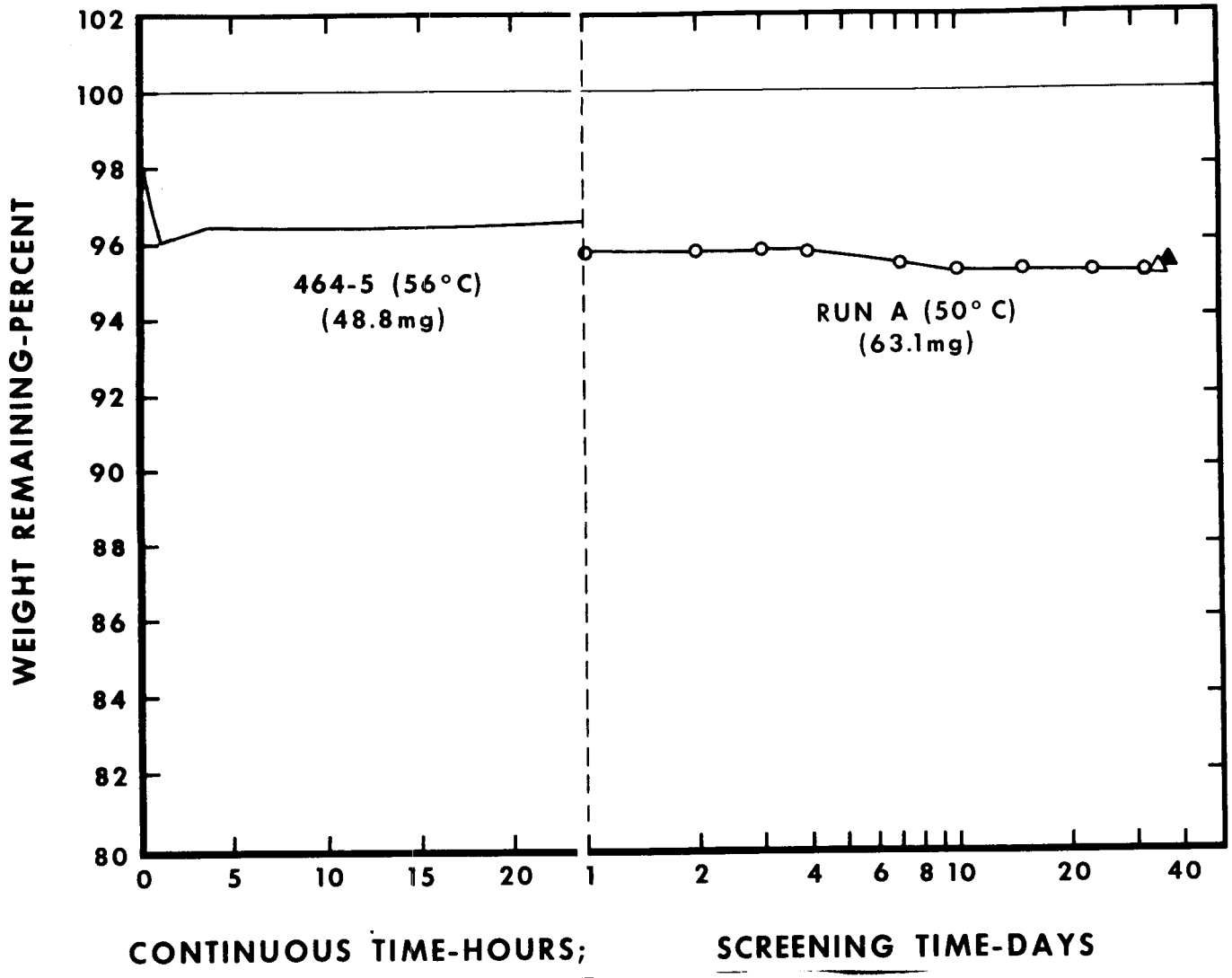

FIGURE 58. - TIME-WEIGHT HISTORIES FOR URETHANE DS-620 DURING EXPOSURE TO VACUUM AT 50°C AND 56°C

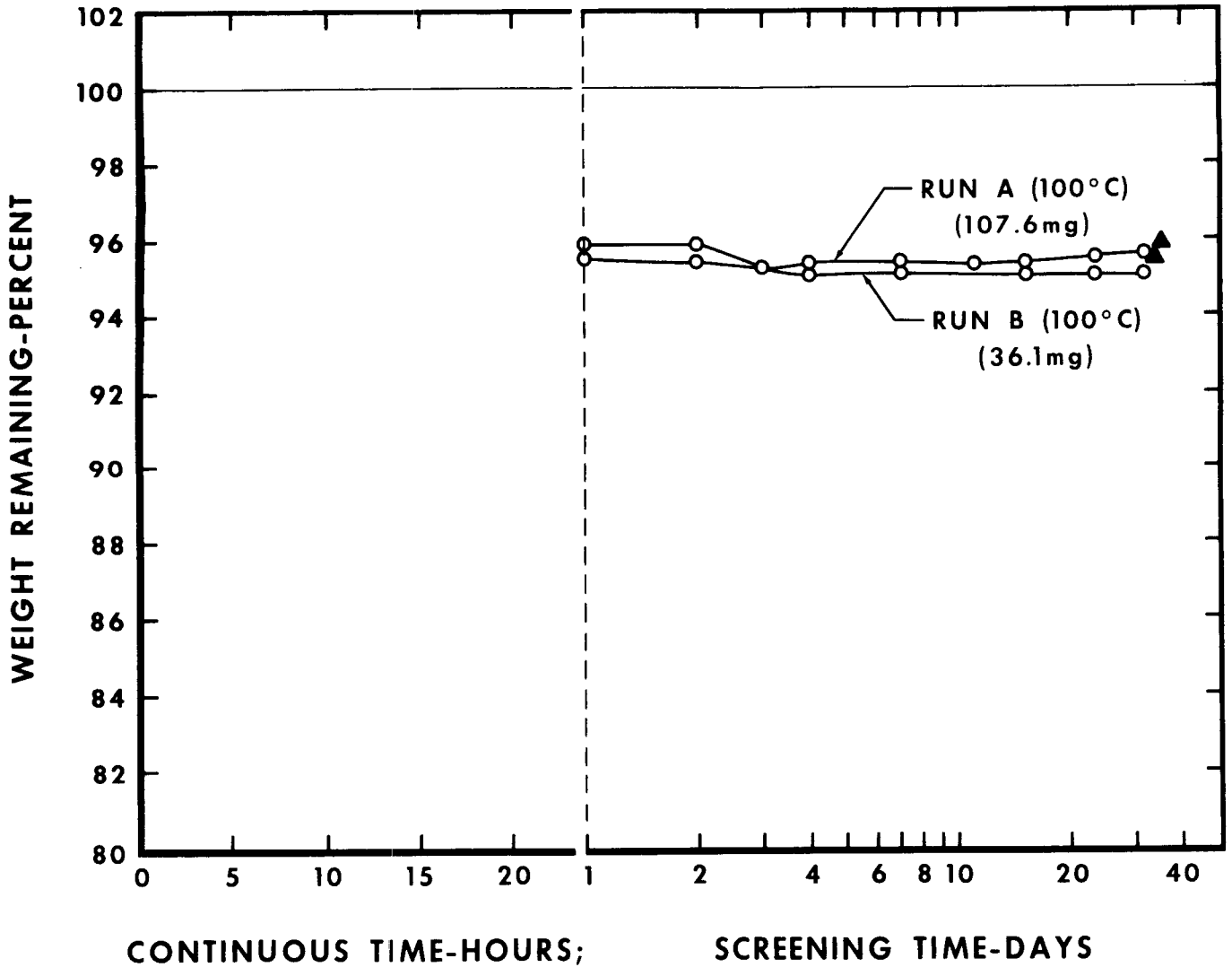

FIGURE 59. - TIME-WEIGHT HISTORIES FOR URETHANE DS-620 DURING EXPOSURE TO VACUUM AT 100°C

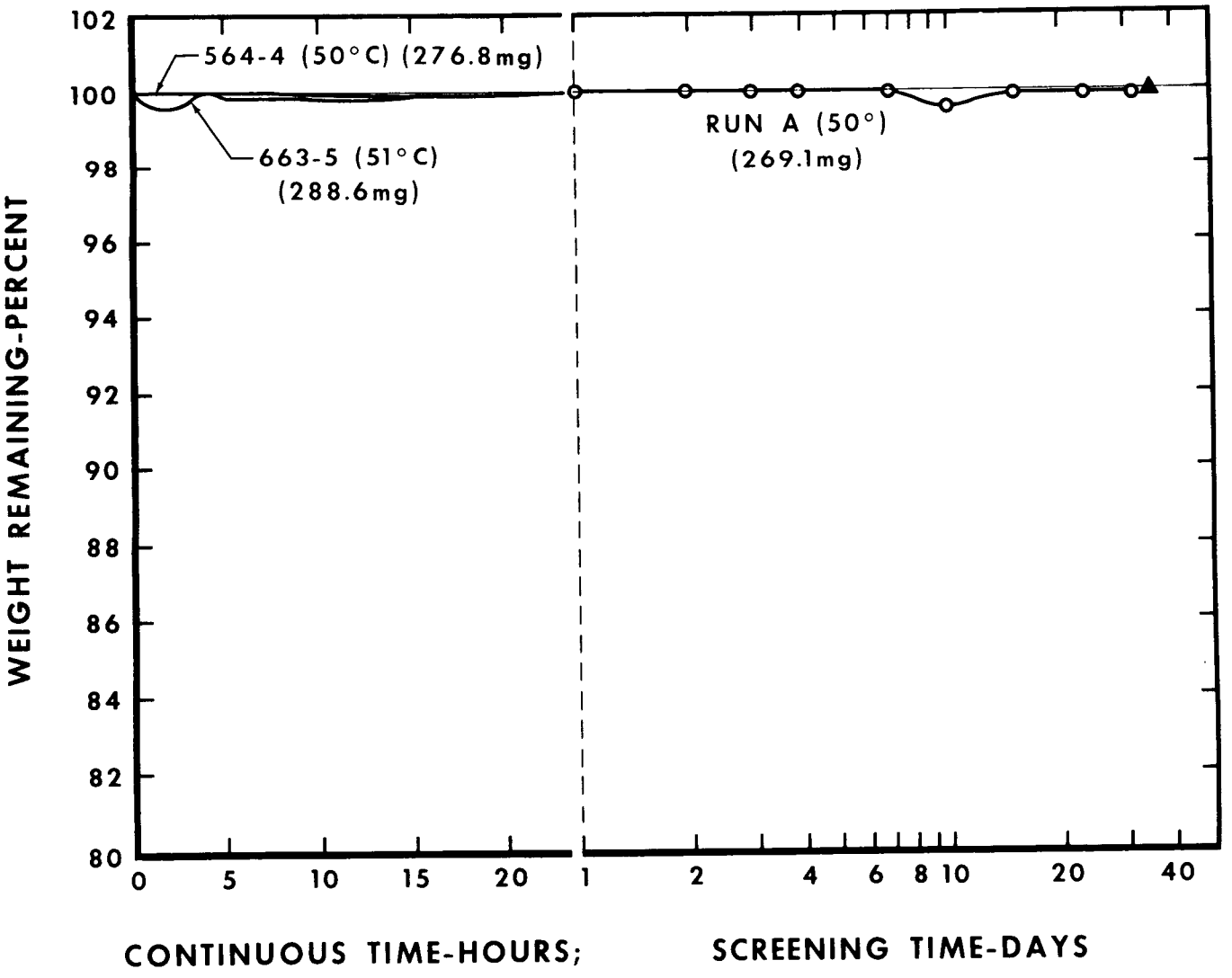

FIGURE 60. - TIME-WEIGHT HISTORIES FOR ECCOFOAM Q DURING EXPOSURE TO VACUUM AT 50°C and 51°C

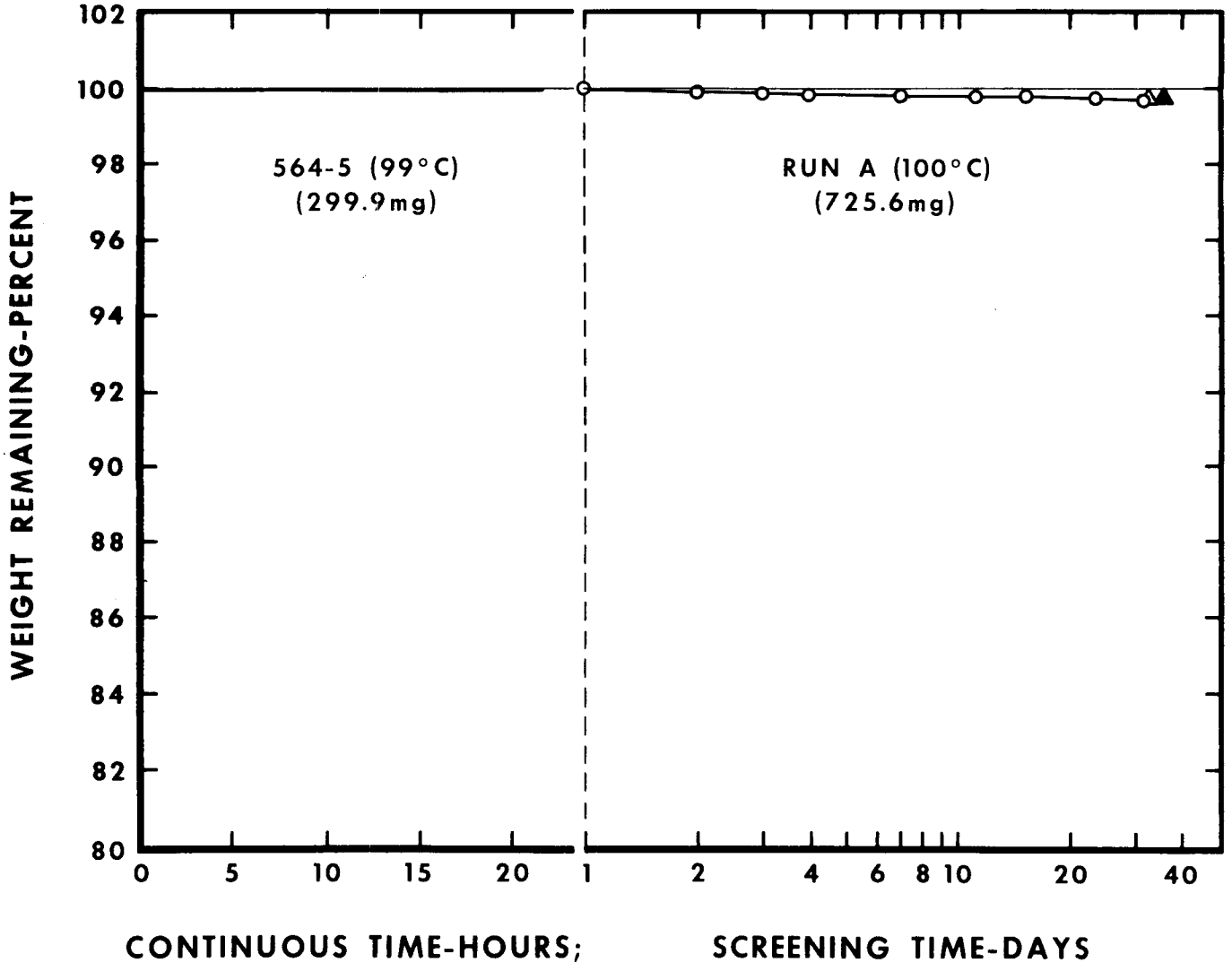

FIGURE 61. - TIME-WEIGHT HISTORIES FOR ECCOFOAM Q DURING EXPOSURE TO VACUUM AT 99°C AND 100°C

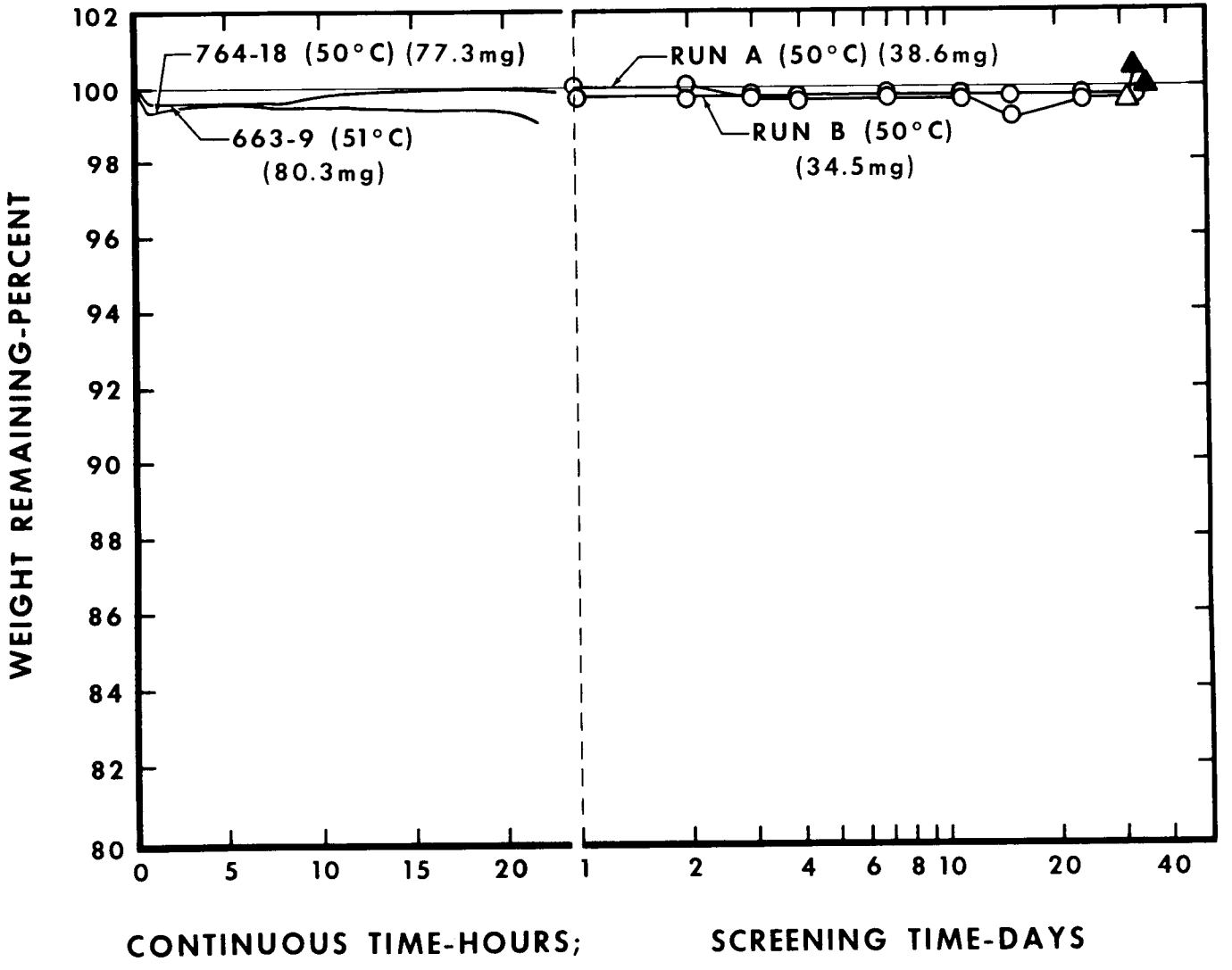

FIGURE 62. - TIME-WEIGHT HISTORIES FOR REFRASIL B-100 DURING EXPOSURE TO VACUUM AT 50°C AND 51°C

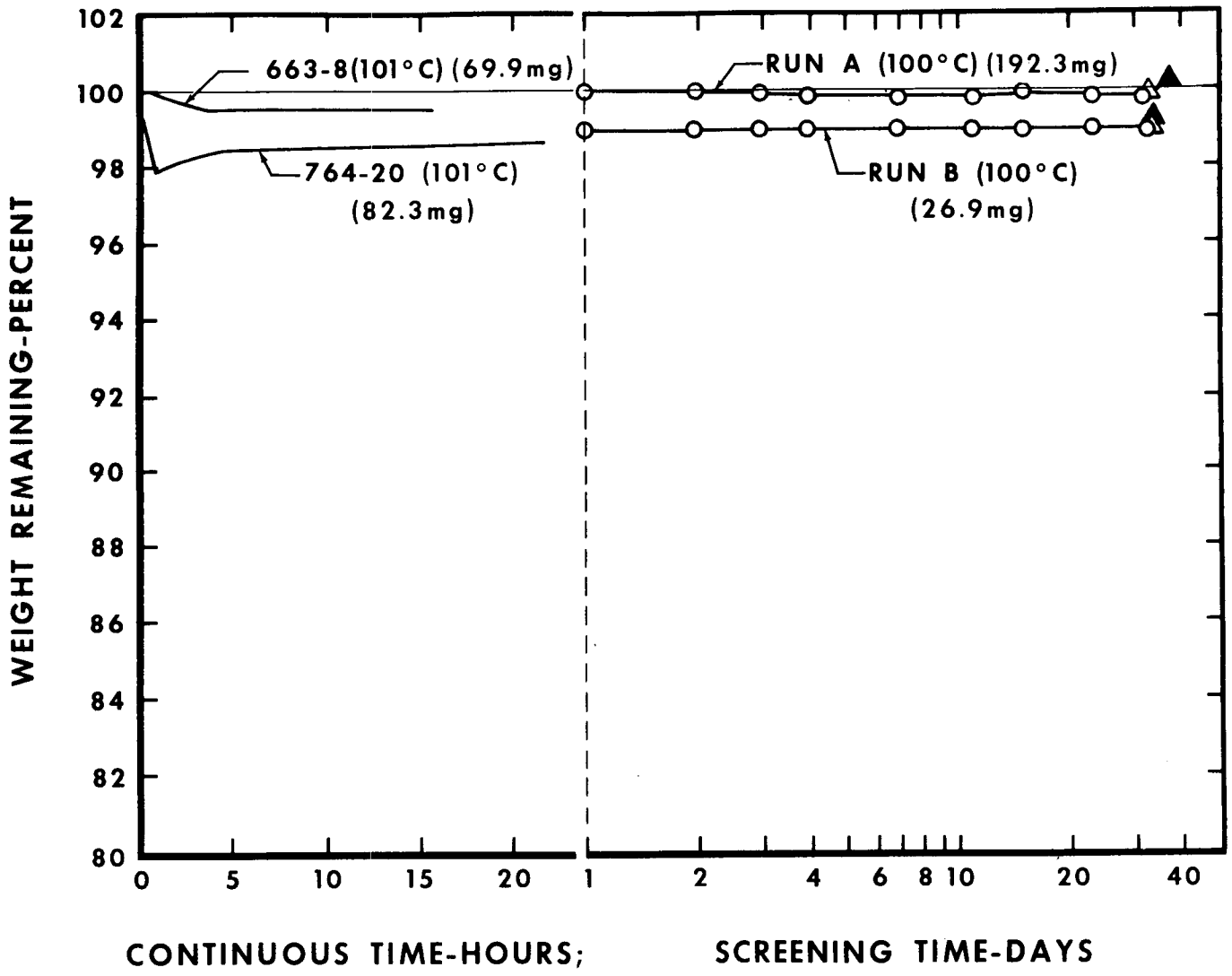

FIGURE 63. - TIME-WEIGHT HISTORIES FOR REFRASIL B-100 DURING EXPOSURE TO VACUUM AT 100°C AND 101°C

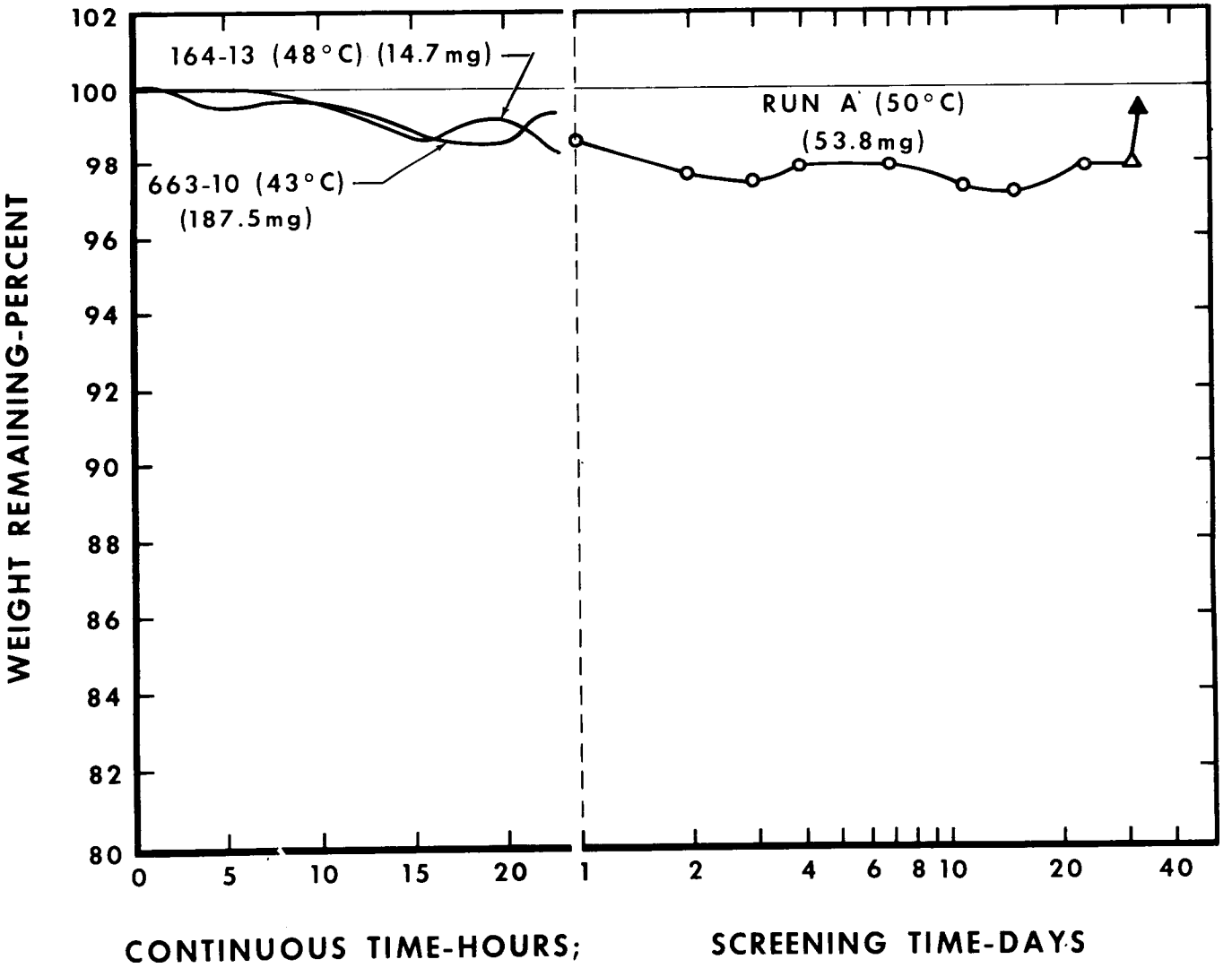

FIGURE 64. - TIME-WEIGHT HISTORIES FOR CPR-20 DURING EXPOSURE TO VACUUM AT 43°C, 48°C, AND 50°C

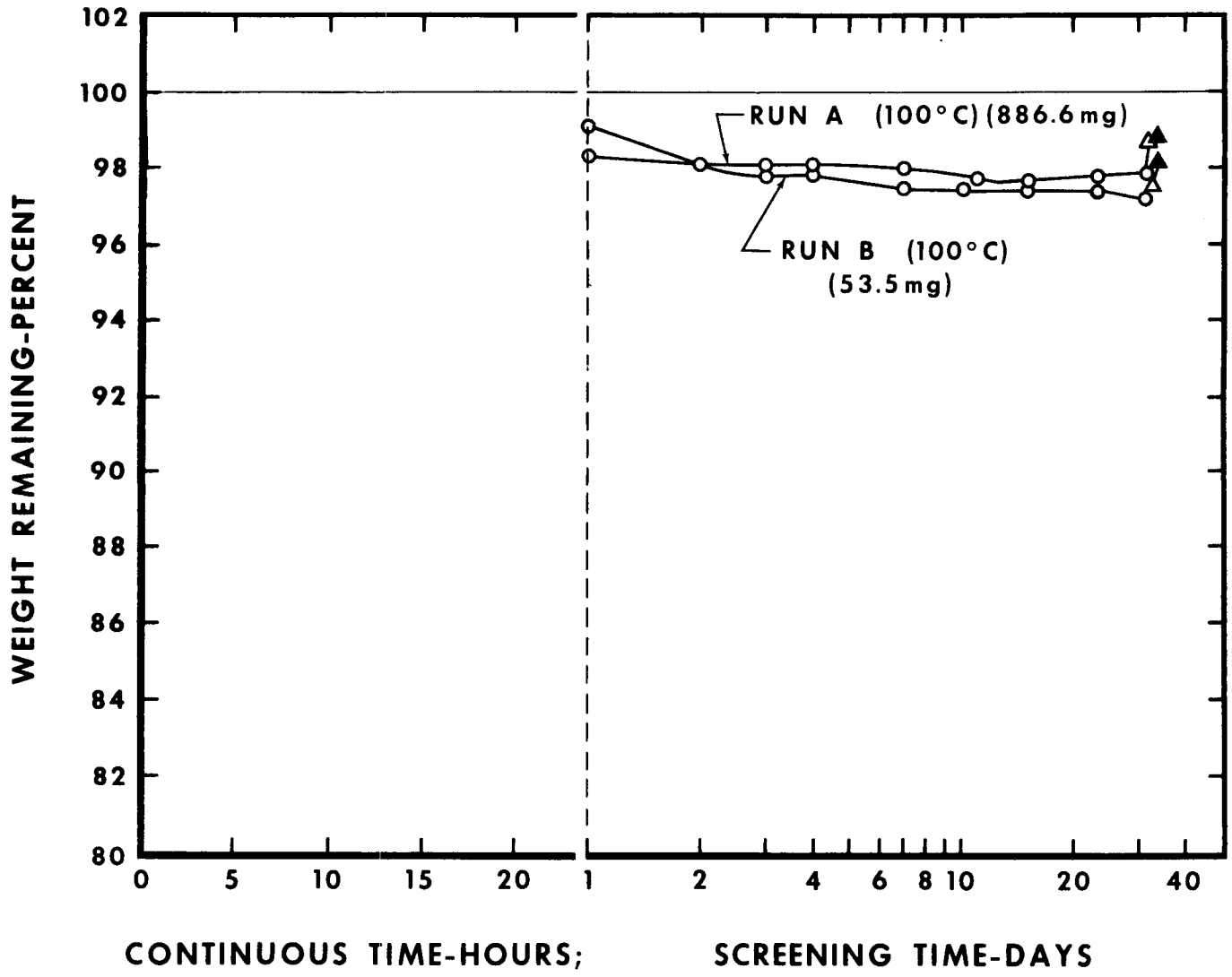

FIGURE 65. - TIME-WEIGHT HISTORIES FOR CPR-20 DURING EXPOSURE TO VACUUM AT 100°C

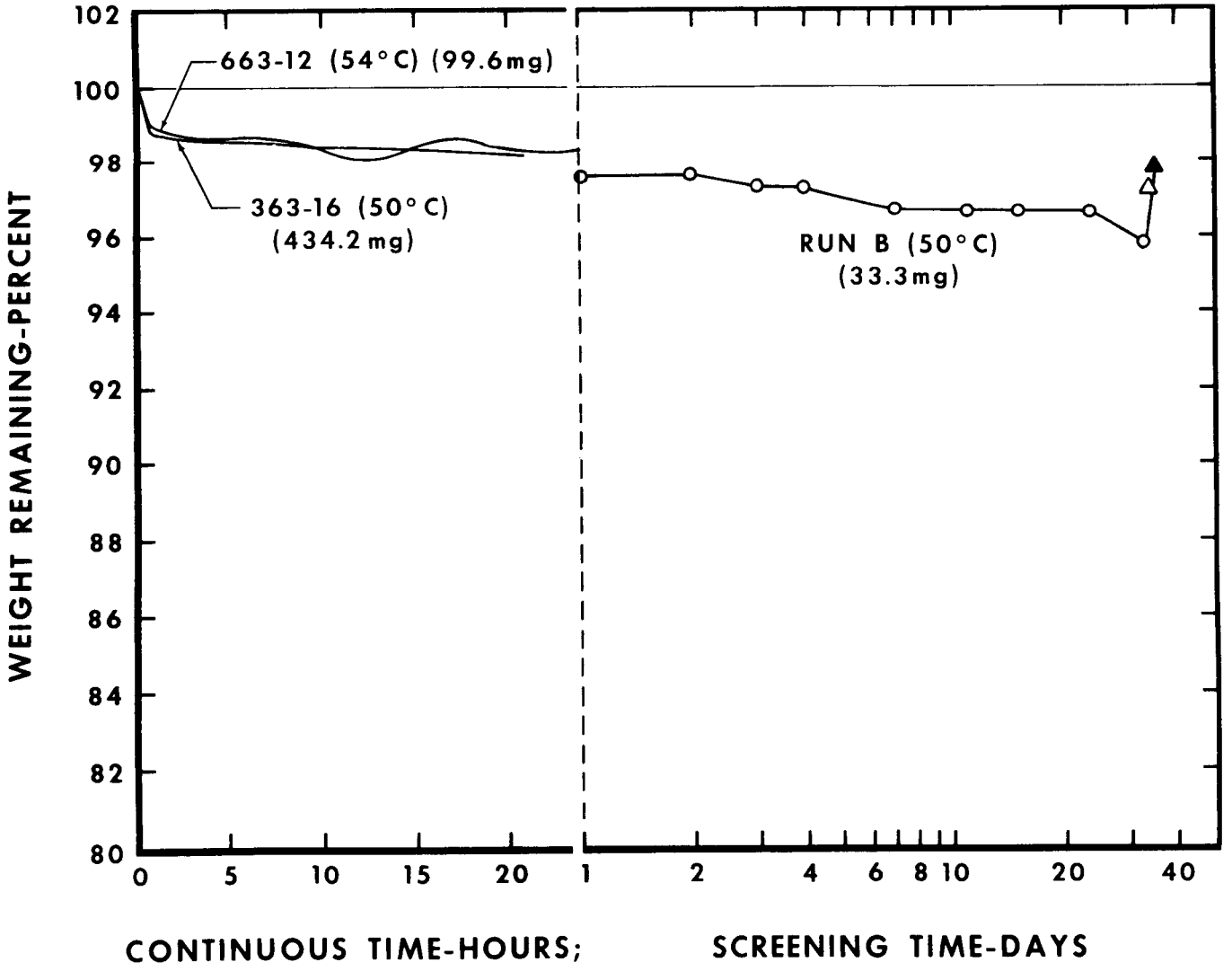

FIGURE 66. - TIME-WEIGHT HISTORIES FOR CPR-1021 DURING EXPOSURE TO VACUUM AT 50°C AND 54°C

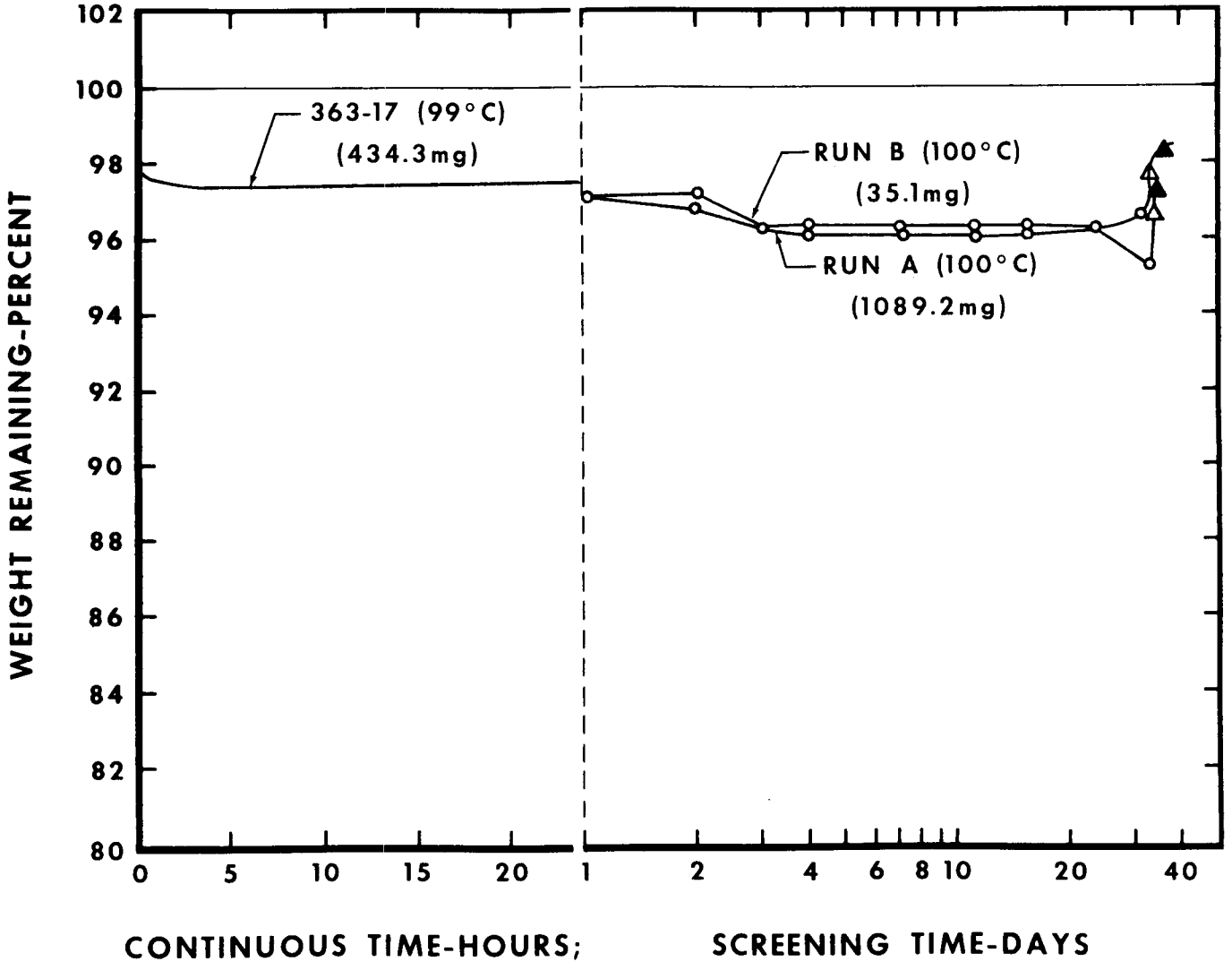

FIGURE 67. - TIME-WEIGHT HISTORIES FOR CPR-1021 DURING EXPOSURE TO VACUUM AT 99°C AND 100°C

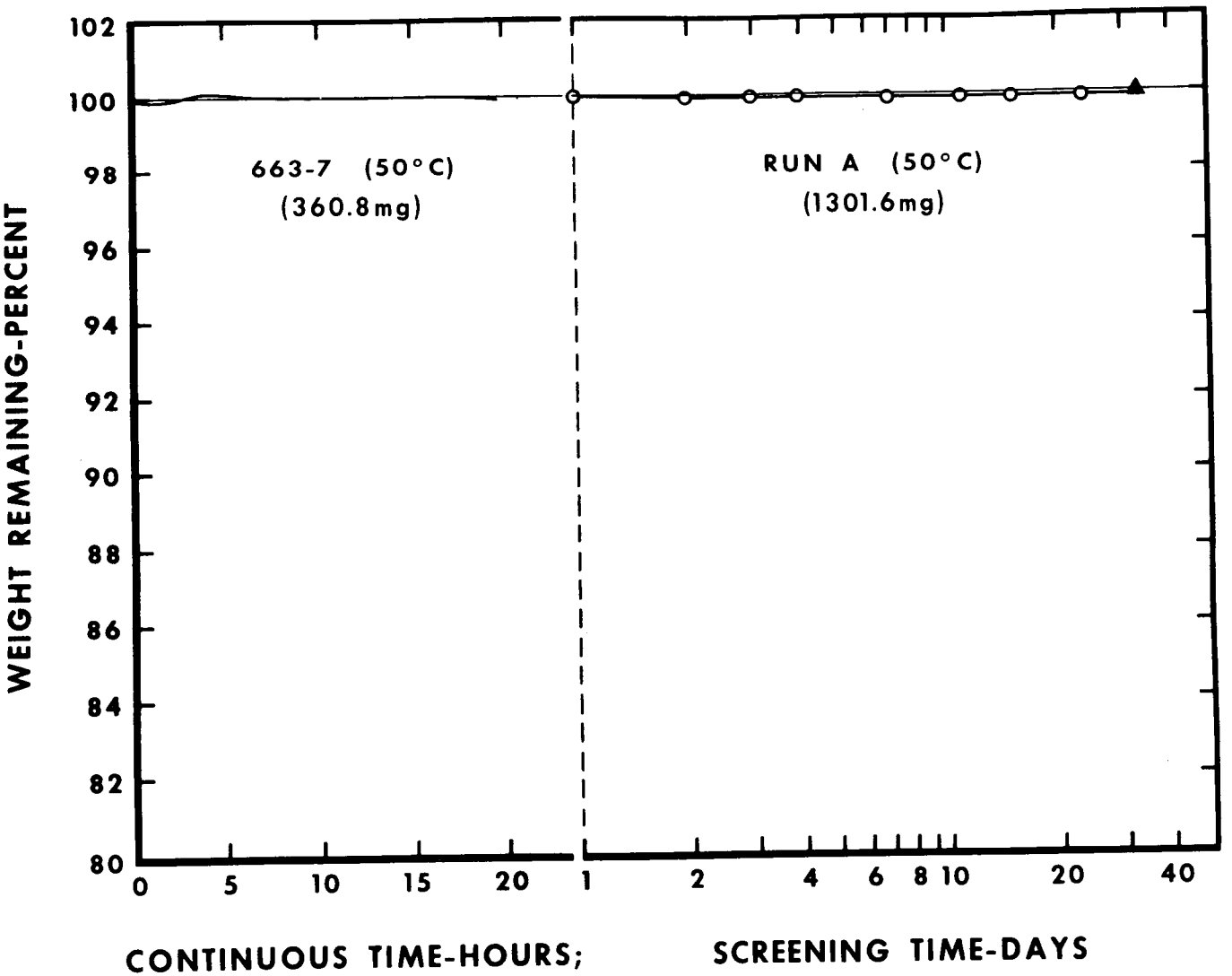

FIGURE 68. - TIME-WEIGHT HISTORIES FOR DUROID 5813 DURING EXPOSURE TO VACUUM AT 50°C

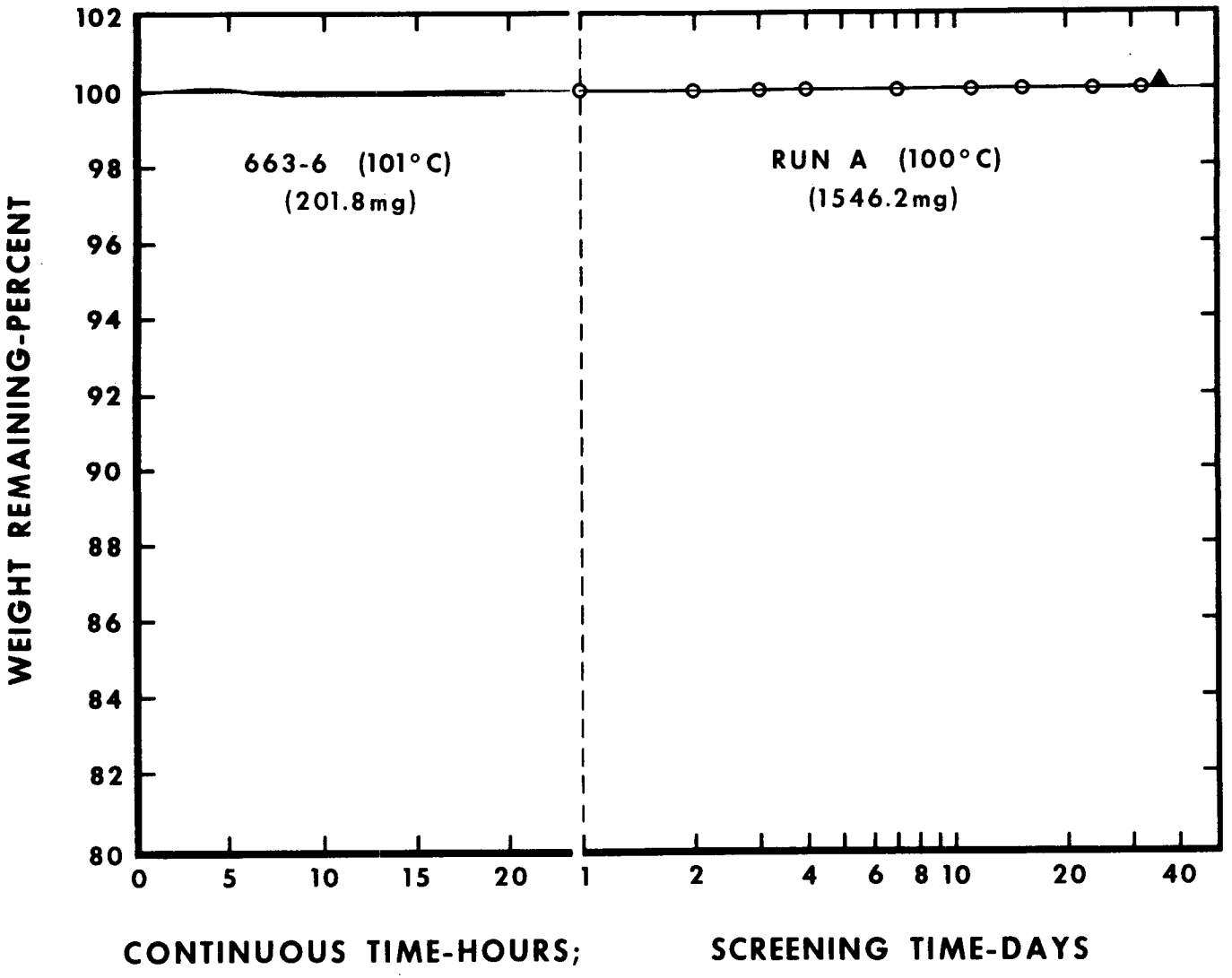

FIGURE 69. - TIME-WEIGHT HISTORIES FOR DUROID 5813 DURING EXPOSURE TO VACUUM AT 100°C AND 101°C

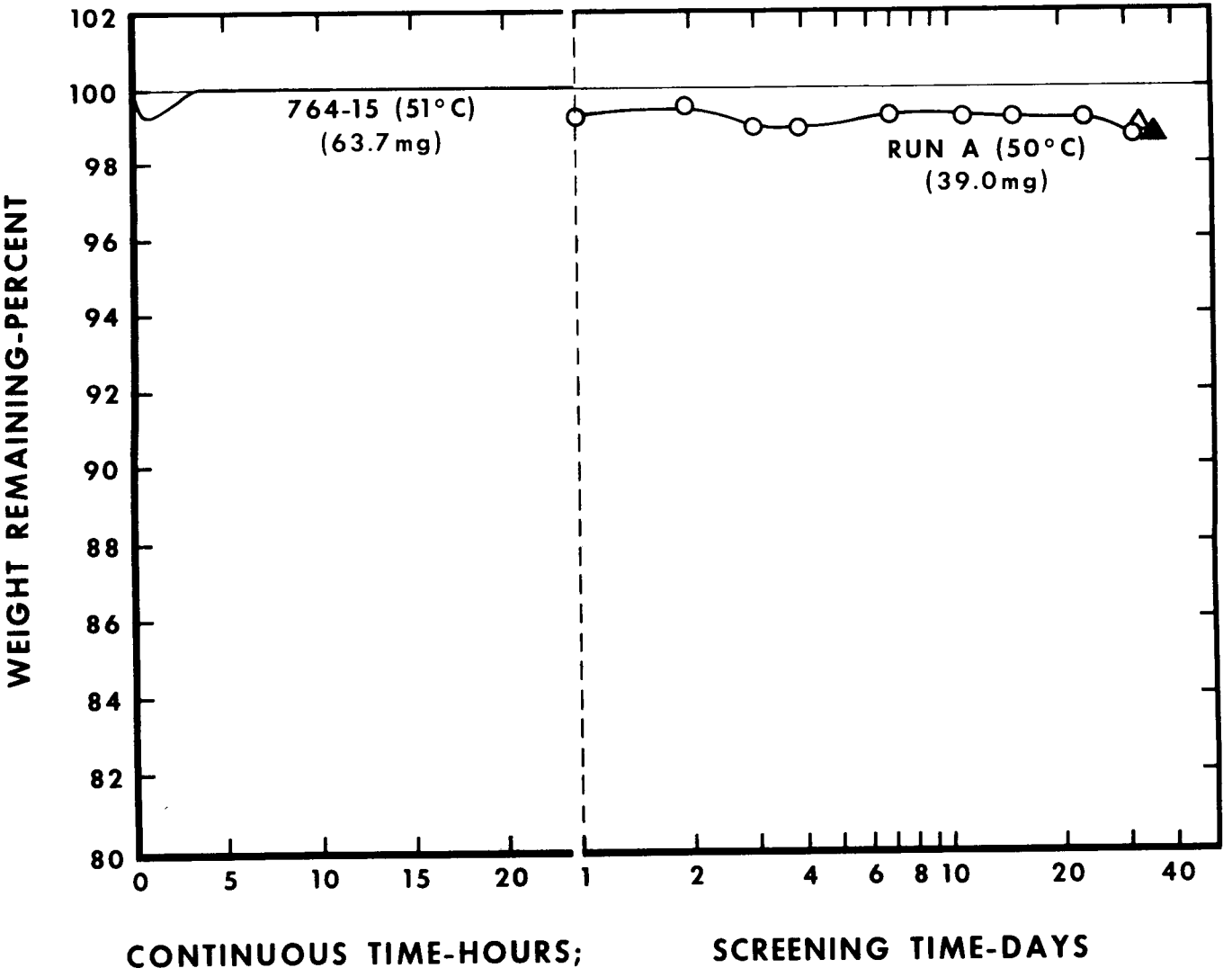

FIGURE 70. - TIME-WEIGHT HISTORIES FOR EPON VIII DURING EXPOSURE TO VACUUM AT 50°C AND 51°C

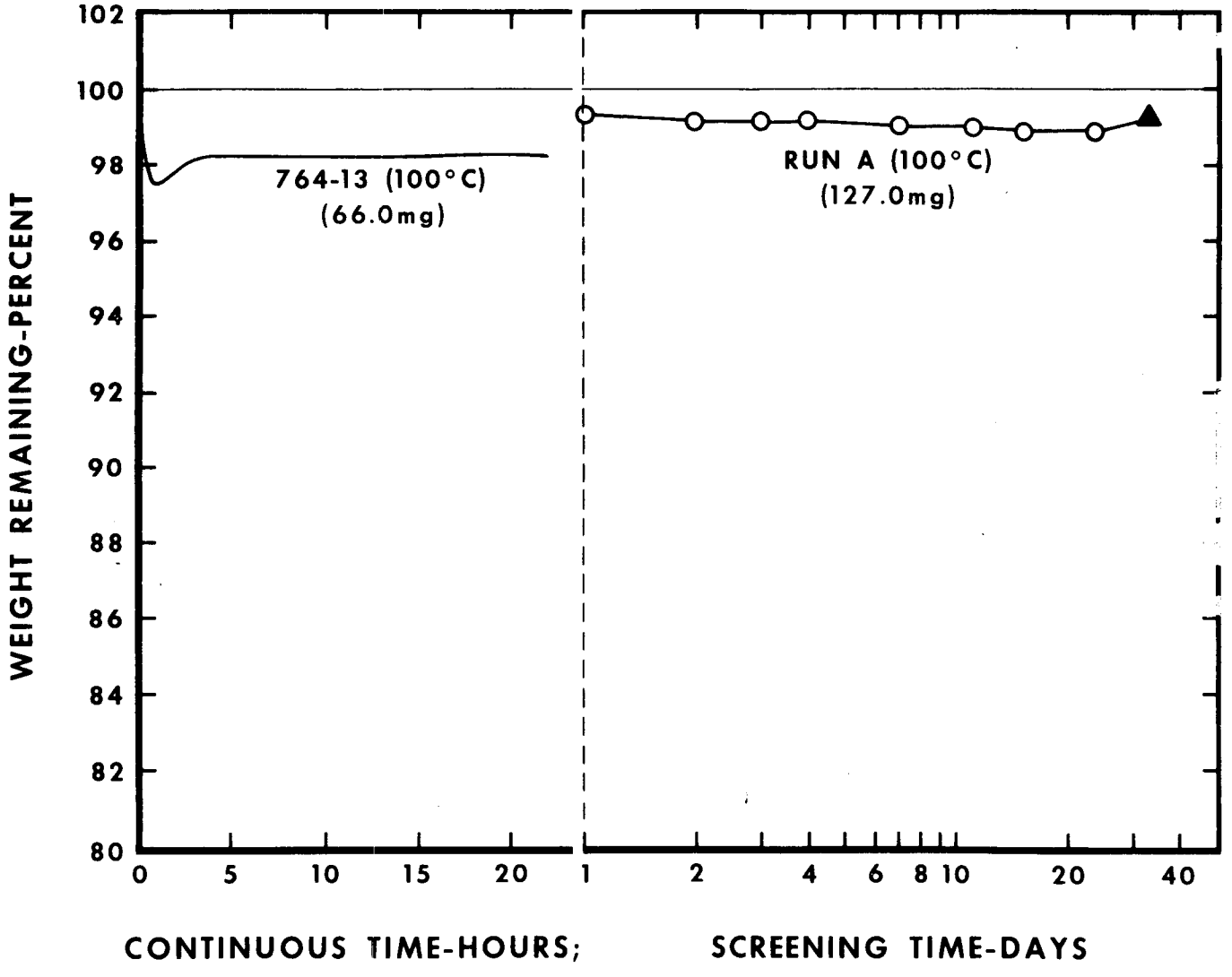

FIGURE 71. - TIME-WEIGHT HISTORIES FOR EPON VIII DURING EXPOSURE TO VACUUM AT 100°C

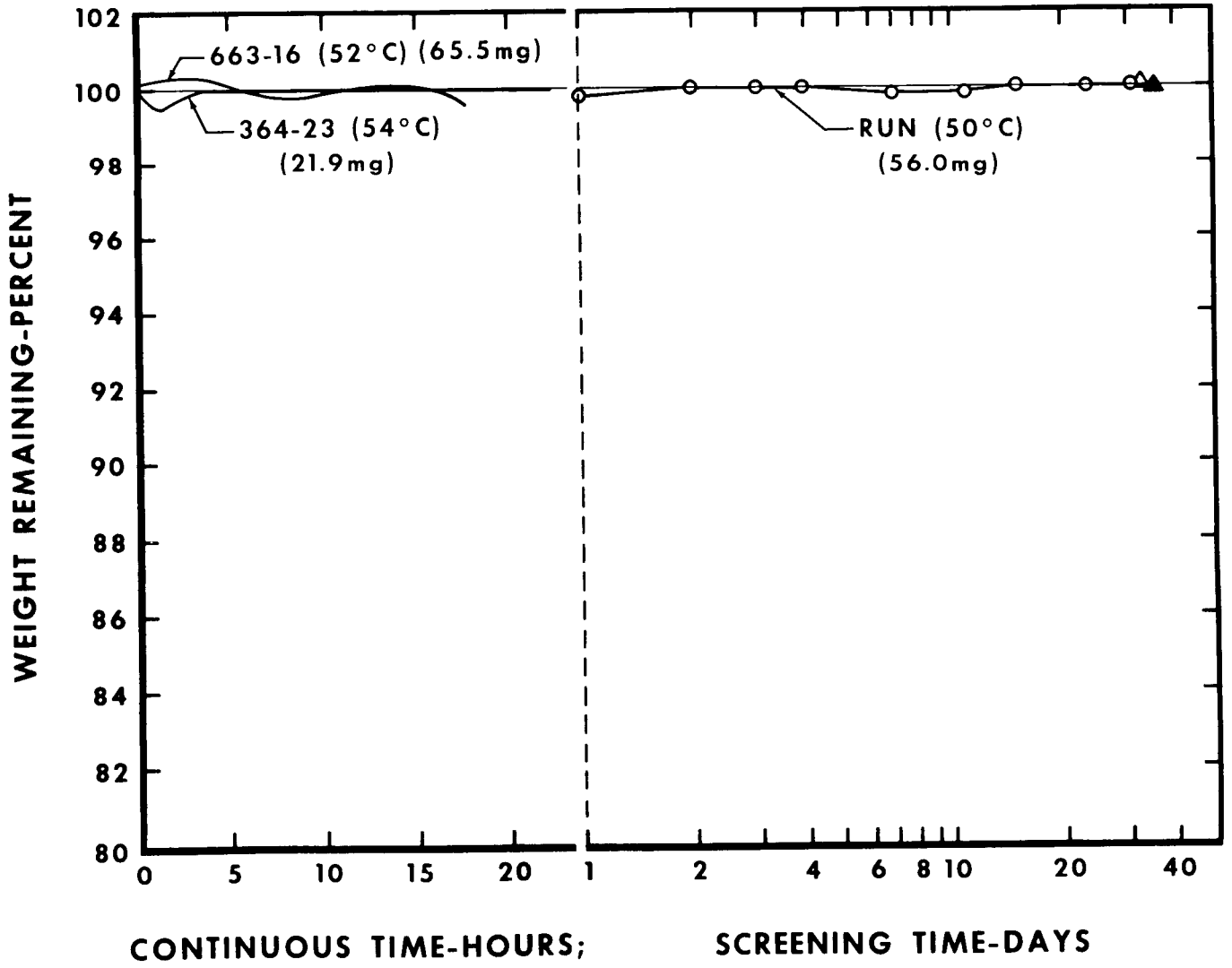

FIGURE 72. - TIME-WEIGHT HISTORIES FOR APCO 1252 DURING EXPOSURE TO VACUUM AT 50°C, 52°C, AND 54°C

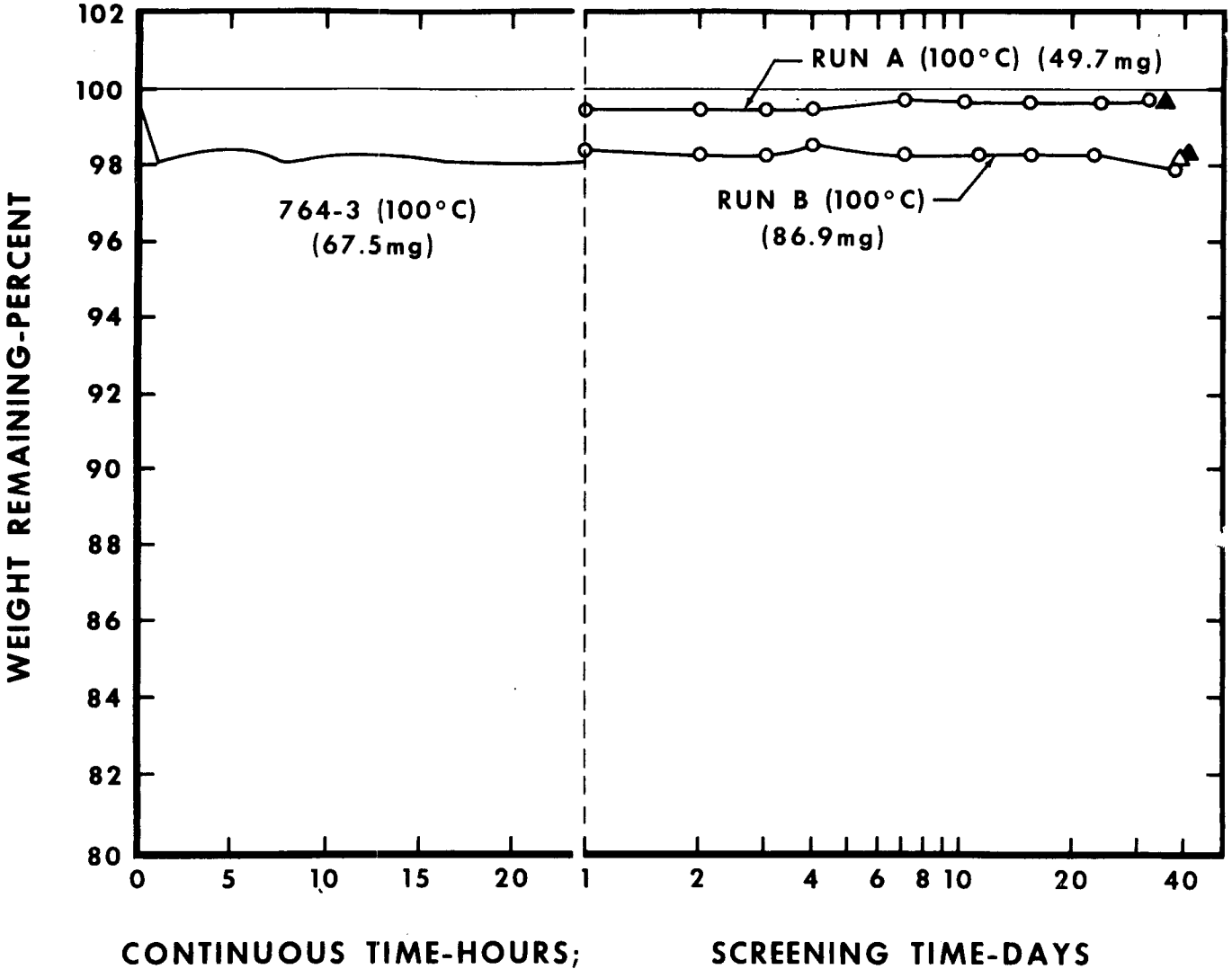

FIGURE 73. - TIME-WEIGHT HISTORIES FOR APCO 1252 DURING EXPOSURE TO VACUUM AT 100°C

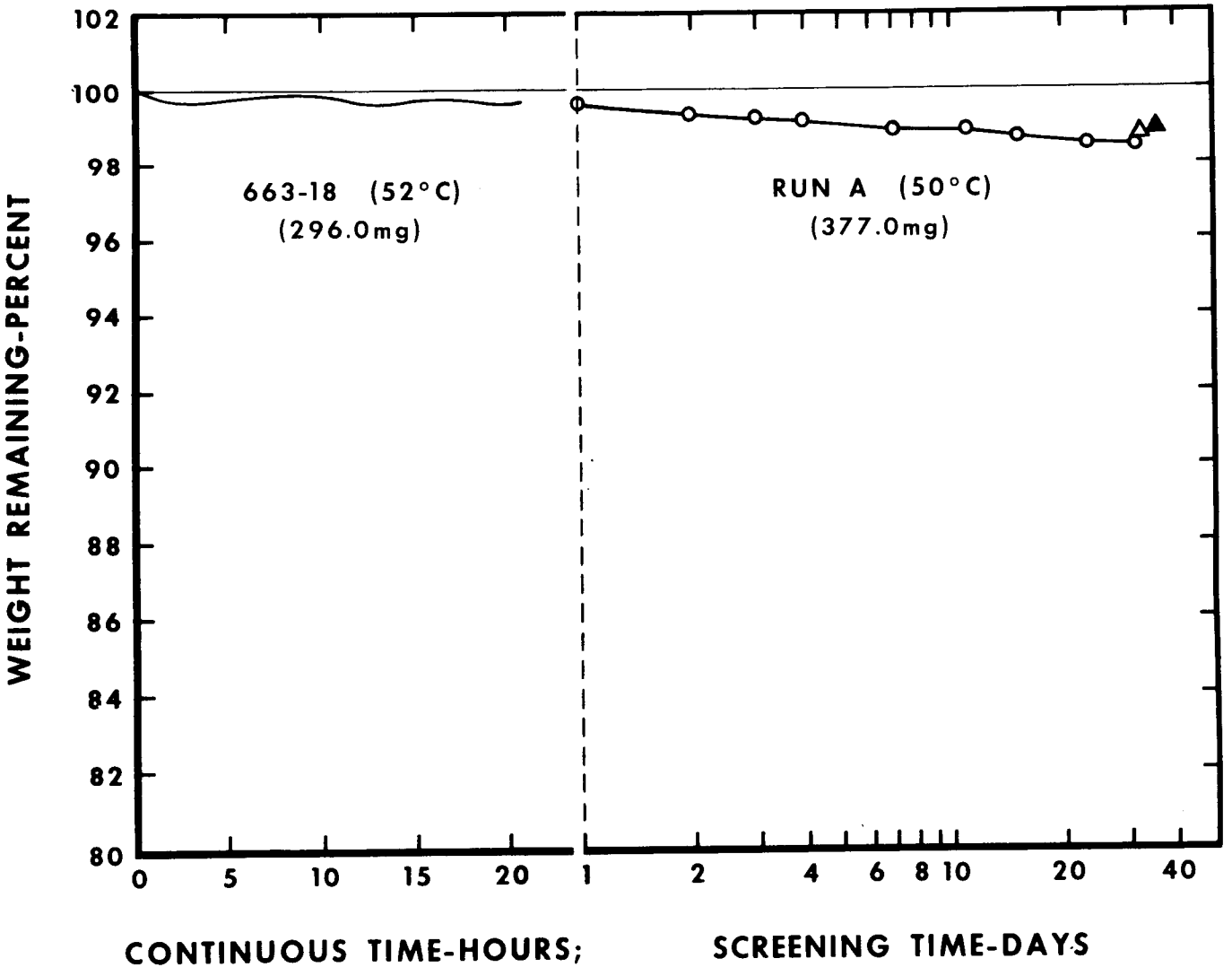

FIGURE 74. - TIME-WEIGHT HISTORIES FOR SHELL 929 DURING EXPOSURE TO VACUUM AT 50°C AND 52°C

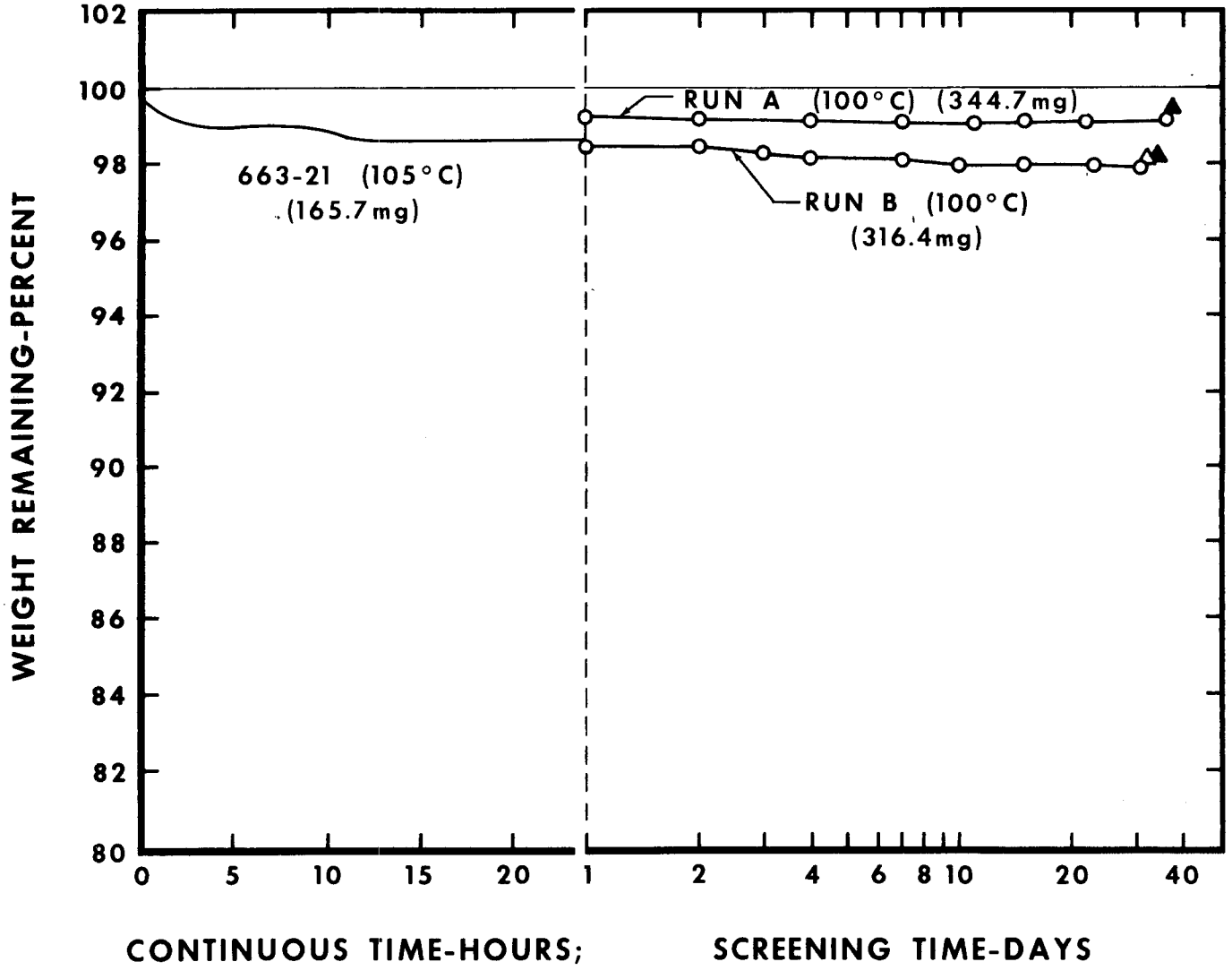

FIGURE 75. - TIME-WEIGHT HISTORIES FOR SHELL 929 DURING EXPOSURE TO VACUUM AT 100°C AND 105°C

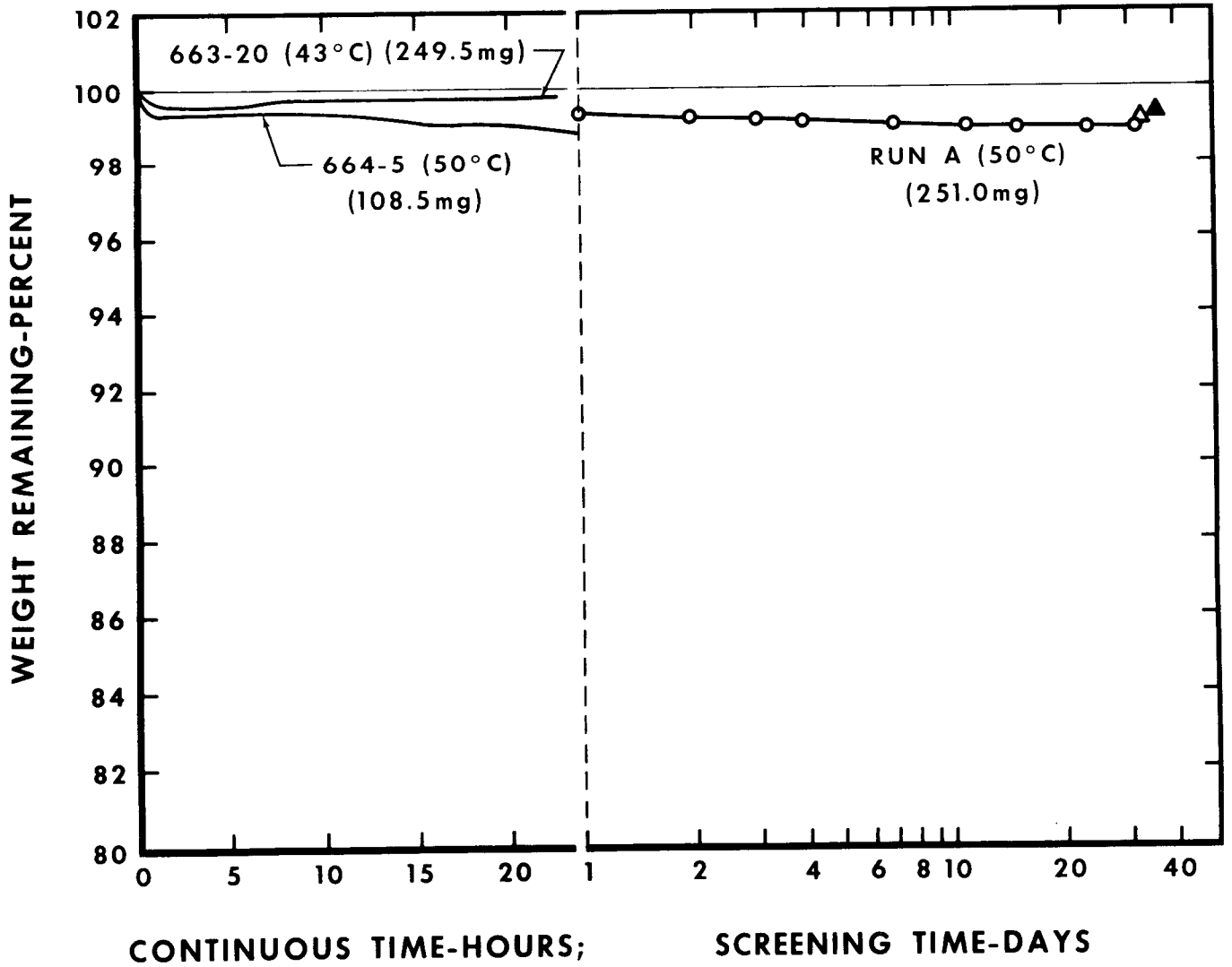

FIGURE 76. - TIME-WEIGHT HISTORIES FOR SHELL 934 DURING EXPOSURE TO VACUUM AT 43°C AND 50°C

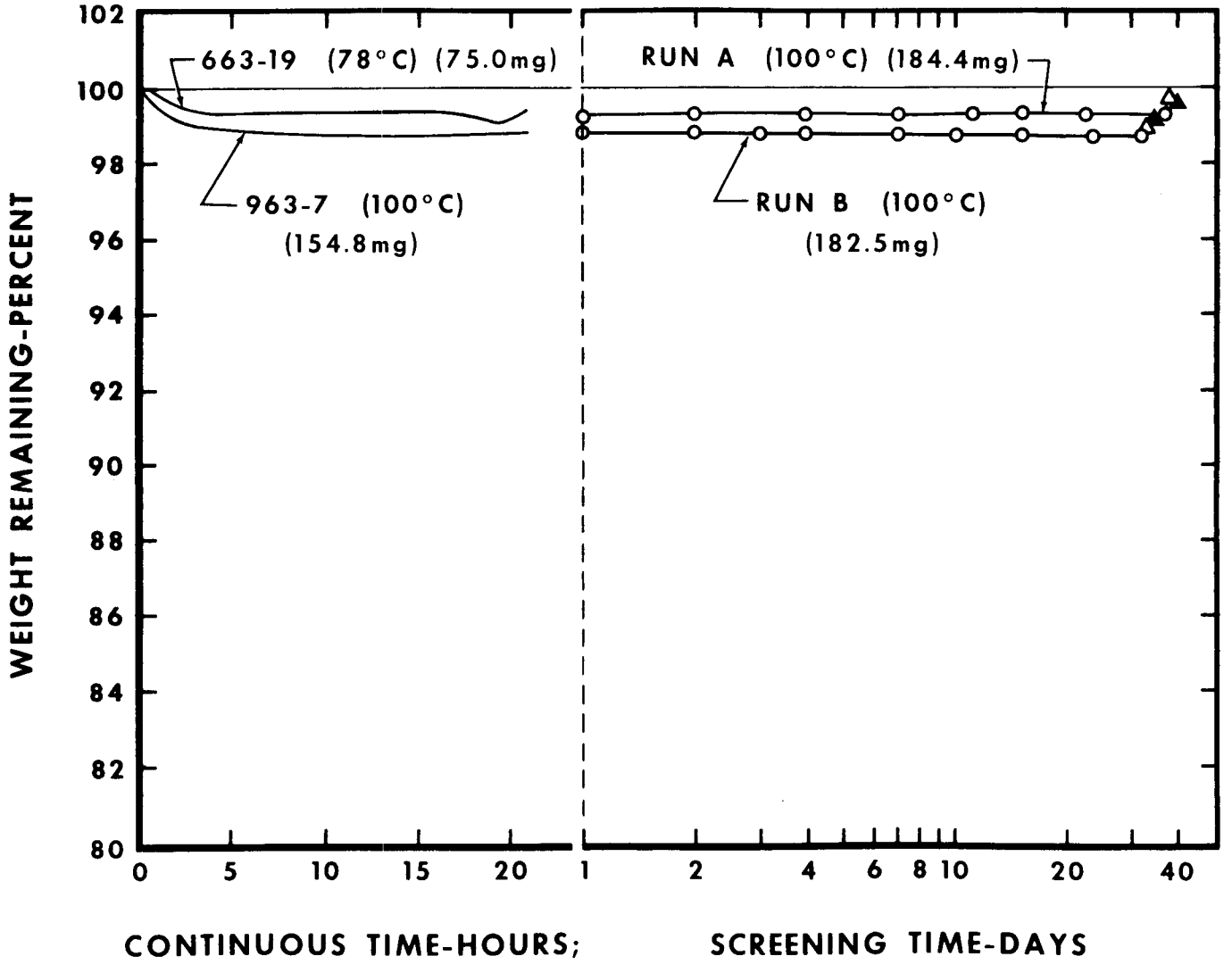

FIGURE 77. - TIME-WEIGHT HISTORIES FOR SHELL 934 DURING EXPOSURE TO VACUUM AT 78°C AND 100°C

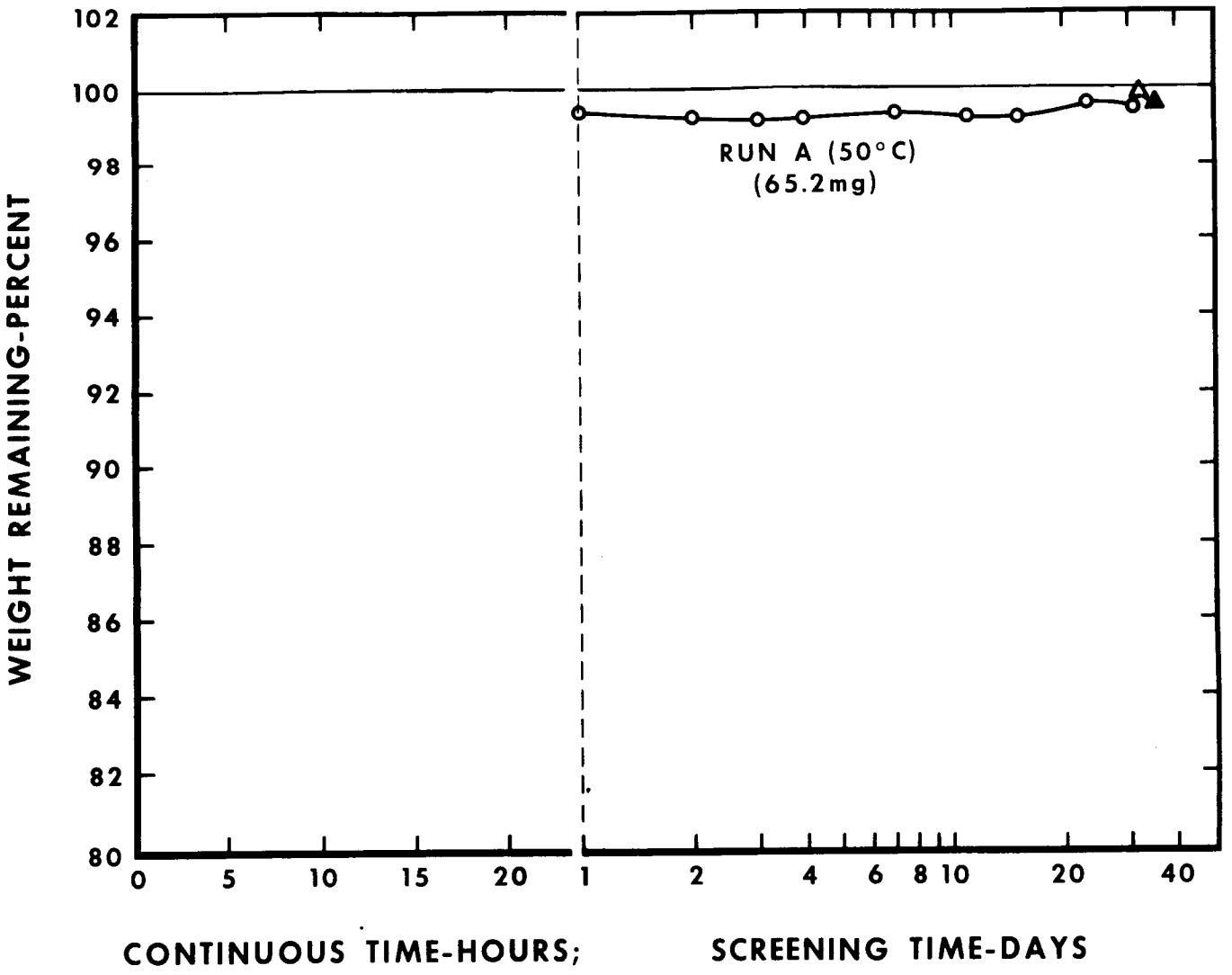

FIGURE 78. - TIME-WEIGHT HISTORIES FOR HT-424 DURING EXPOSURE TO VACUUM AT 50°C

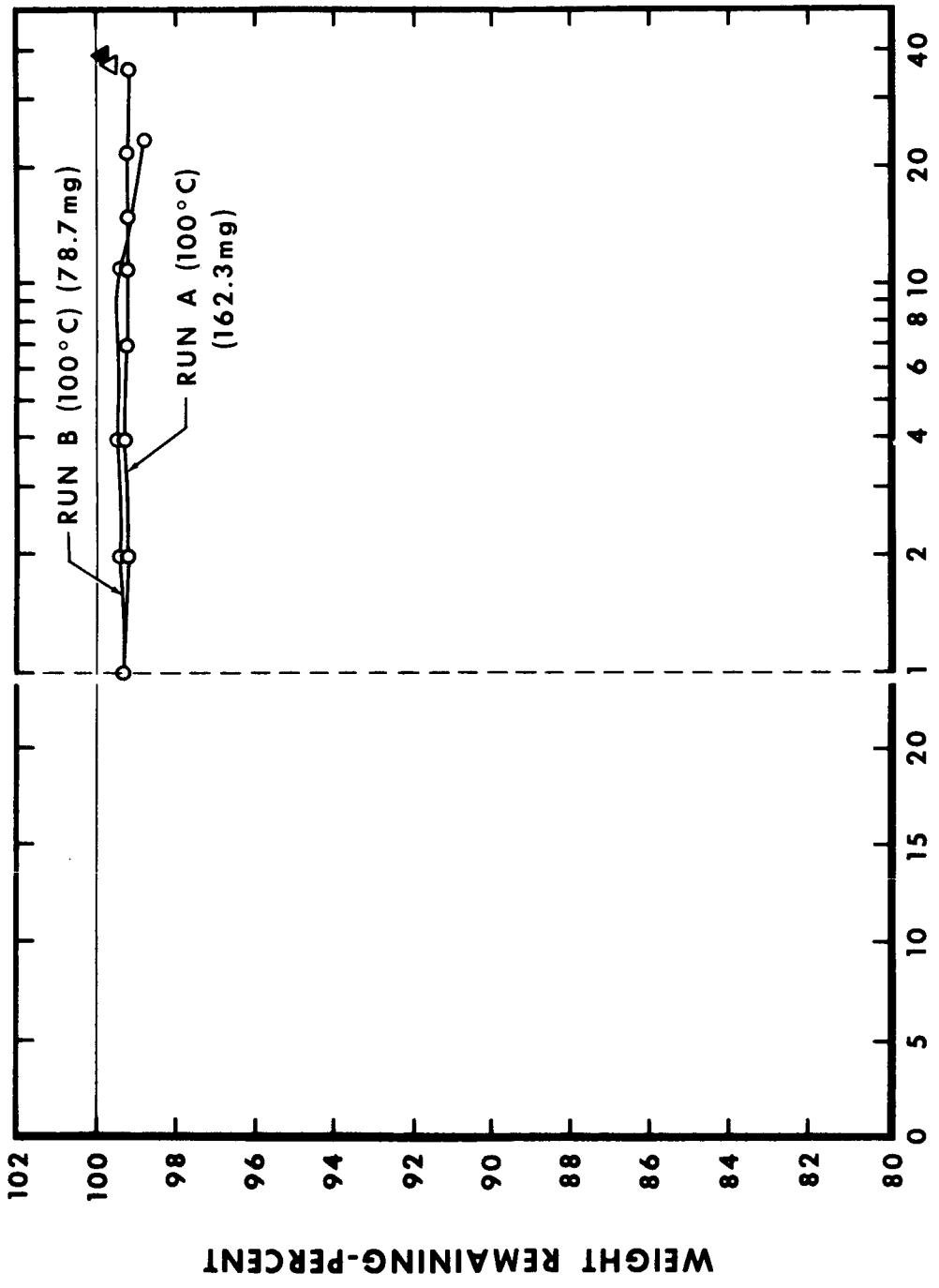

FIGURE 79. - TIME-WEIGHT HISTORIES FOR HT-424 DURING EXPOSURE TO VACUUM AT 100°C

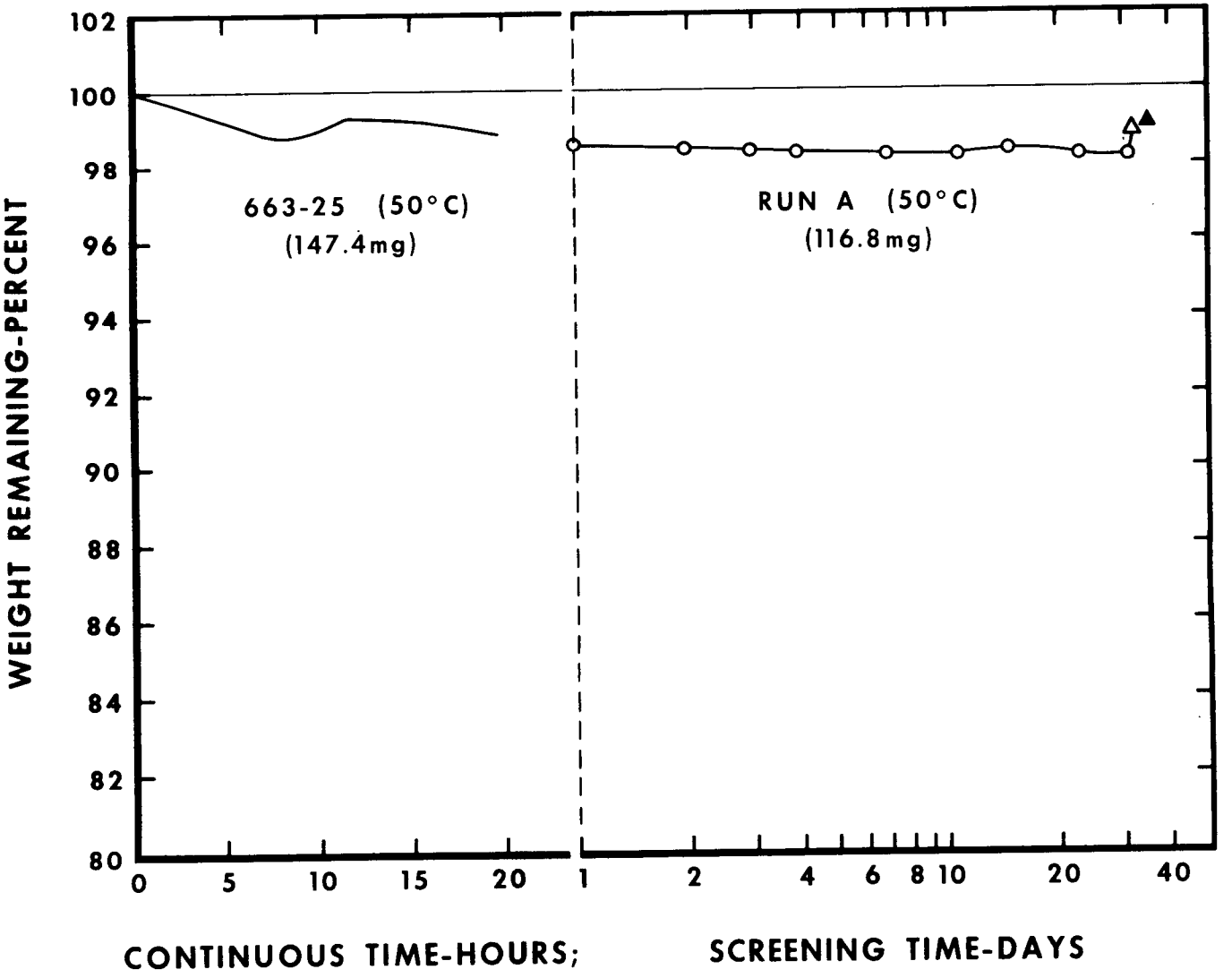

FIGURE 80. - TIME-WEIGHT HISTORIES FOR NARMCO A DURING EXPOSURE TO VACUUM AT 50°C

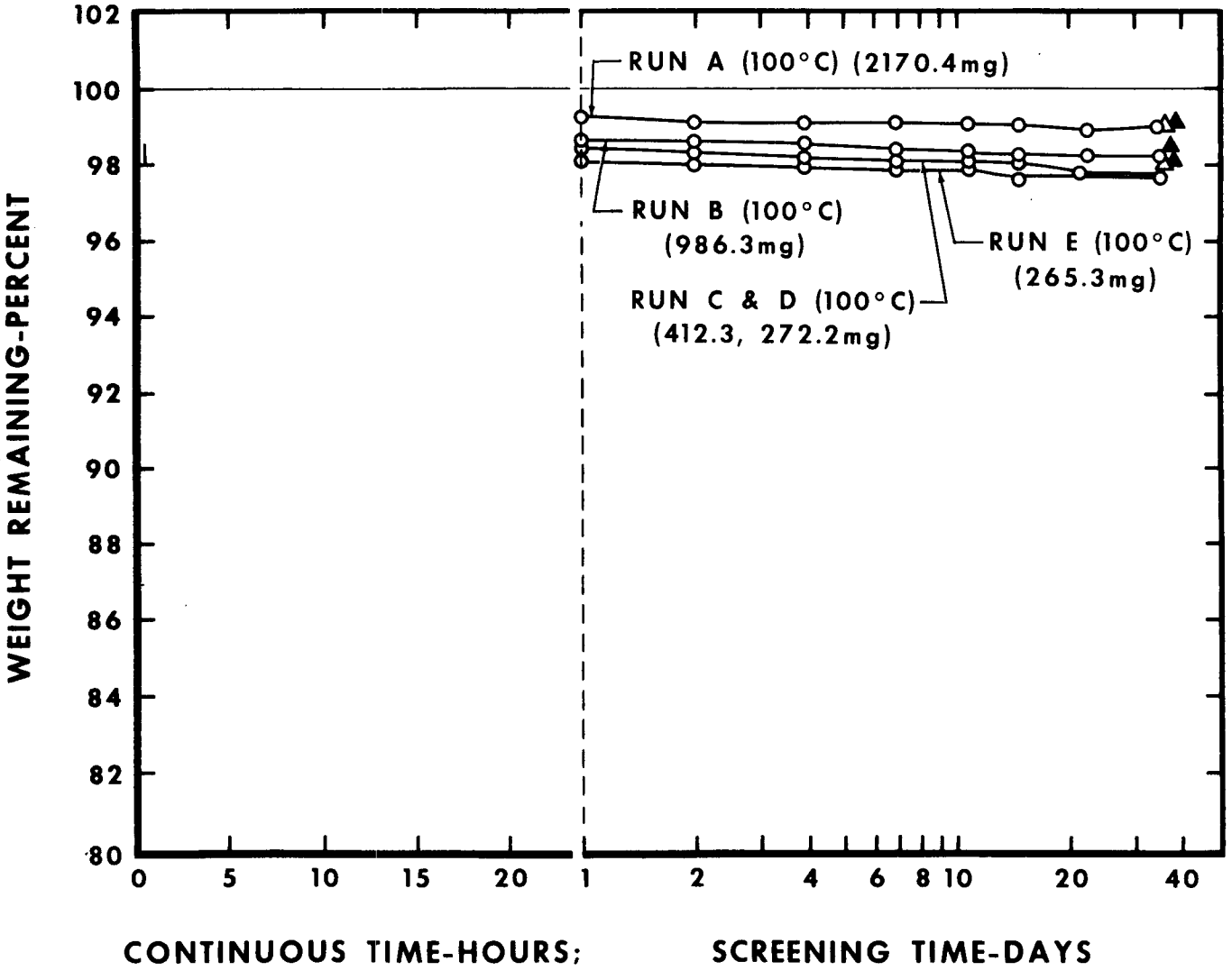

FIGURE 81. - TIME-WEIGHT HISTORIES FOR NARMCO A DURING EXPOSURE TO VACUUM AT 100°C

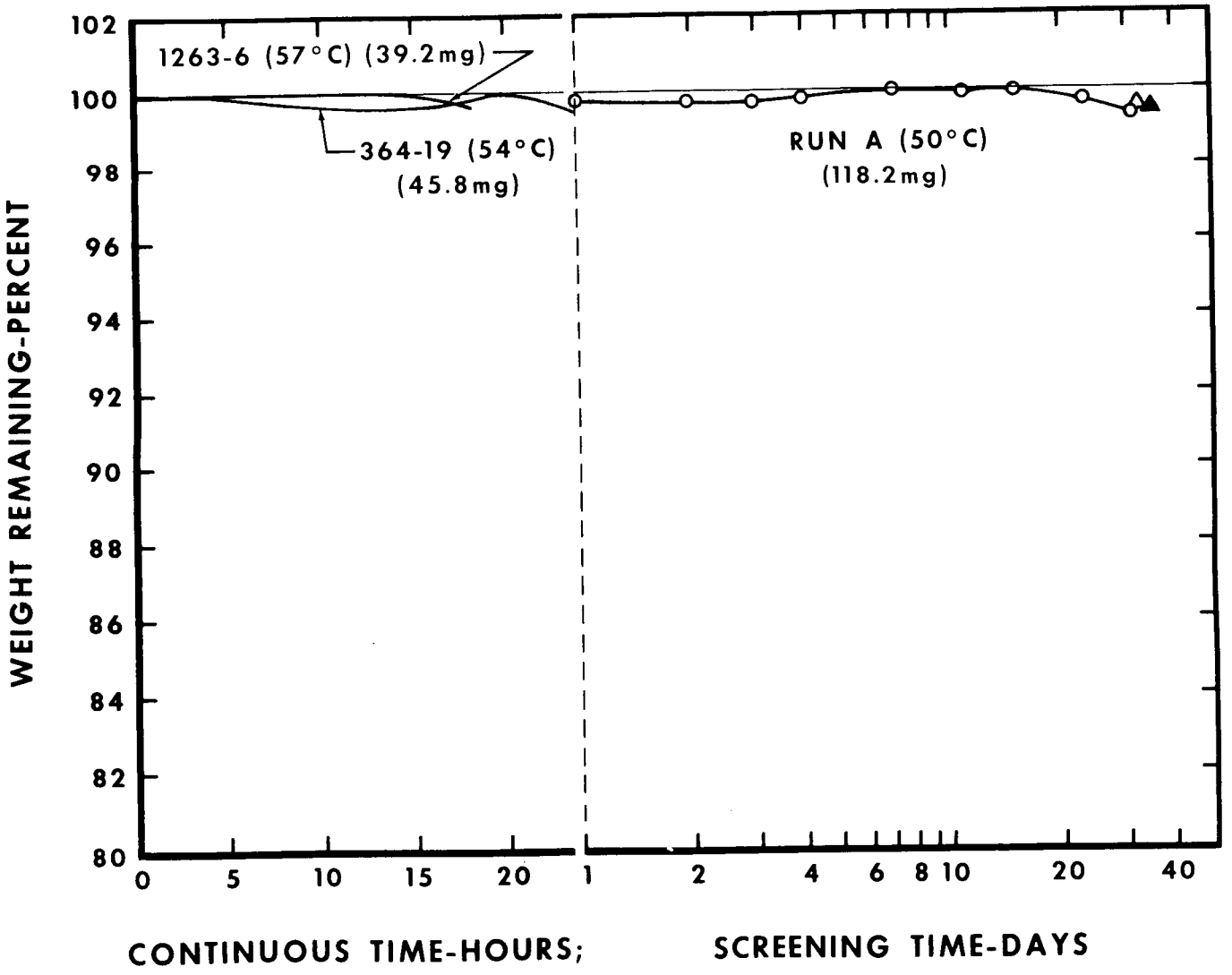

FIGURE 82. - TIME-WEIGHT HISTORIES FOR NARMCO C DURING EXPOSURE TO VACUUM AT 50°C, 54°C, AND 57°C

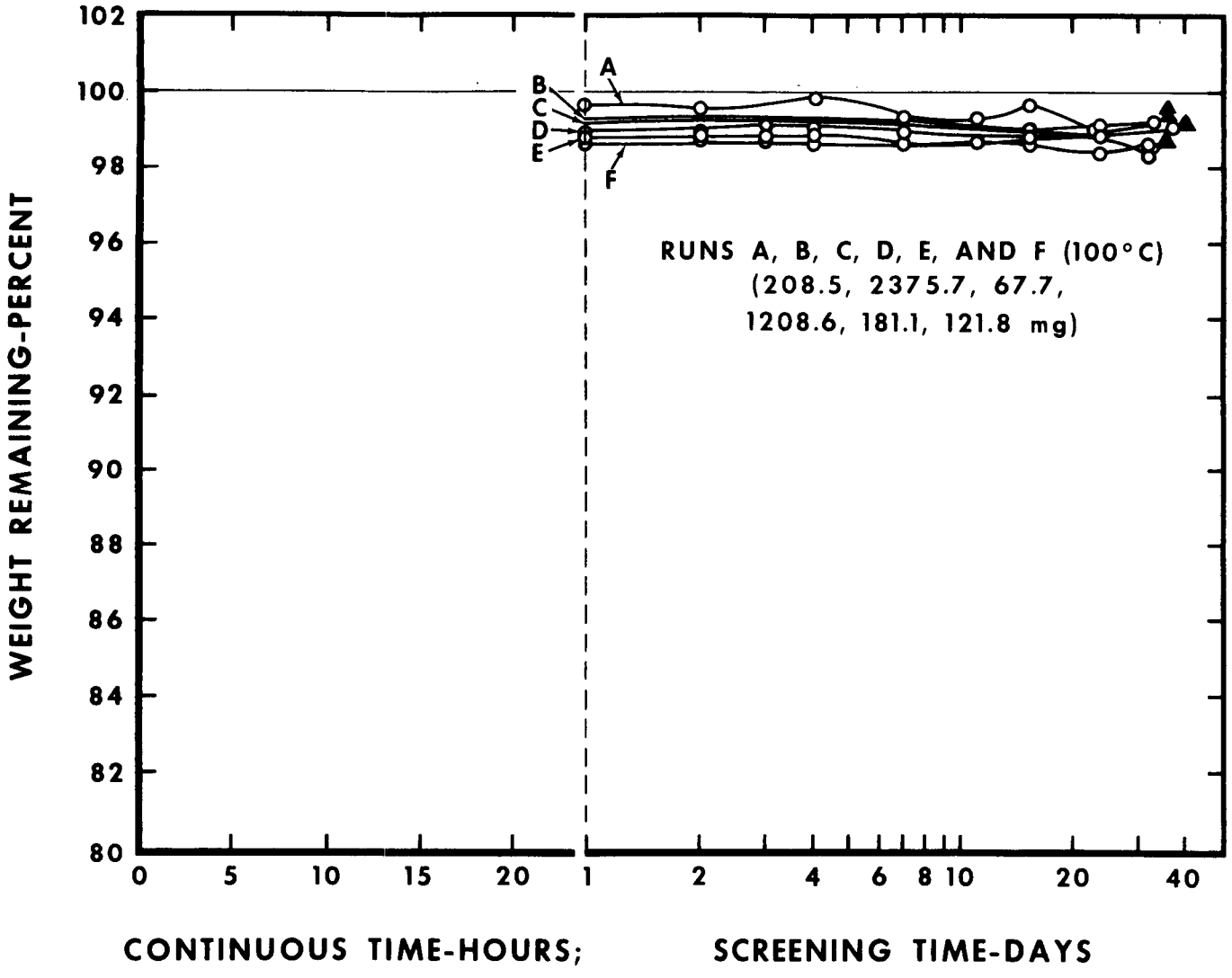

FIGURE 83. - TIME-WEIGHT HISTORIES FOR NARMCO C DURING EXPOSURE TO VACUUM AT 100°C

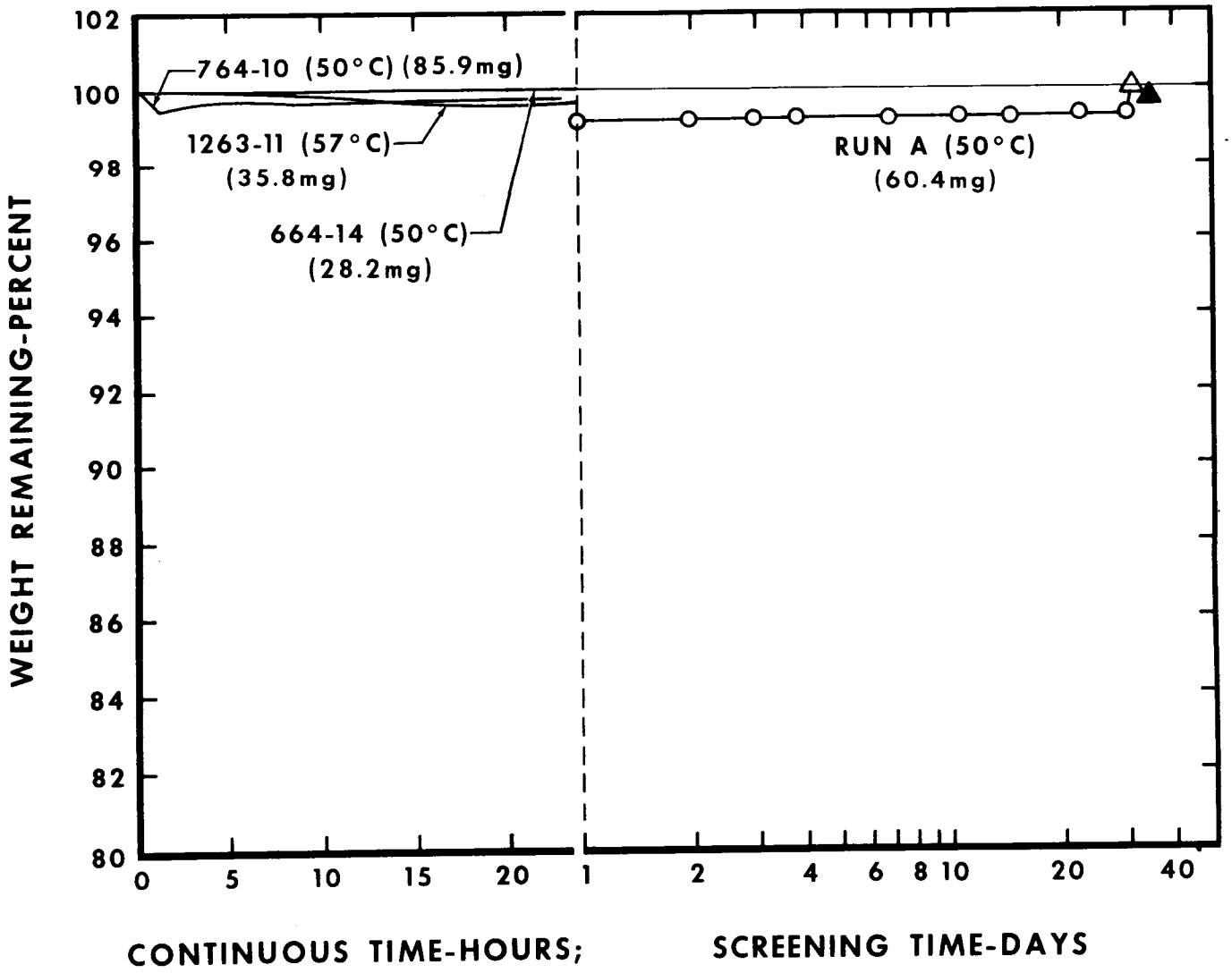

FIGURE 84. - TIME-WEIGHT HISTORIES FOR AEROBOND 430 DURING EXPOSURE TO VACUUM AT 50°C AND 57°C

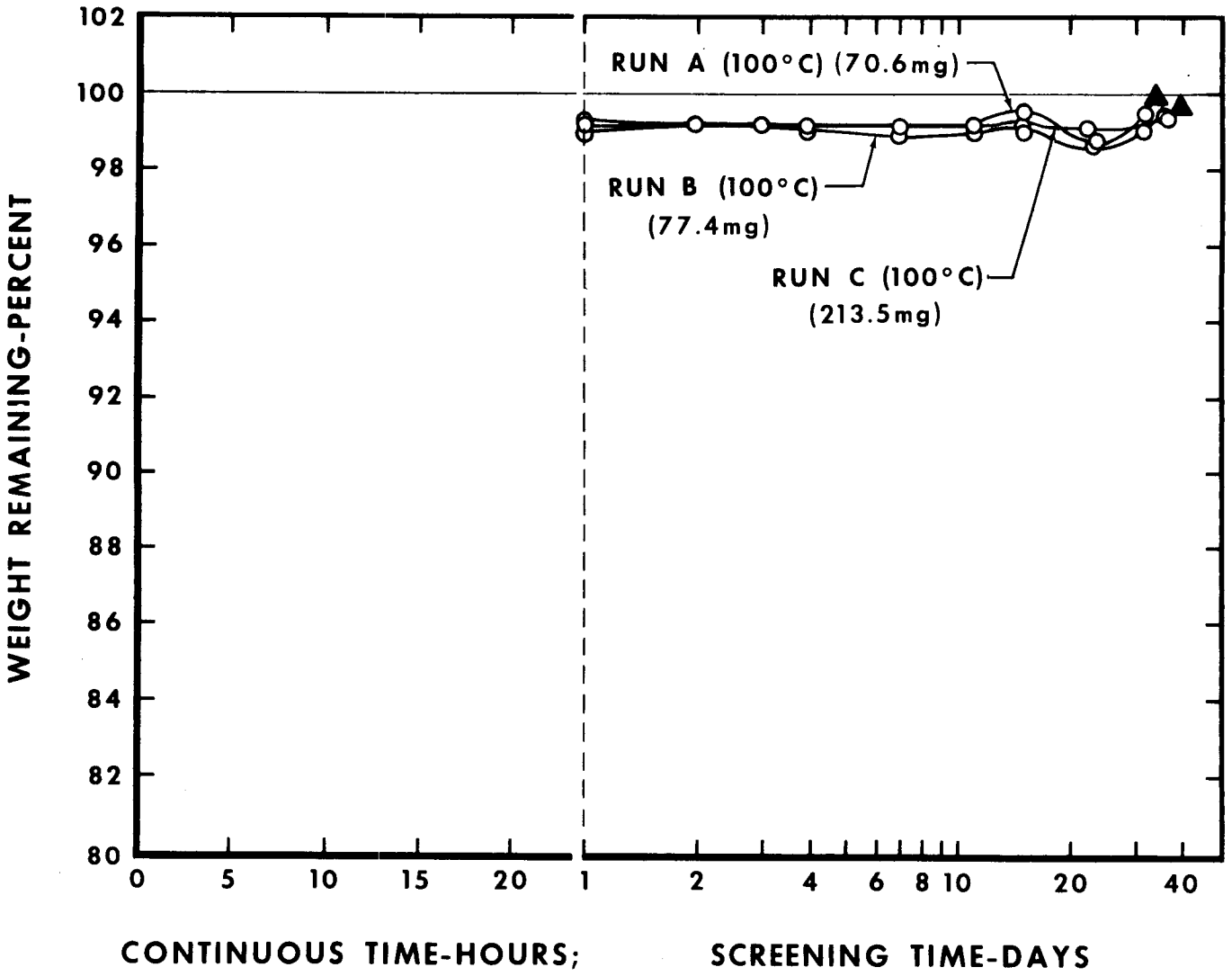

FIGURE 85. - TIME-WEIGHT HISTORIES FOR AEROBOND 430 DURING EXPOSURE TO VACUUM AT 100°C

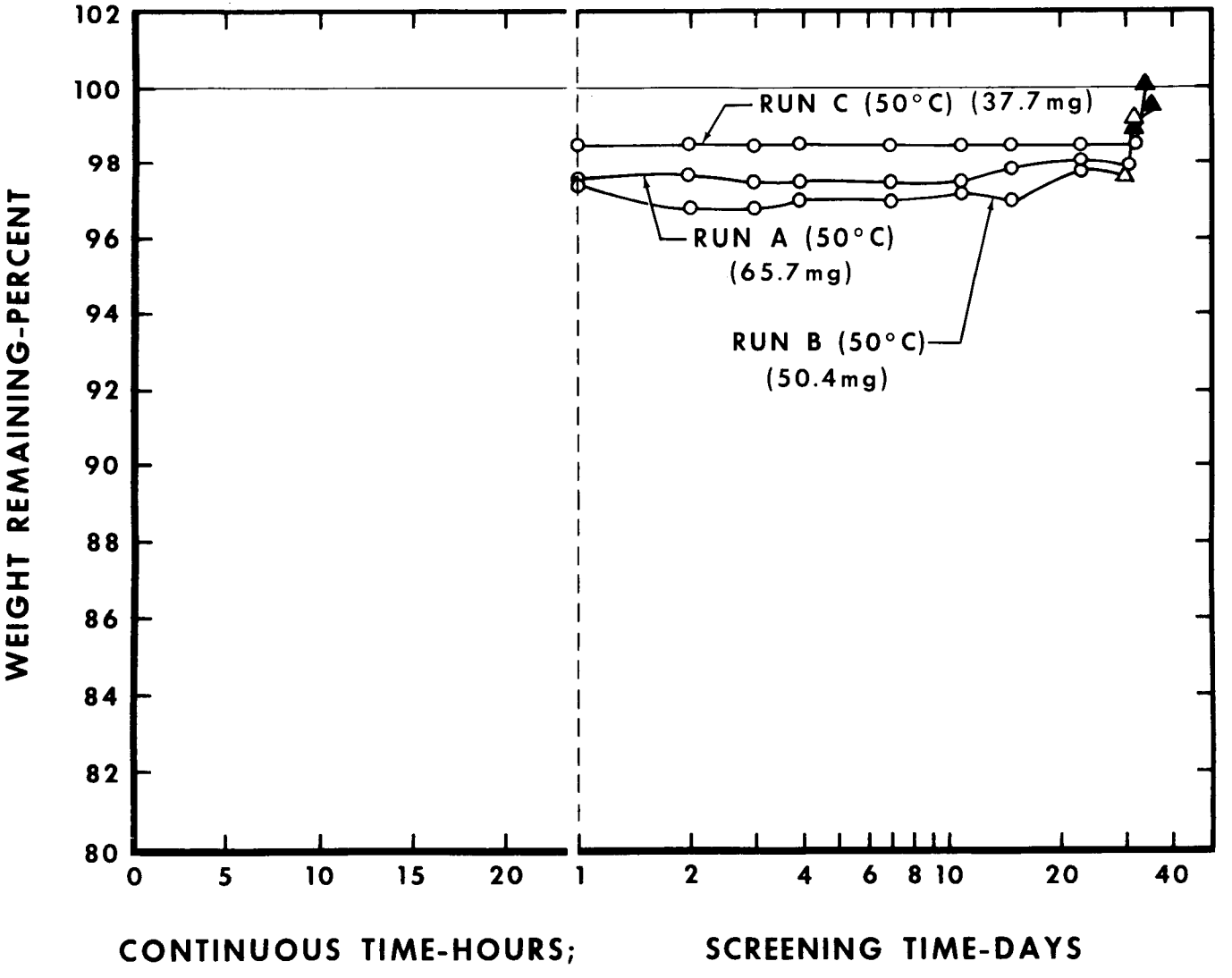

FIGURE 86. - TIME-WEIGHT HISTORIES FOR FM-1000 DURING EXPOSURE TO VACUUM AT 50°C

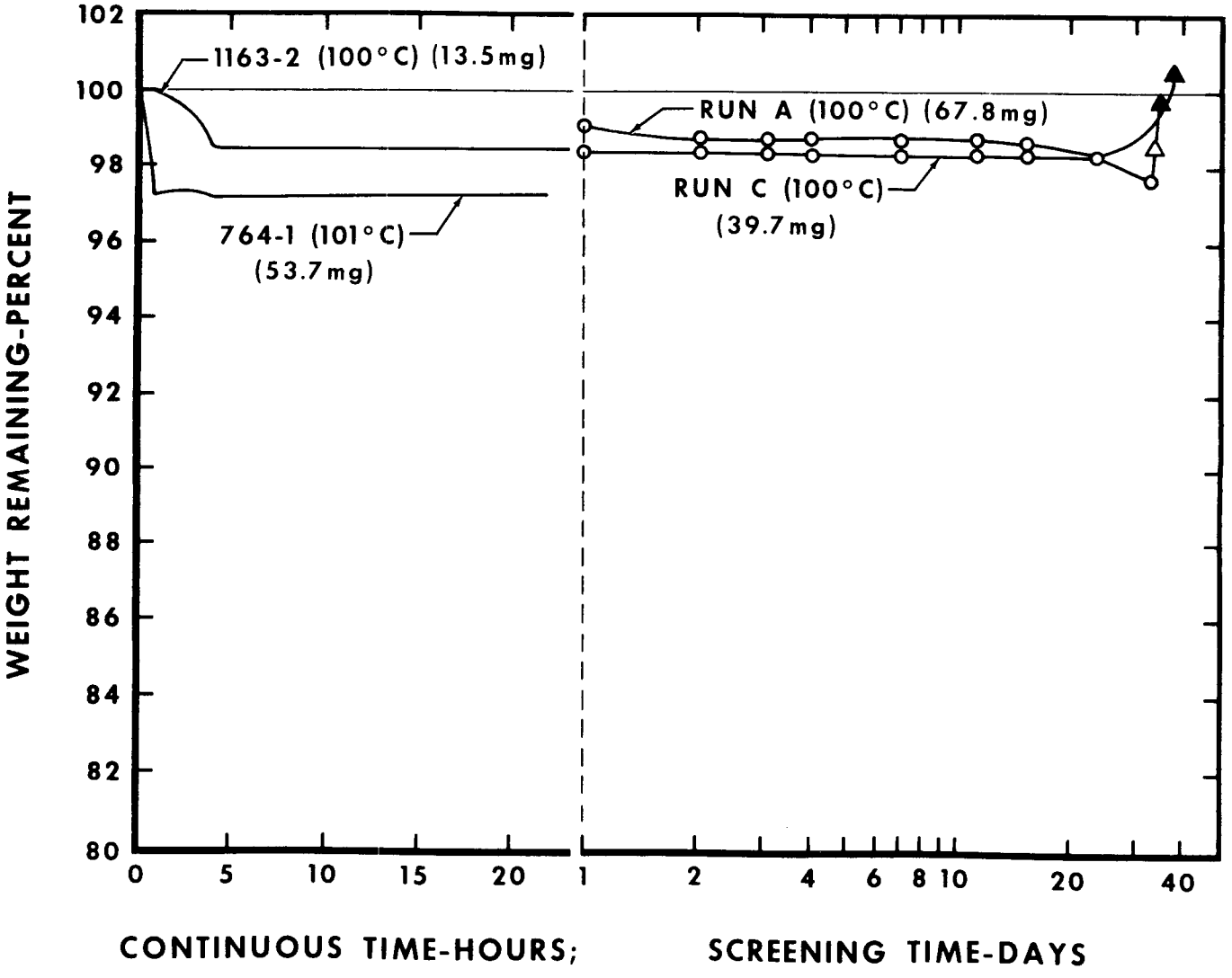

FIGURE 87. - TIME-WEIGHT HISTORIES FOR FM-1000 DURING EXPOSURE TO VACUUM AT 100°C AND 101°C

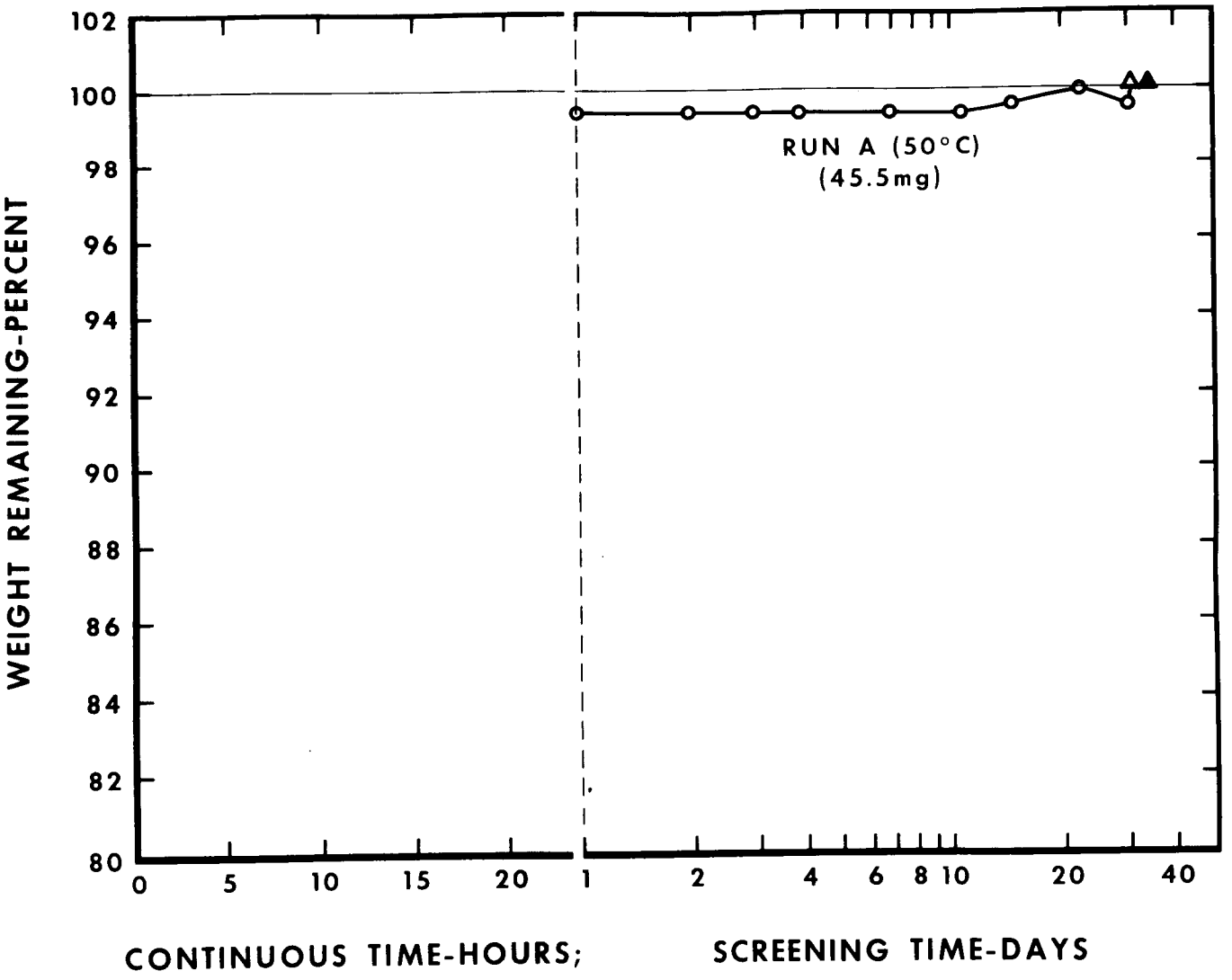

FIGURE 88. - TIME-WEIGHT HISTORIES FOR NARMCO 302A DURING EXPOSURE TO VACUUM AT 50°C

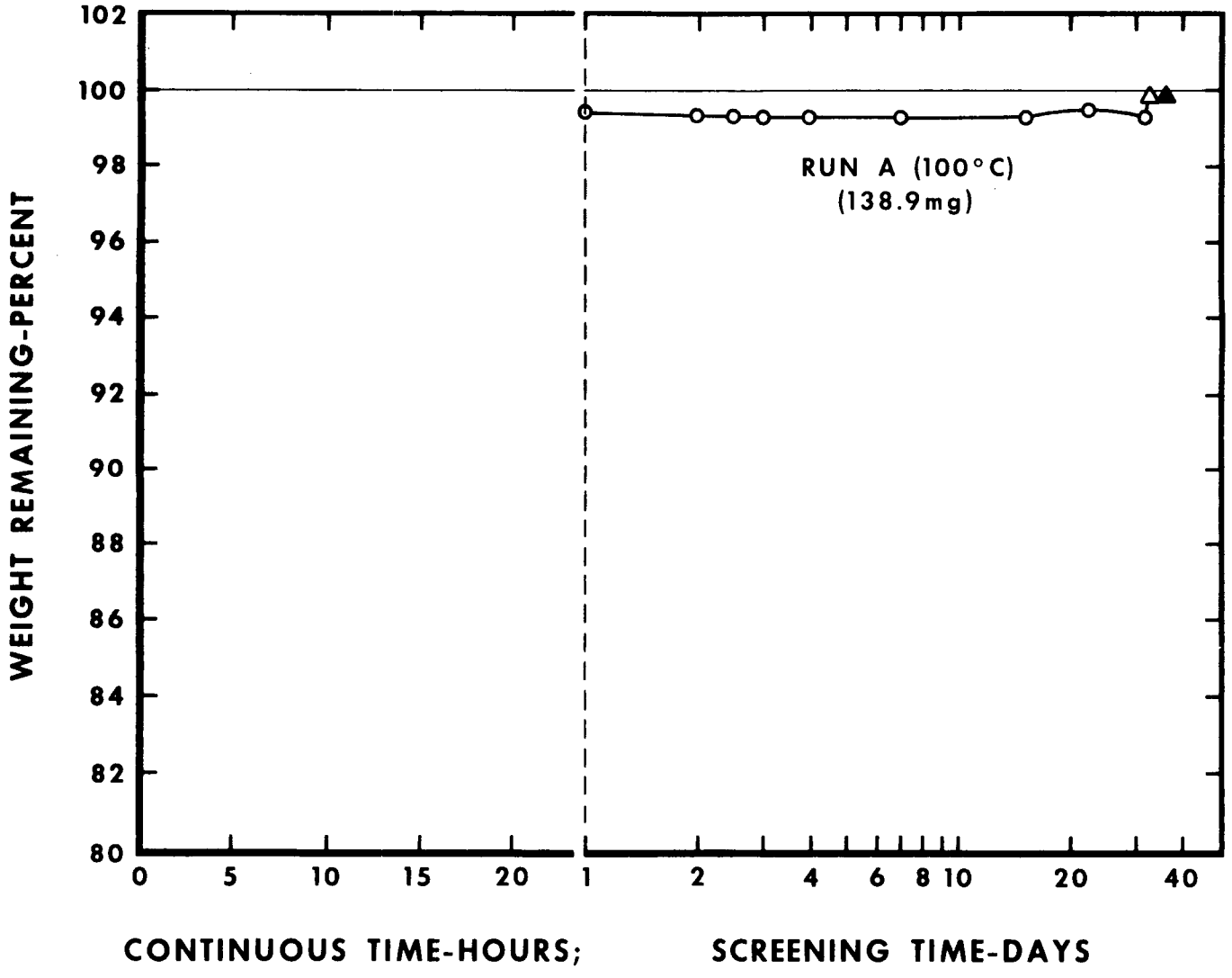

FIGURE 89. - TIME-WEIGHT HISTORIES FOR NARMCO 302A DURING EXPOSURE TO VACUUM AT 100°C

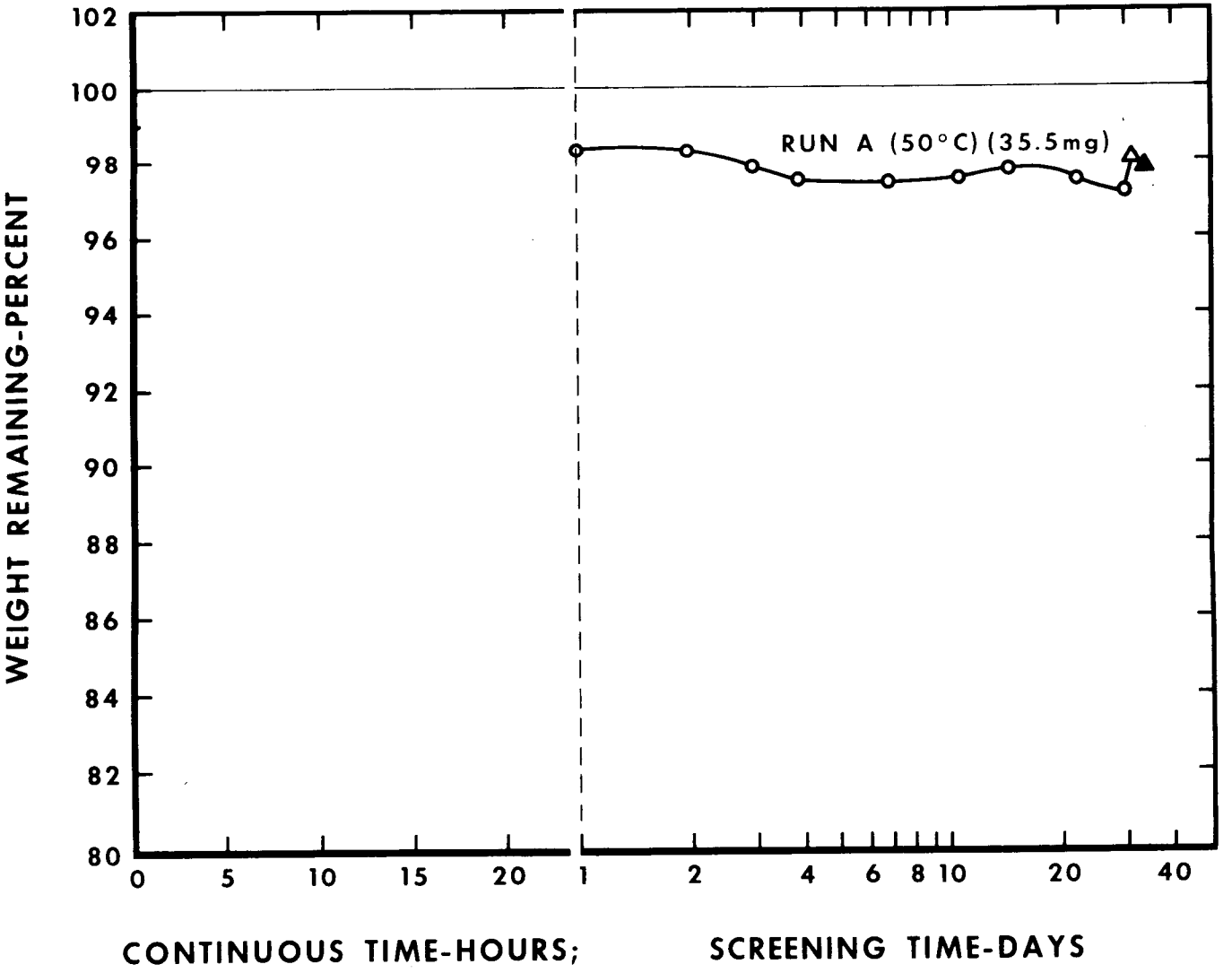

FIGURE 90. - TIME-WEIGHT HISTORIES FOR AF-6 DURING EXPOSURE TO VACUUM AT 50°C

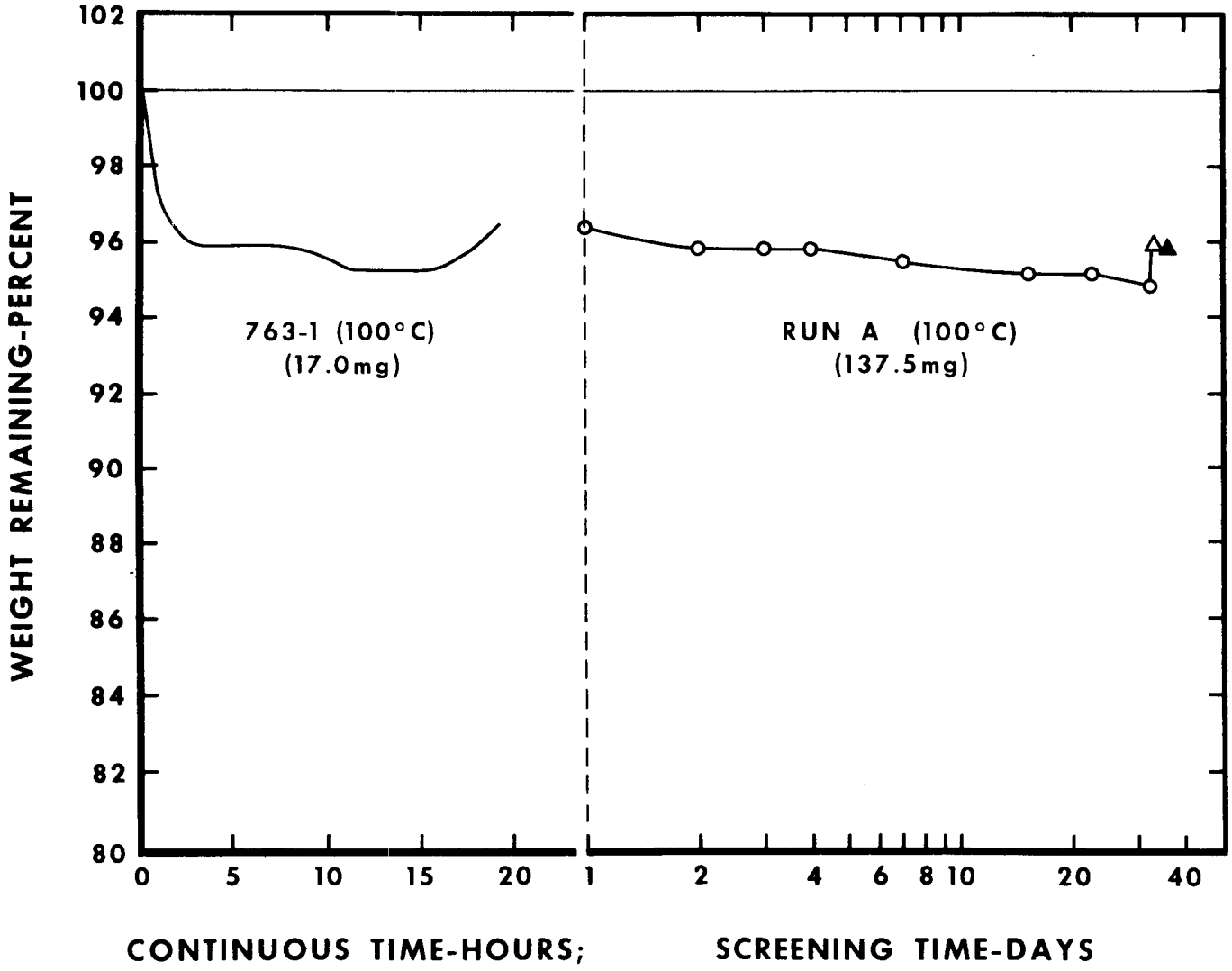

FIGURE 91. - TIME-WEIGHT HISTORIES FOR AF-6 DURING EXPOSURE TO VACUUM AT 100°C

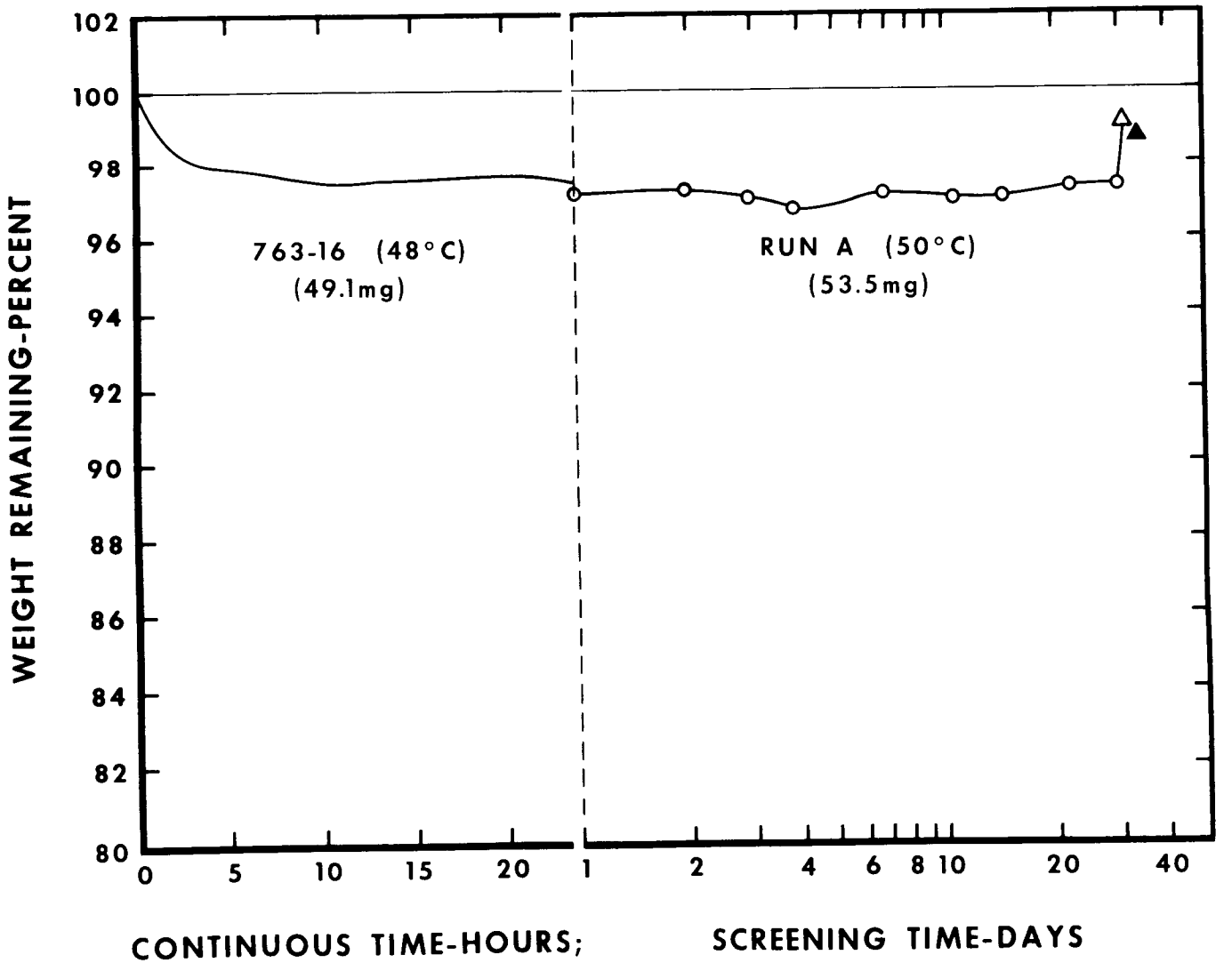

FIGURE 92. - TIME-WEIGHT HISTORIES FOR AF-40 DURING EXPOSURE TO VACUUM AT 48°C AND 50°C

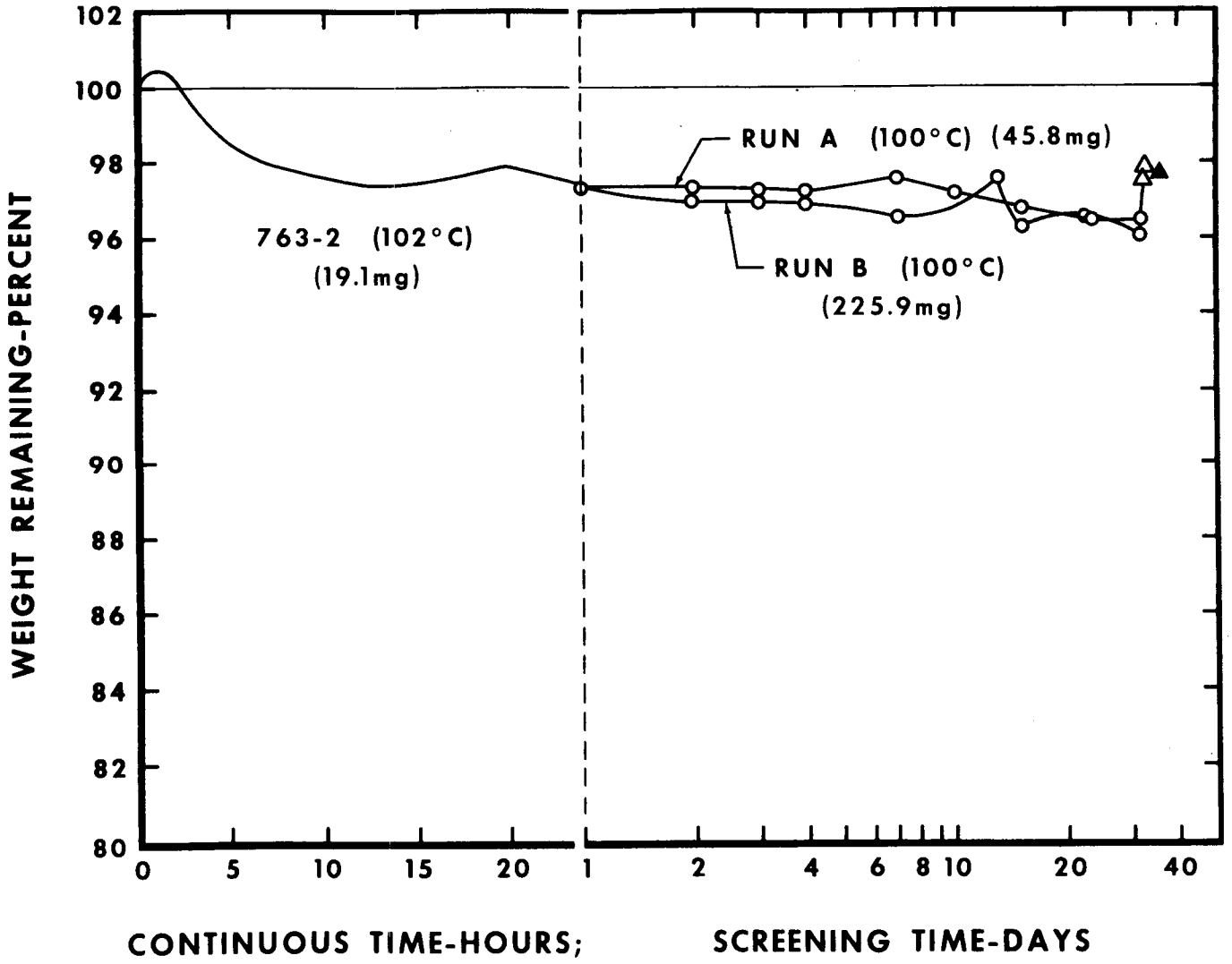

FIGURE 93. - TIME-WEIGHT HISTORIES FOR AF-40 DURING EXPOSURE TO VACUUM AT 100°C AND 102°C

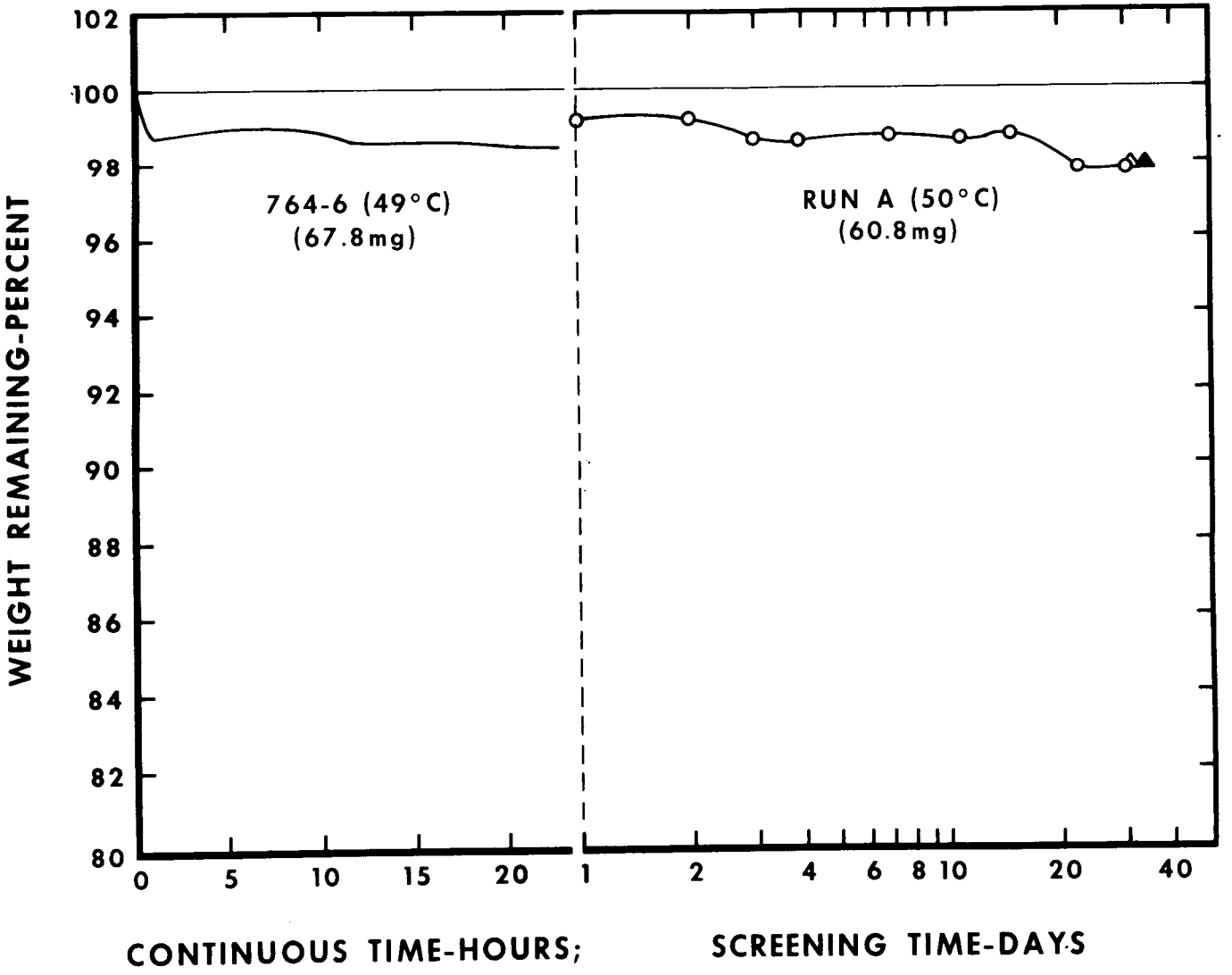

FIGURE 94. - TIME-WEIGHT HISTORIES FOR NARMCO 4021 DURING EXPOSURE TO VACUUM AT 49°C AND 50°C

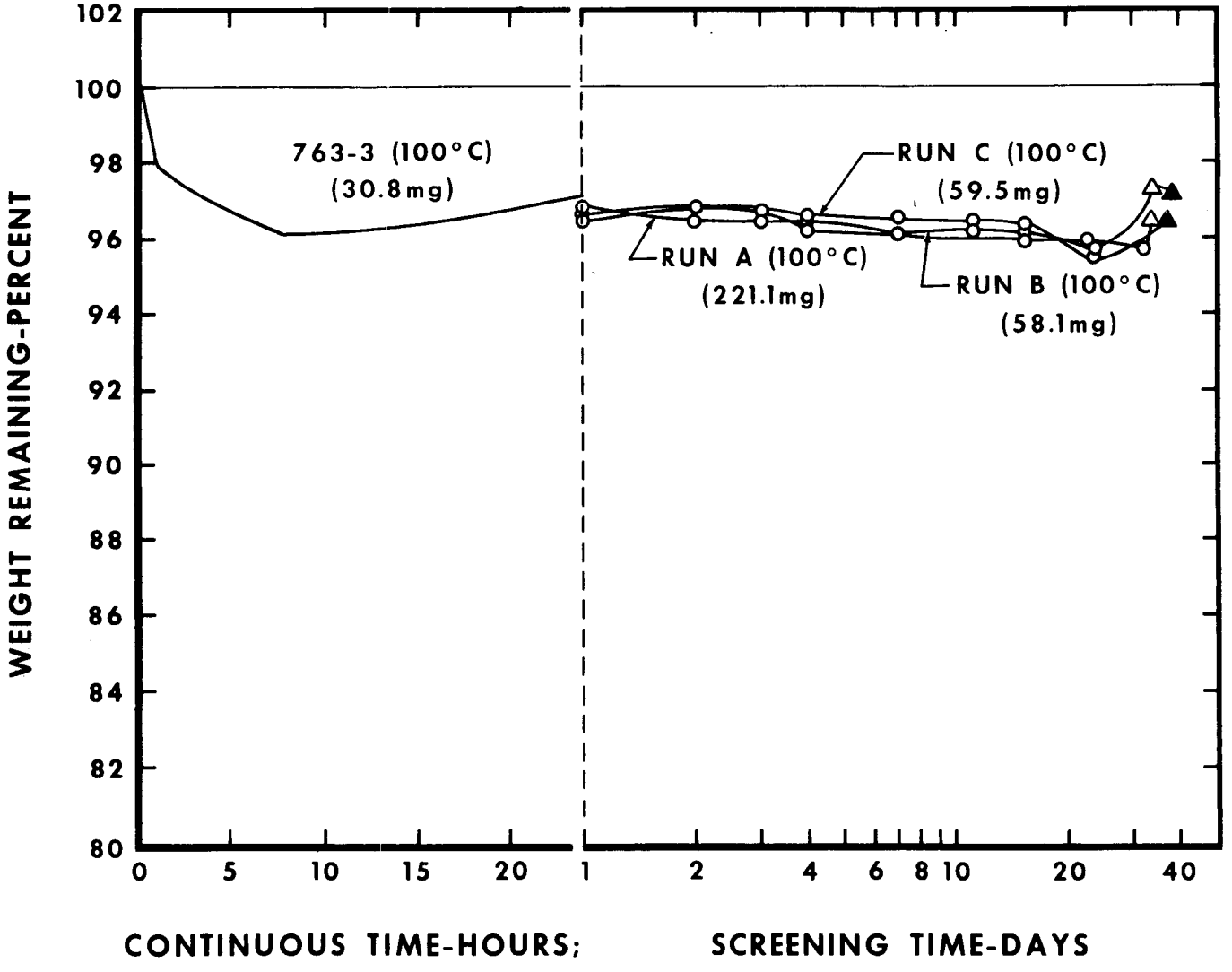

FIGURE 95. - TIME-WEIGHT HISTORIES FOR NARMCO 4021 DURING EXPOSURE TO VACUUM AT 100°C

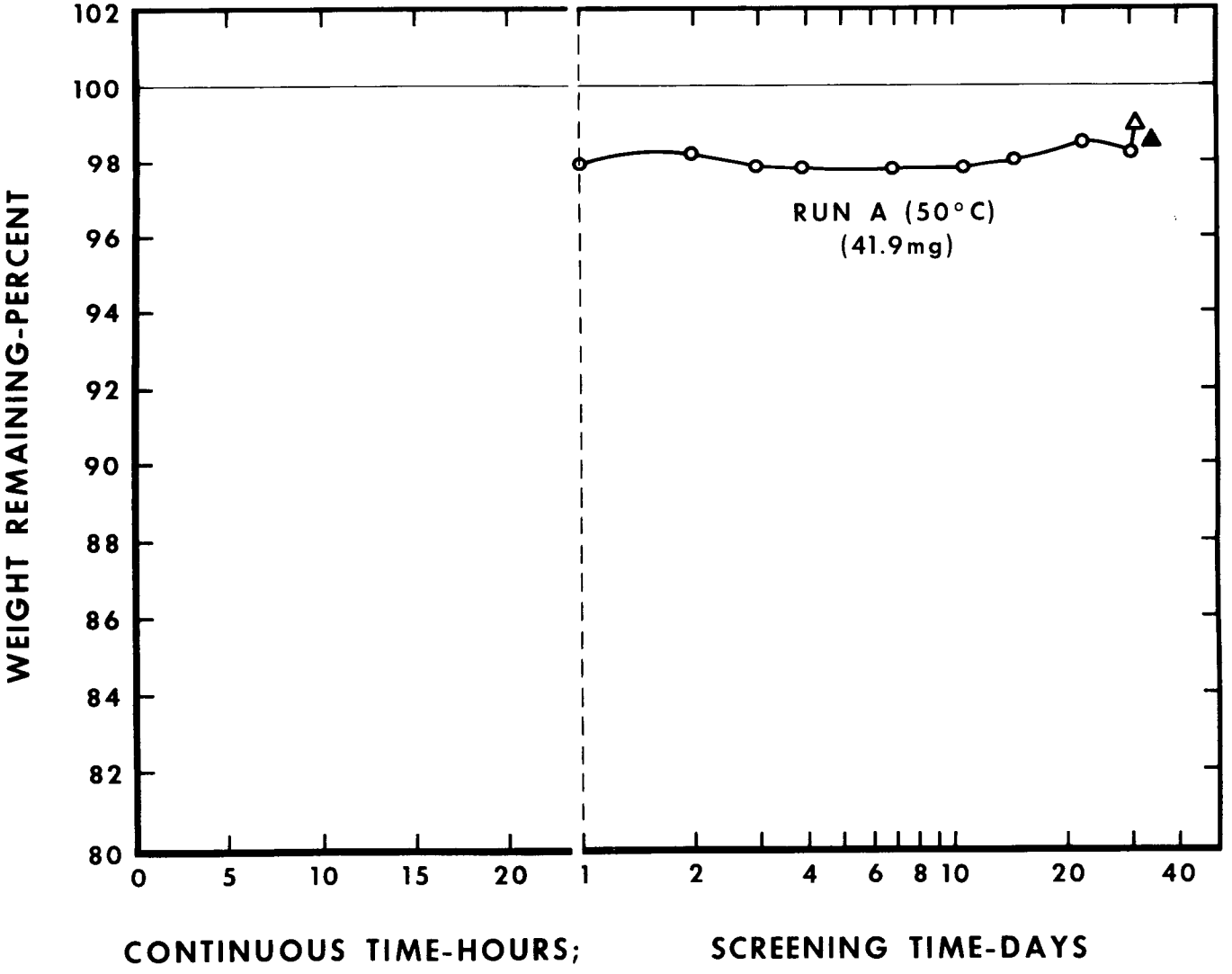

FIGURE 96. - TIME-WEIGHT HISTORIES FOR NARMCO 408 DURING EXPOSURE TO VACUUM AT 50°C

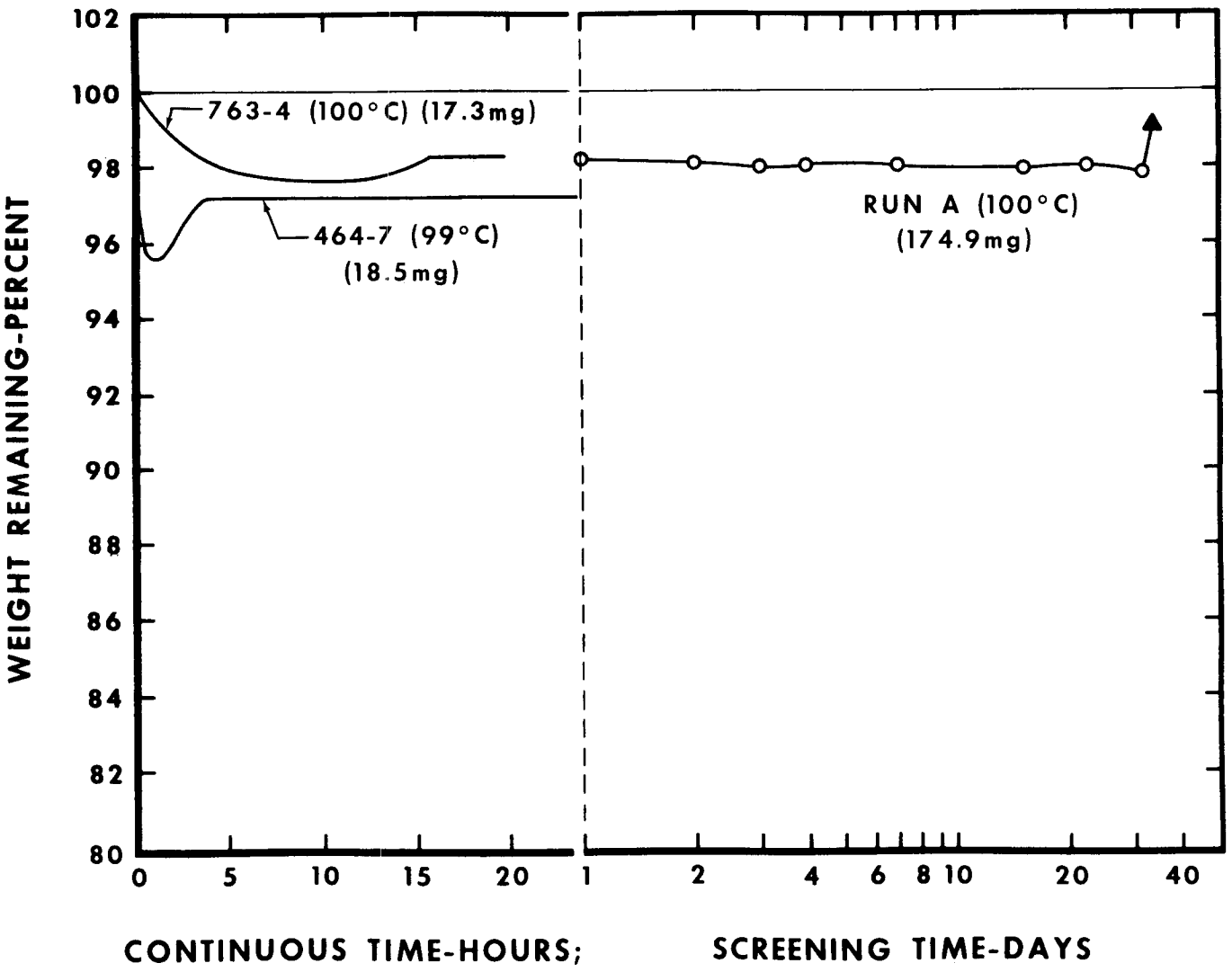

FIGURE 97. - TIME-WEIGHT HISTORIES FOR NARMCO 408 DURING EXPOSURE TO VACUUM AT 99°C AND 100°C

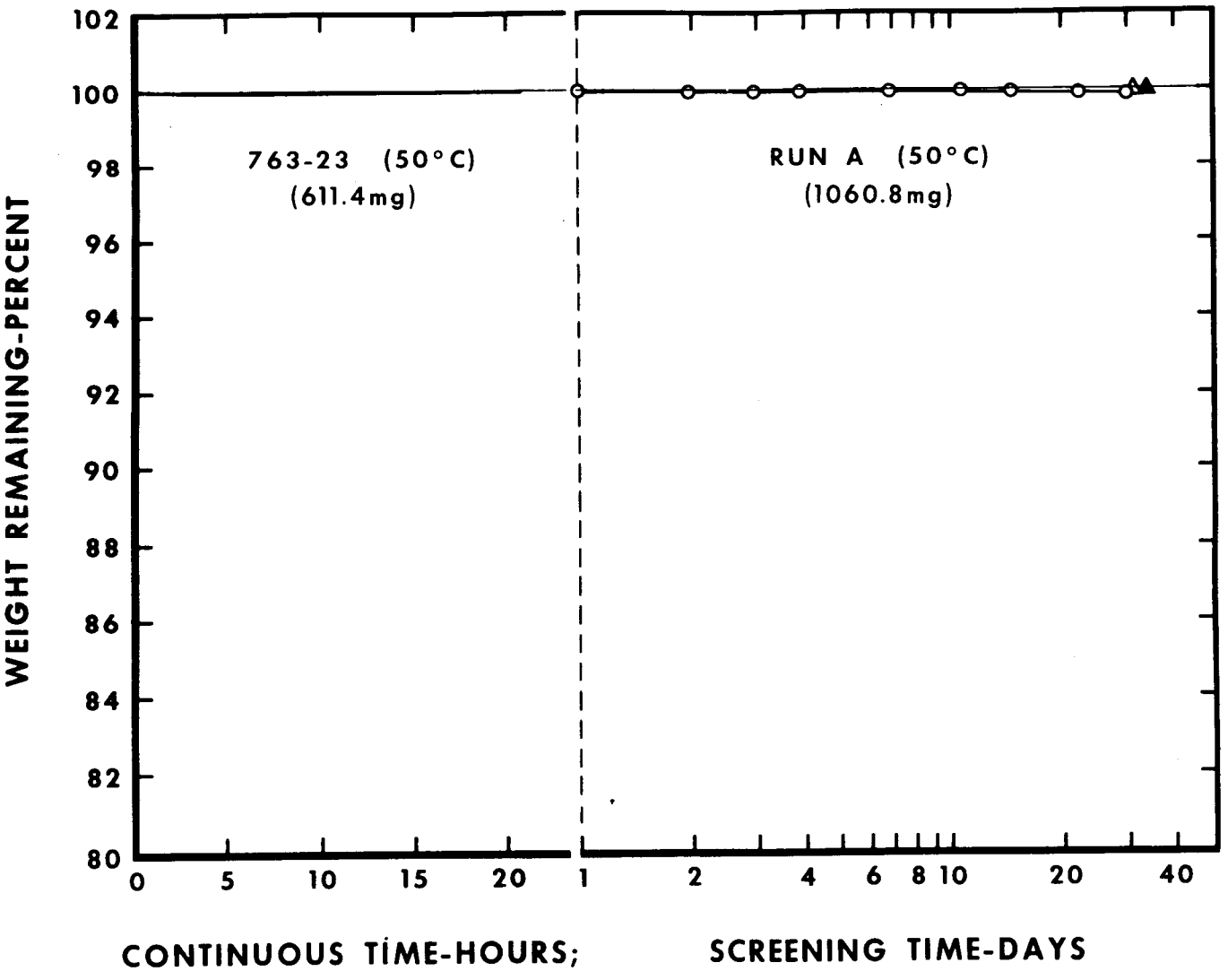

FIGURE 98. - TIME-WEIGHT HISTORIES FOR SELECTRON 5003 DURING EXPOSURE TO VACUUM AT 50°C

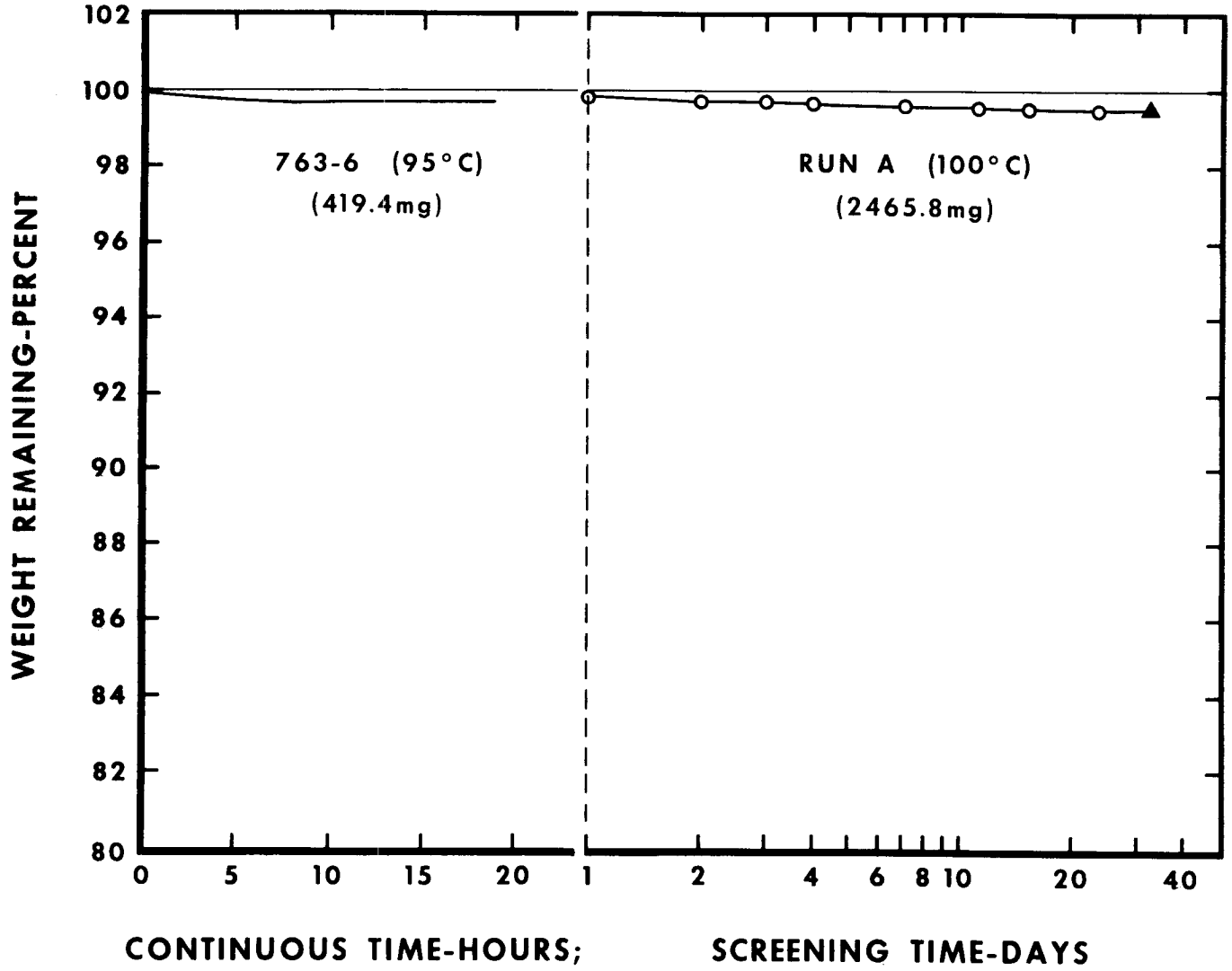

FIGURE 99. - TIME-WEIGHT HISTORIES FOR SELECTRON 5003 DURING EXPOSURE TO VACUUM AT 95°C AND 100°C

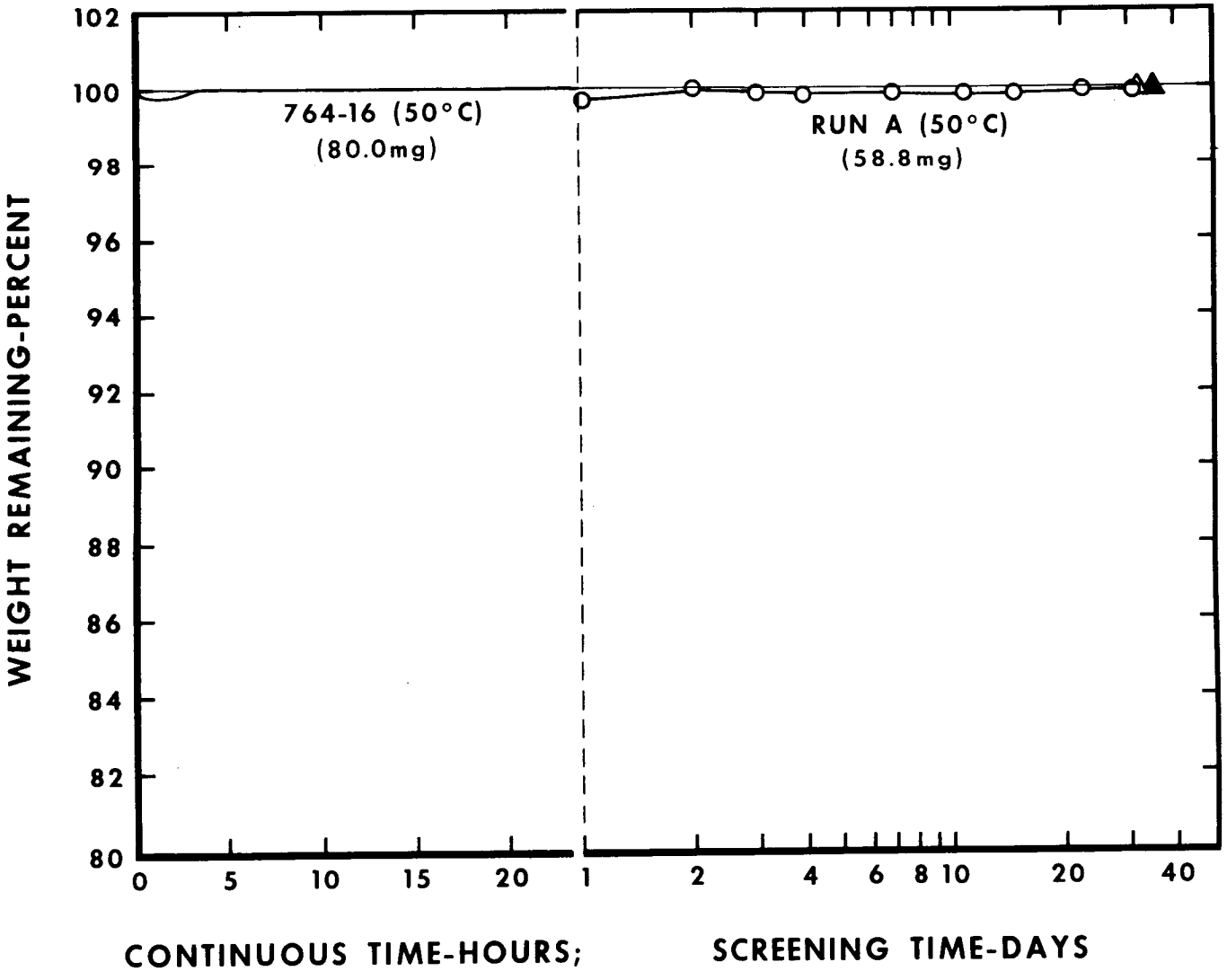

FIGURE 100. - TIME-WEIGHT HISTORIES FOR KYNAR DURING EXPOSURE TO VACUUM AT 50°C

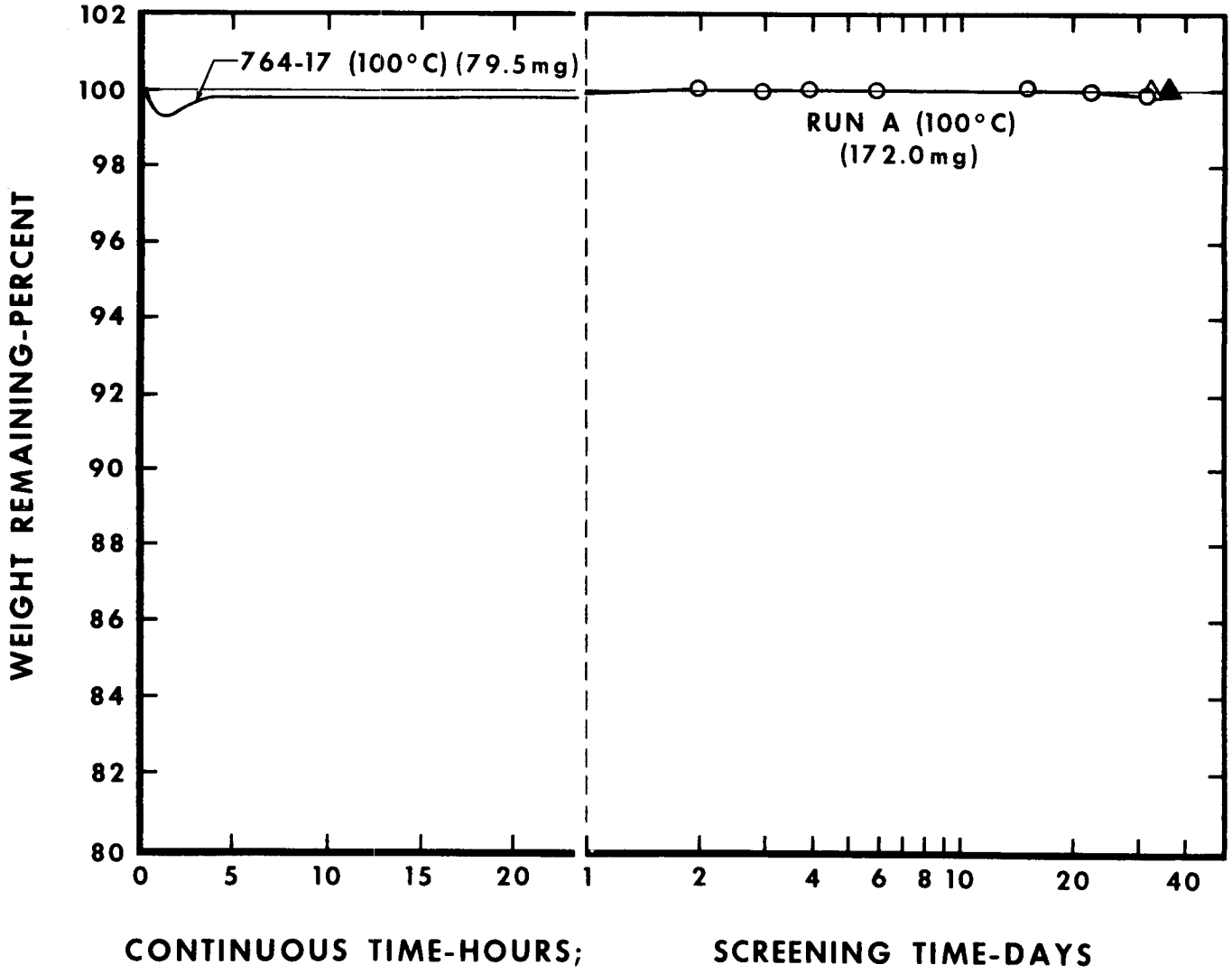

FIGURE 101. - TIME-WEIGHT HISTORIES FOR KYNAR DURING EXPOSURE TO VACUUM AT 100°C

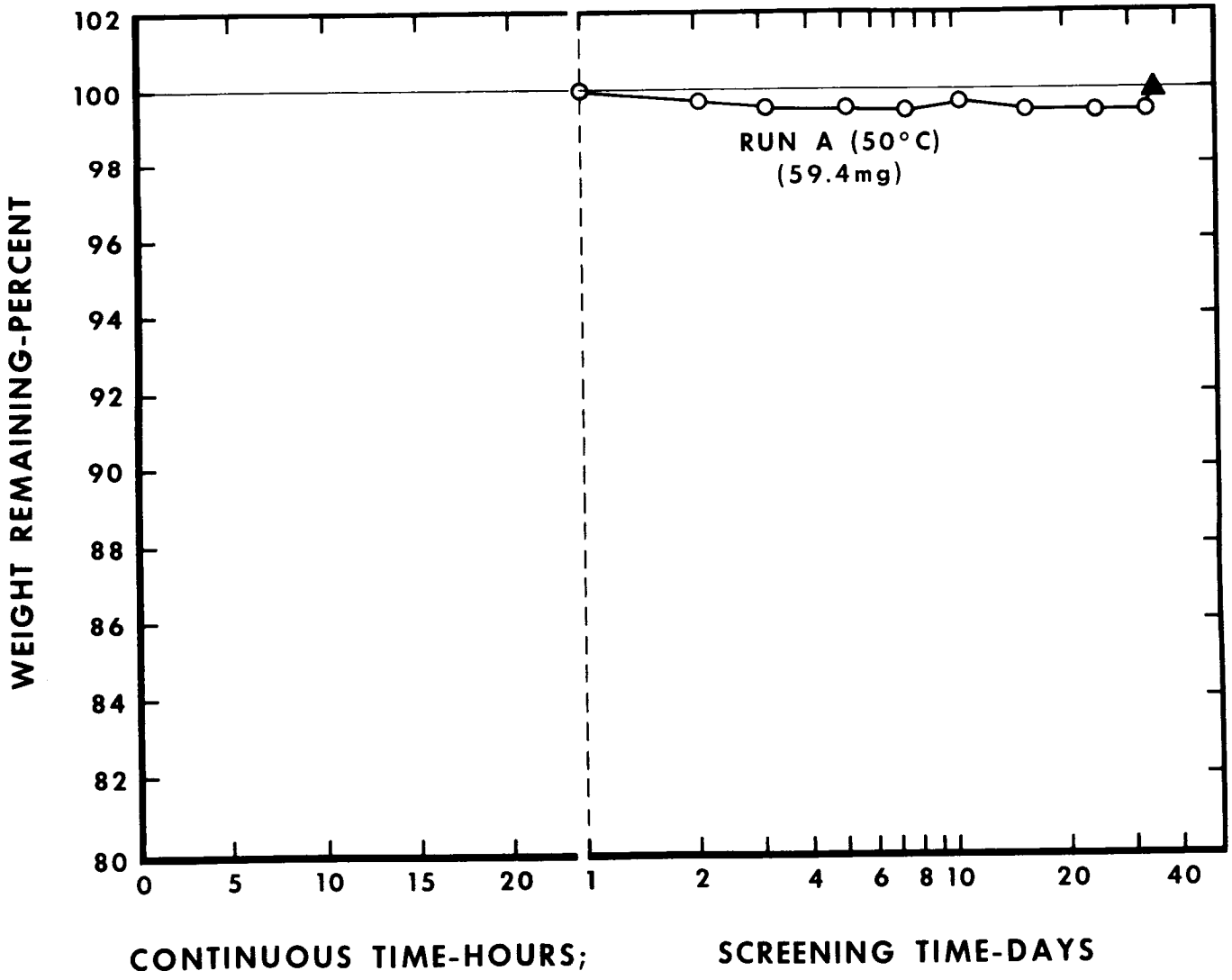

FIGURE 102. - TIME-WEIGHT HISTORIES FOR MB 302A DURING EXPOSURE TO VACUUM AT 50°C

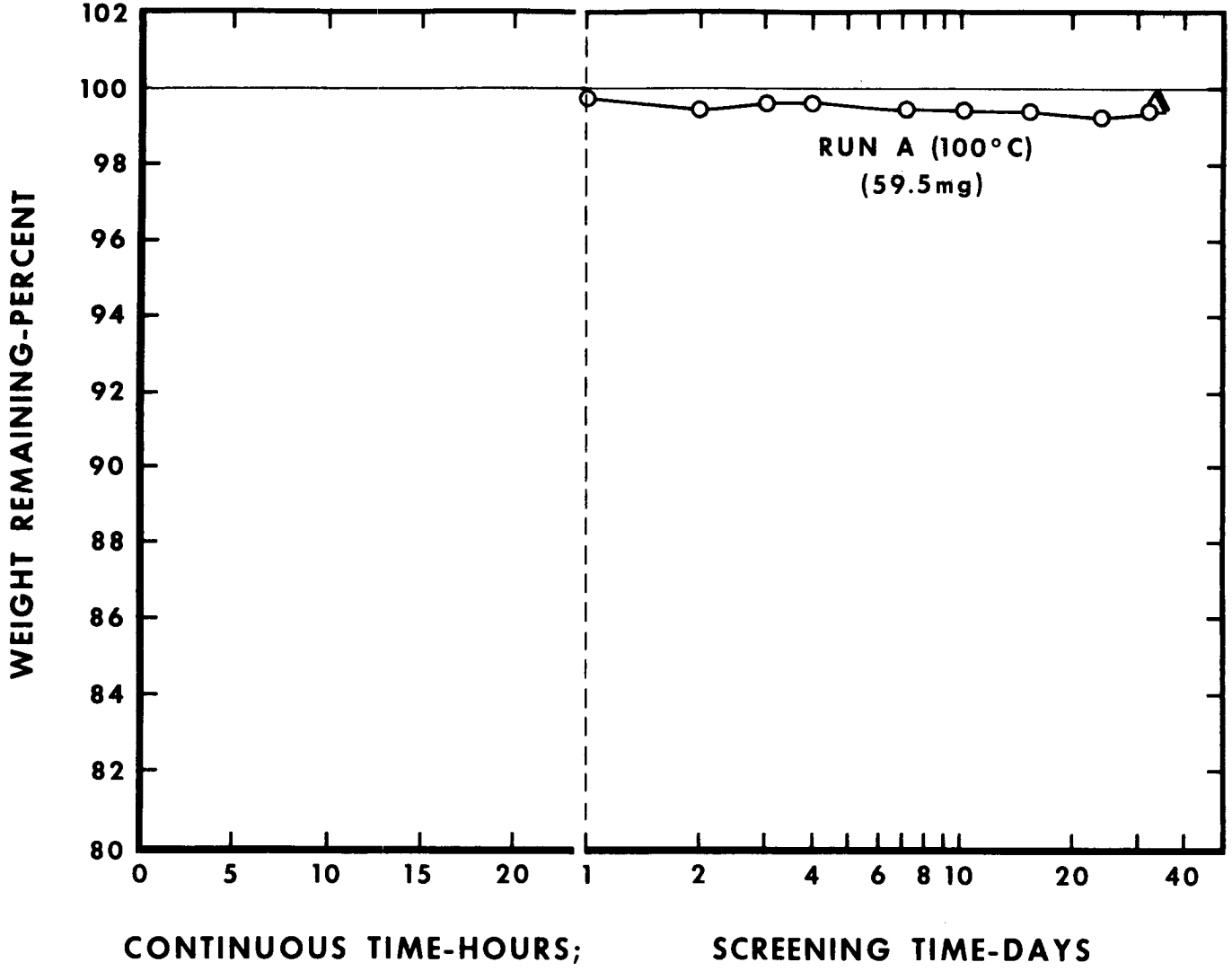

FIGURE 103. - TIME-WEIGHT HISTORIES FOR MB 302A DURING EXPOSURE TO VACUUM AT 100°C

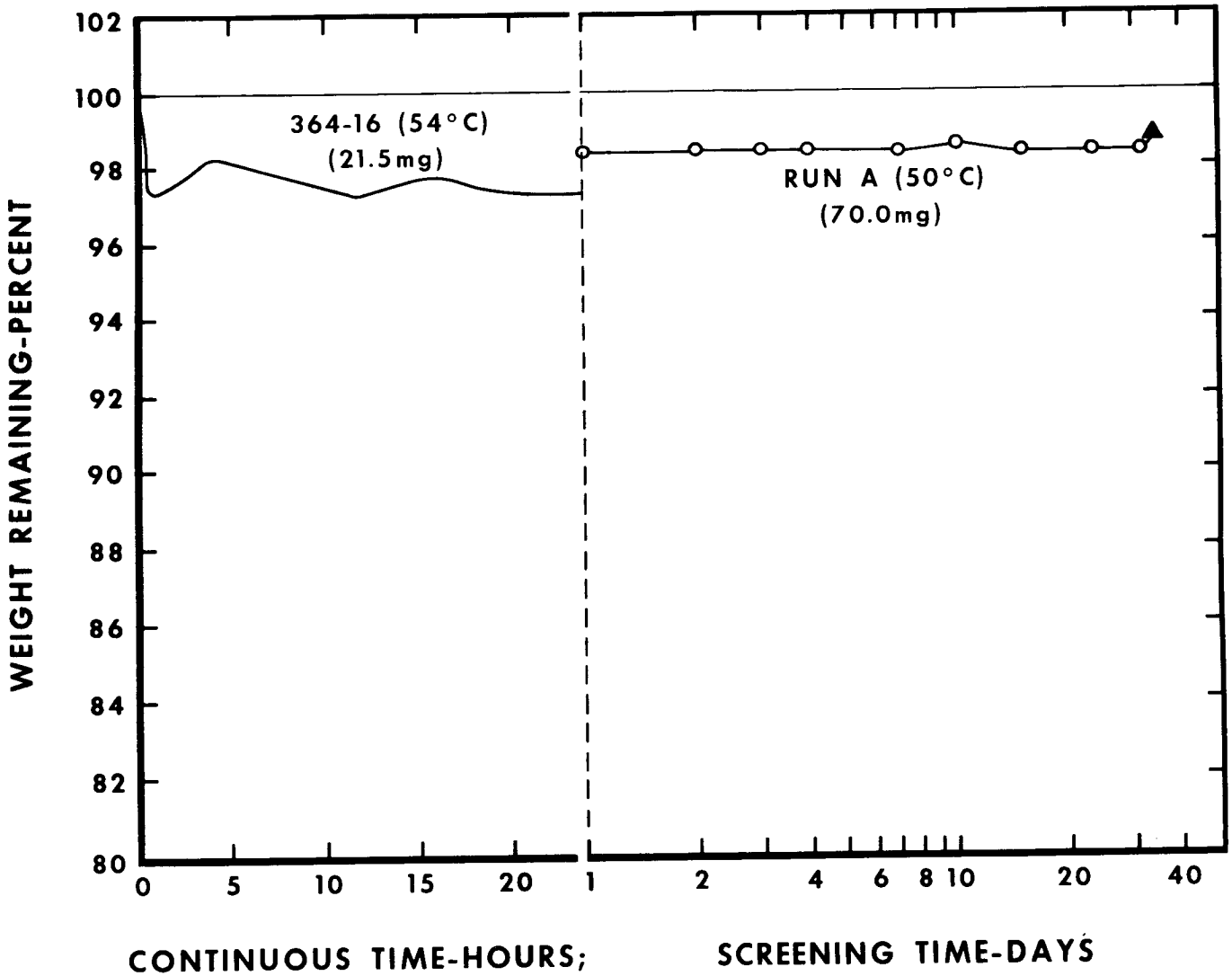

FIGURE 104. - TIME-WEIGHT HISTORIES FOR MB 406 DURING EXPOSURE TO VACUUM AT 50°C AND 54°C

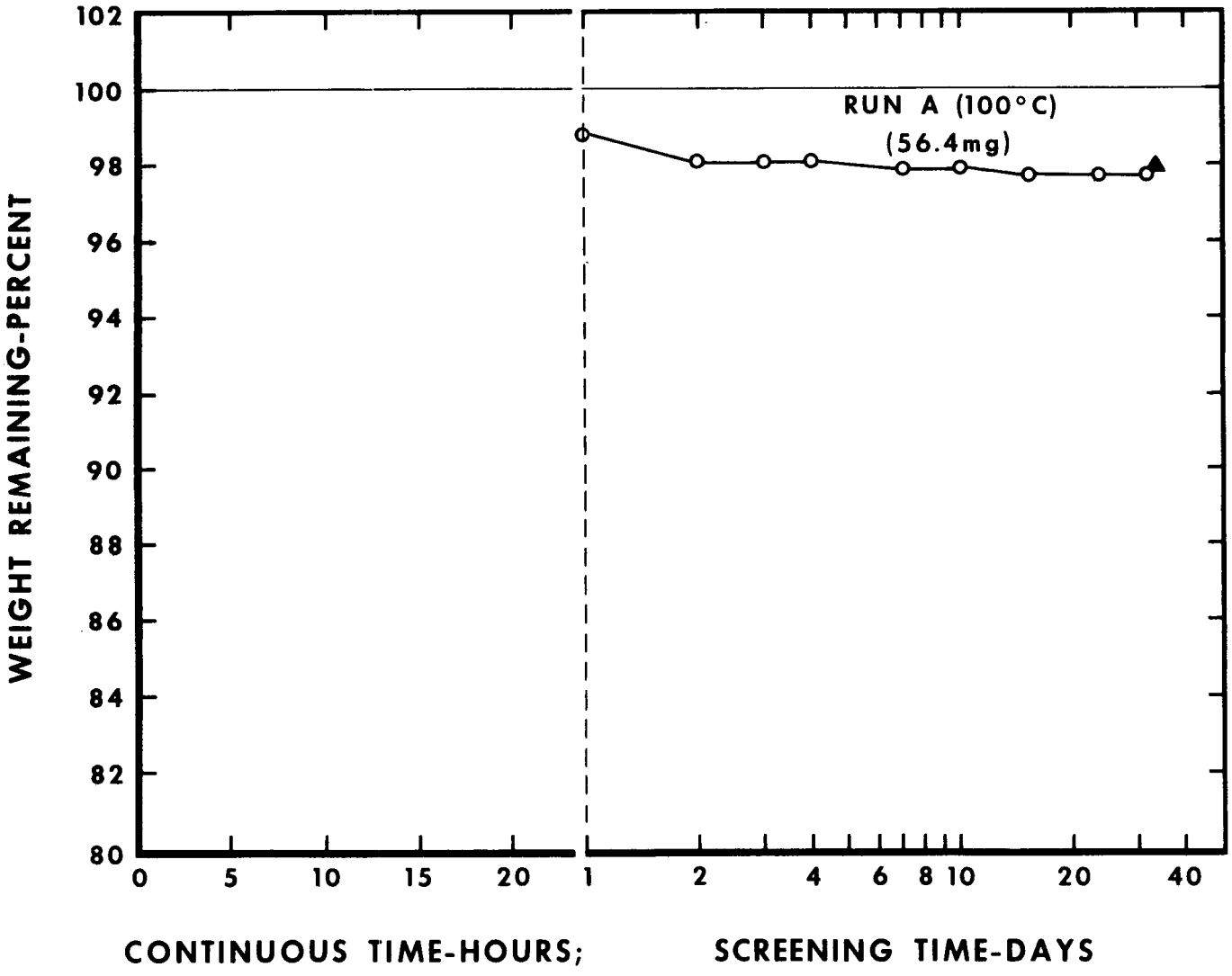

FIGURE 105. - TIME-WEIGHT HISTORIES FOR MB 406 DURING EXPOSURE TO VACUUM AT 100°C

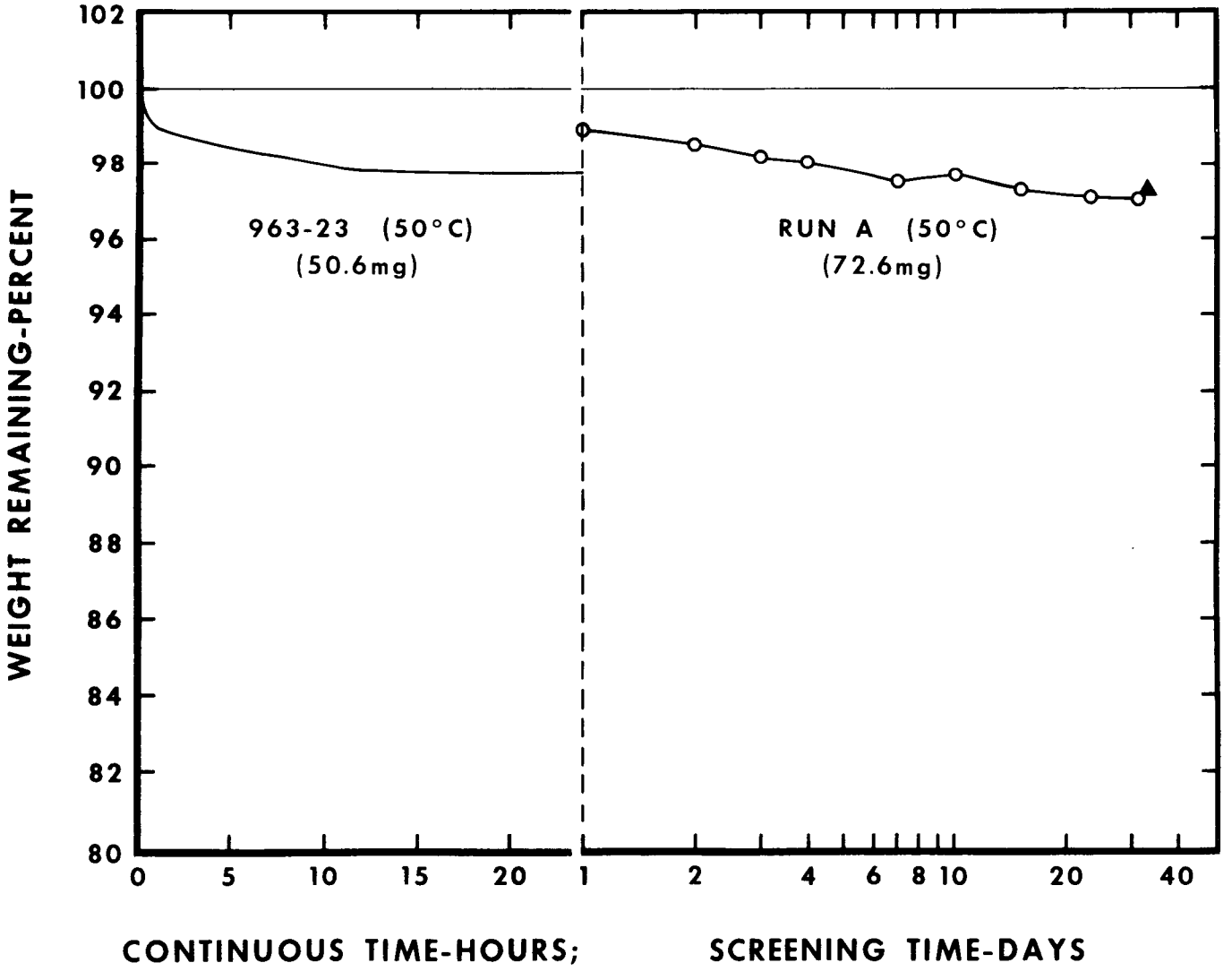

FIGURE 106. - TIME-WEIGHT HISTORIES FOR MB 4021 DURING EXPOSURE TO VACUUM AT 50°C

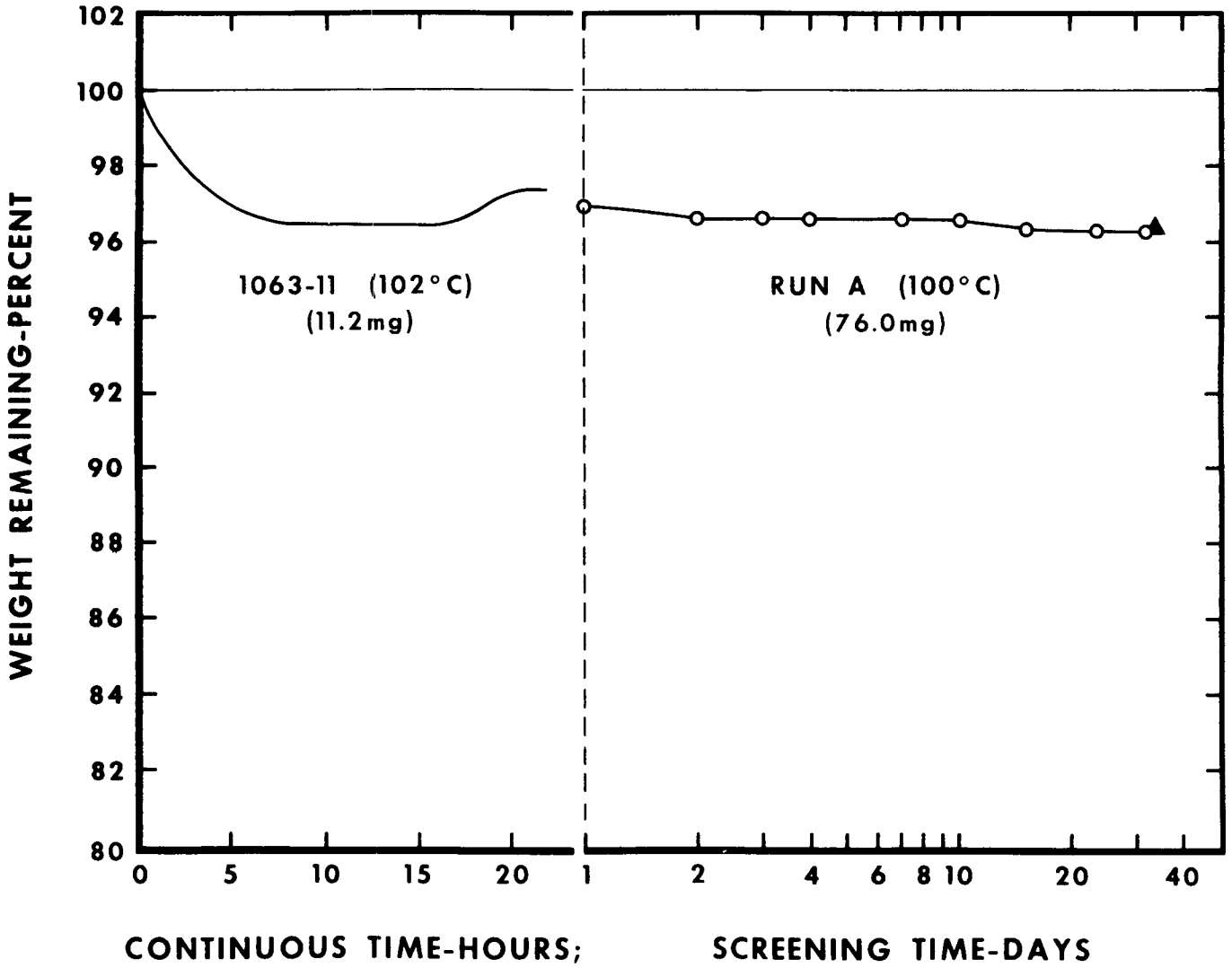

FIGURE 107. - TIME-WEIGHT HISTORIES FOR MB 4021 DURING EXPOSURE TO VACUUM AT 100°C AND 102°C

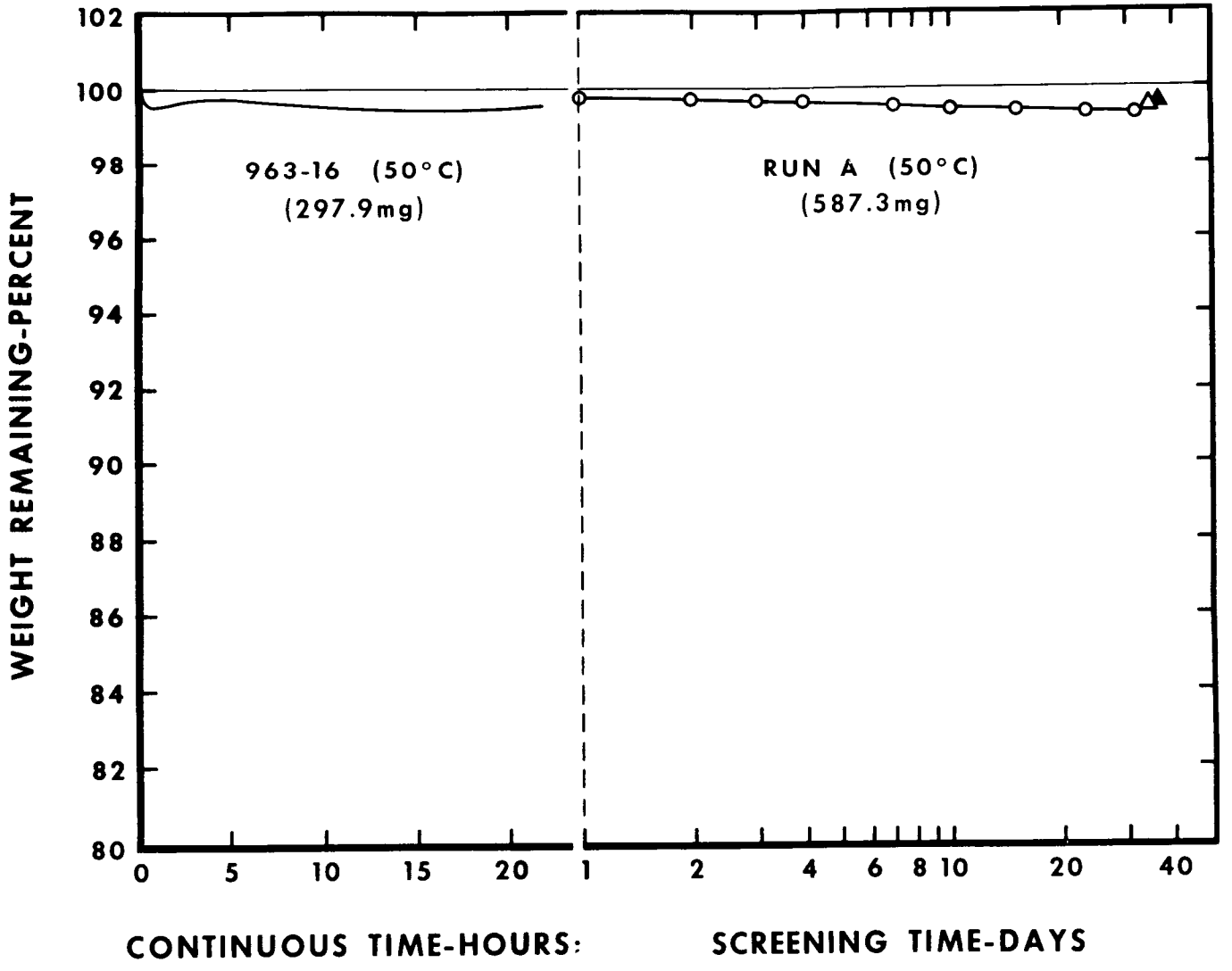

FIGURE 108. - TIME-WEIGHT HISTORIES FOR SCOTCHCAST 212 DURING EXPOSURE TO VACUUM AT 50°C

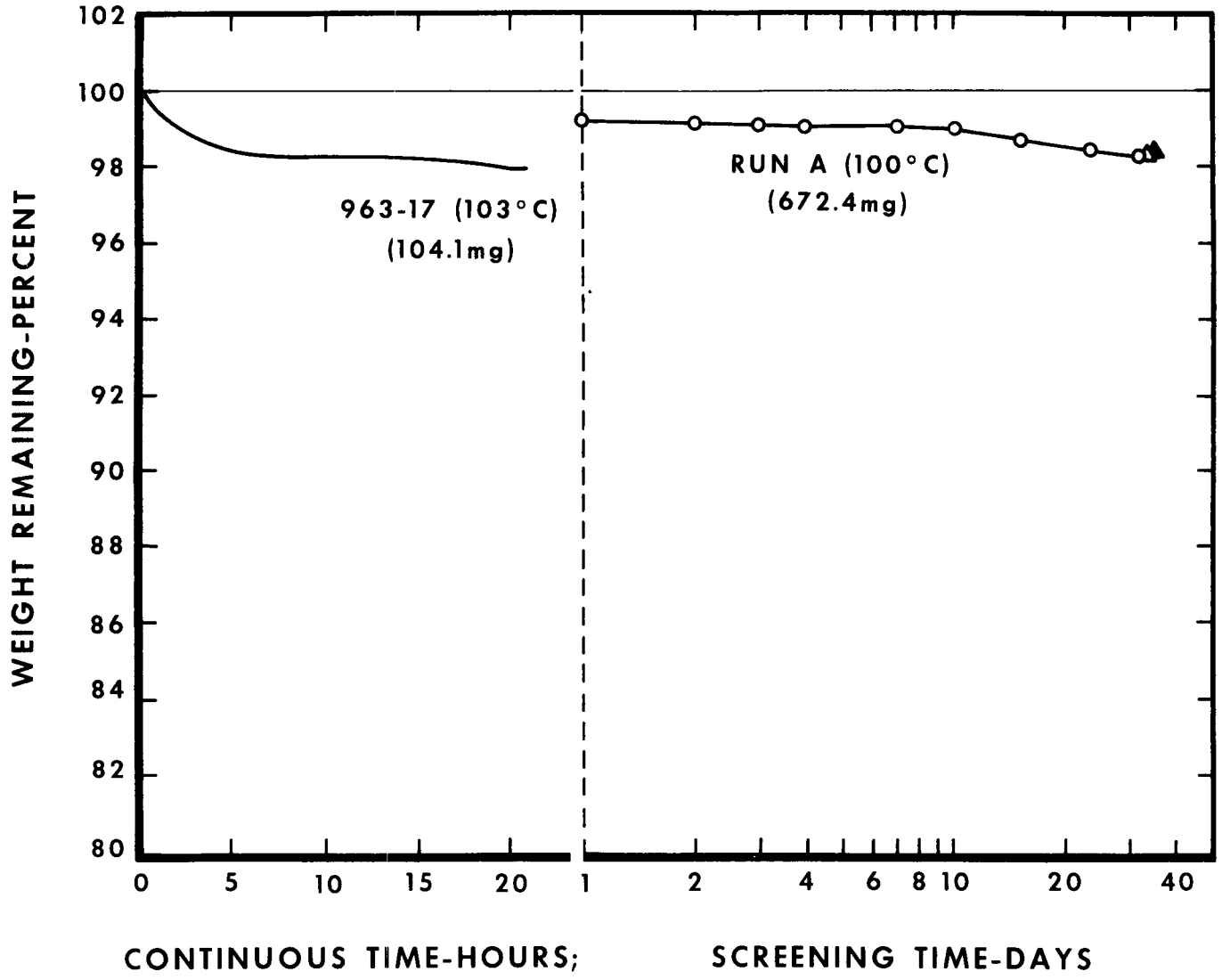

FIGURE 109. - TIME-WEIGHT HISTORIES FOR SCOTCHCAST 212 DURING EXPOSURE TO VACUUM AT 100°C AND 103°C

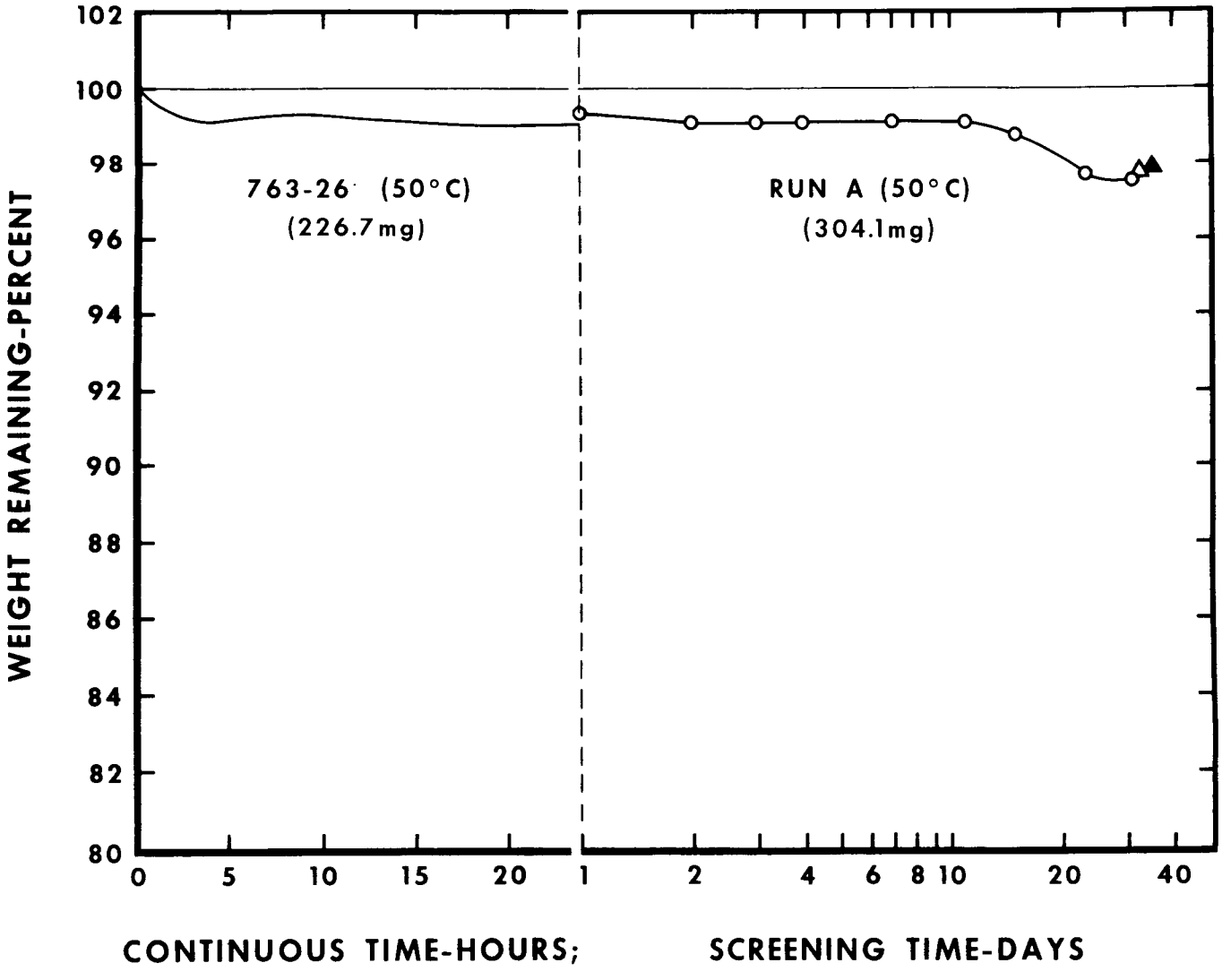

FIGURE 110. - TIME-WEIGHT HISTORIES FOR EC 1949 DURING EXPOSURE TO VACUUM AT 50°C

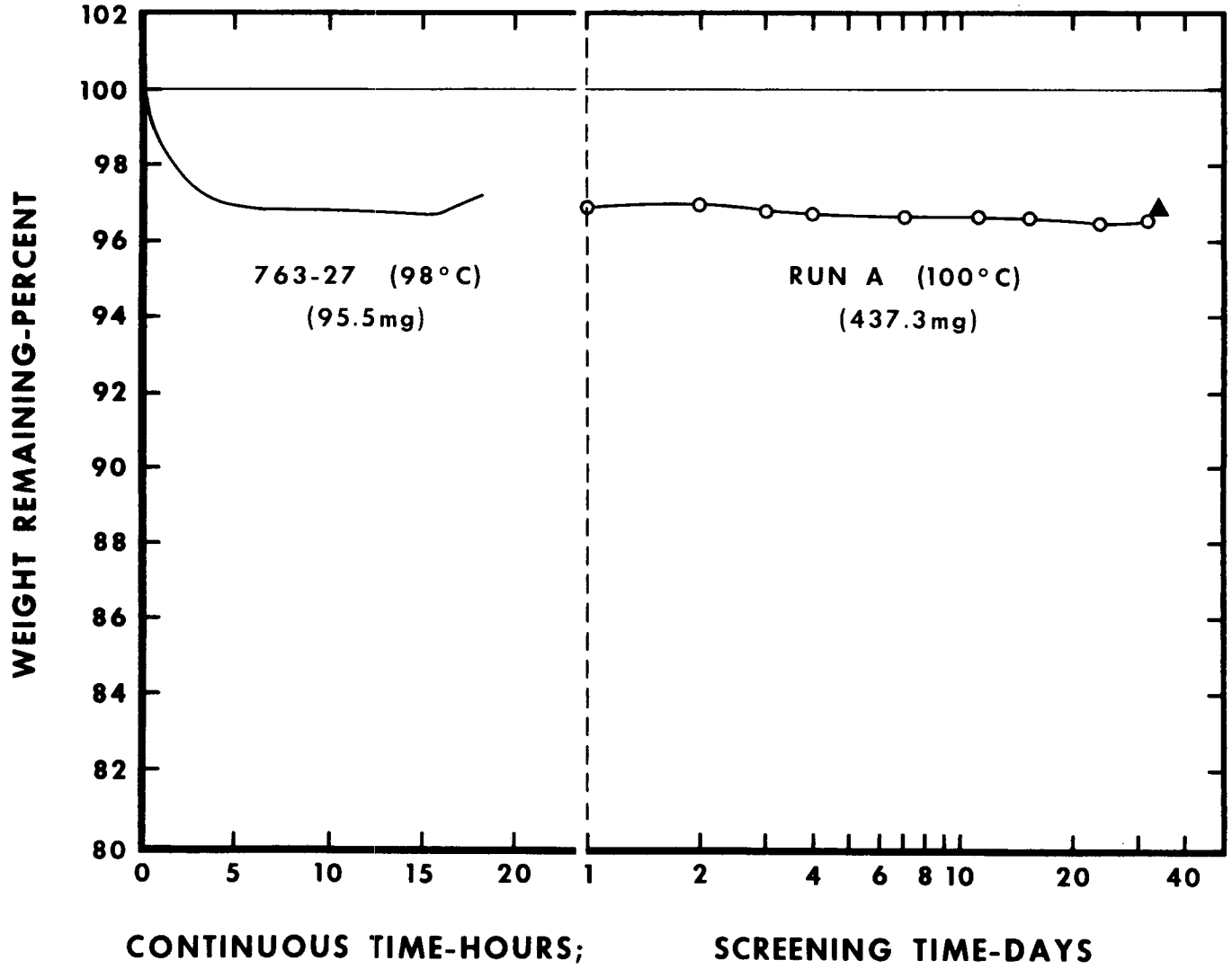

FIGURE 111. - TIME-WEIGHT HISTORIES FOR EC 1949 DURING EXPOSURE TO VACUUM AT 98°C AND 100°C

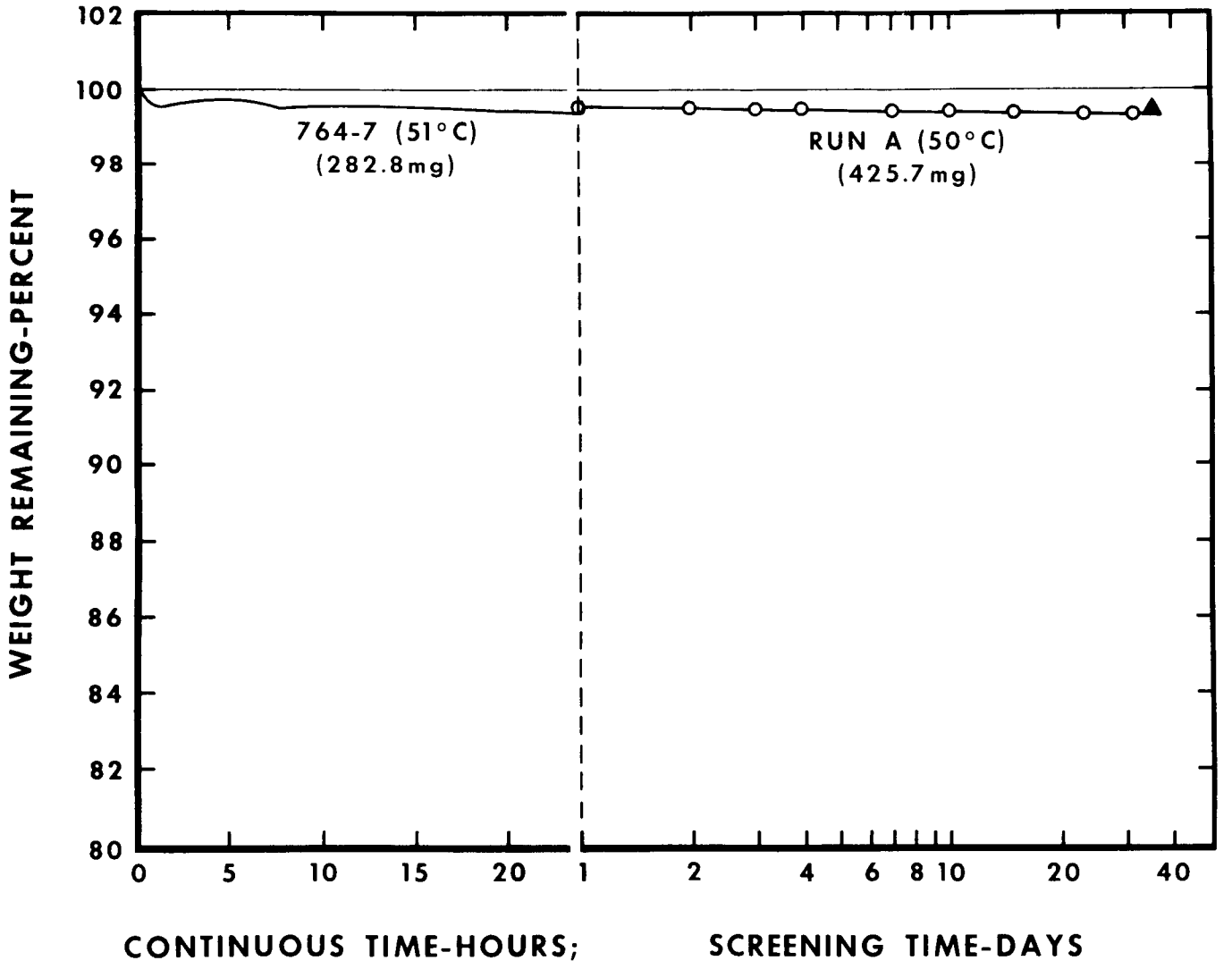

FIGURE 112. - TIME-WEIGHT HISTORIES FOR EC 1663 DURING EXPOSURE TO VACUUM AT 50°C AND 51°C

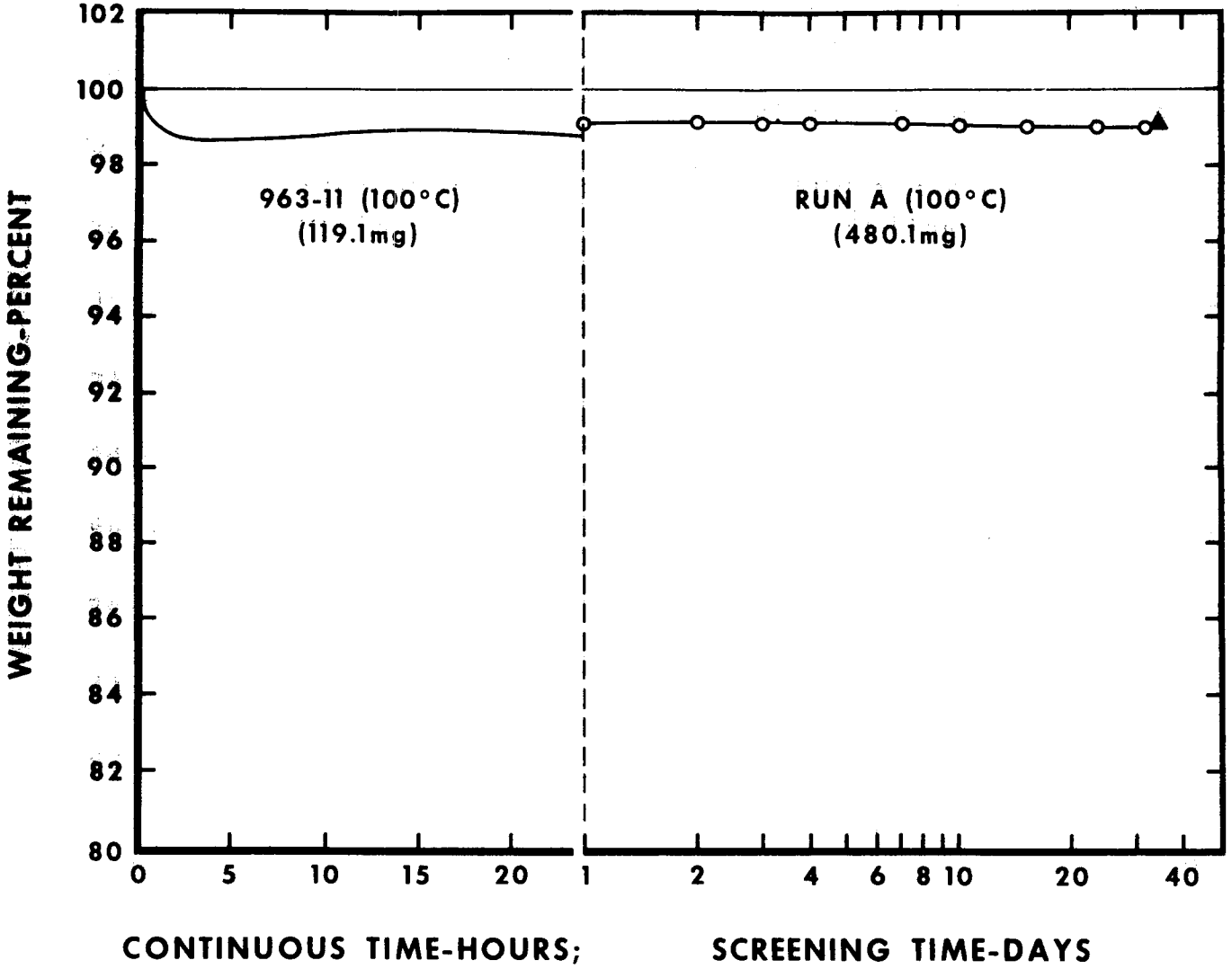

FIGURE 113. - TIME-WEIGHT HISTORIES FOR EC 1663 DURING EXPOSURE TO VACUUM AT 100°C

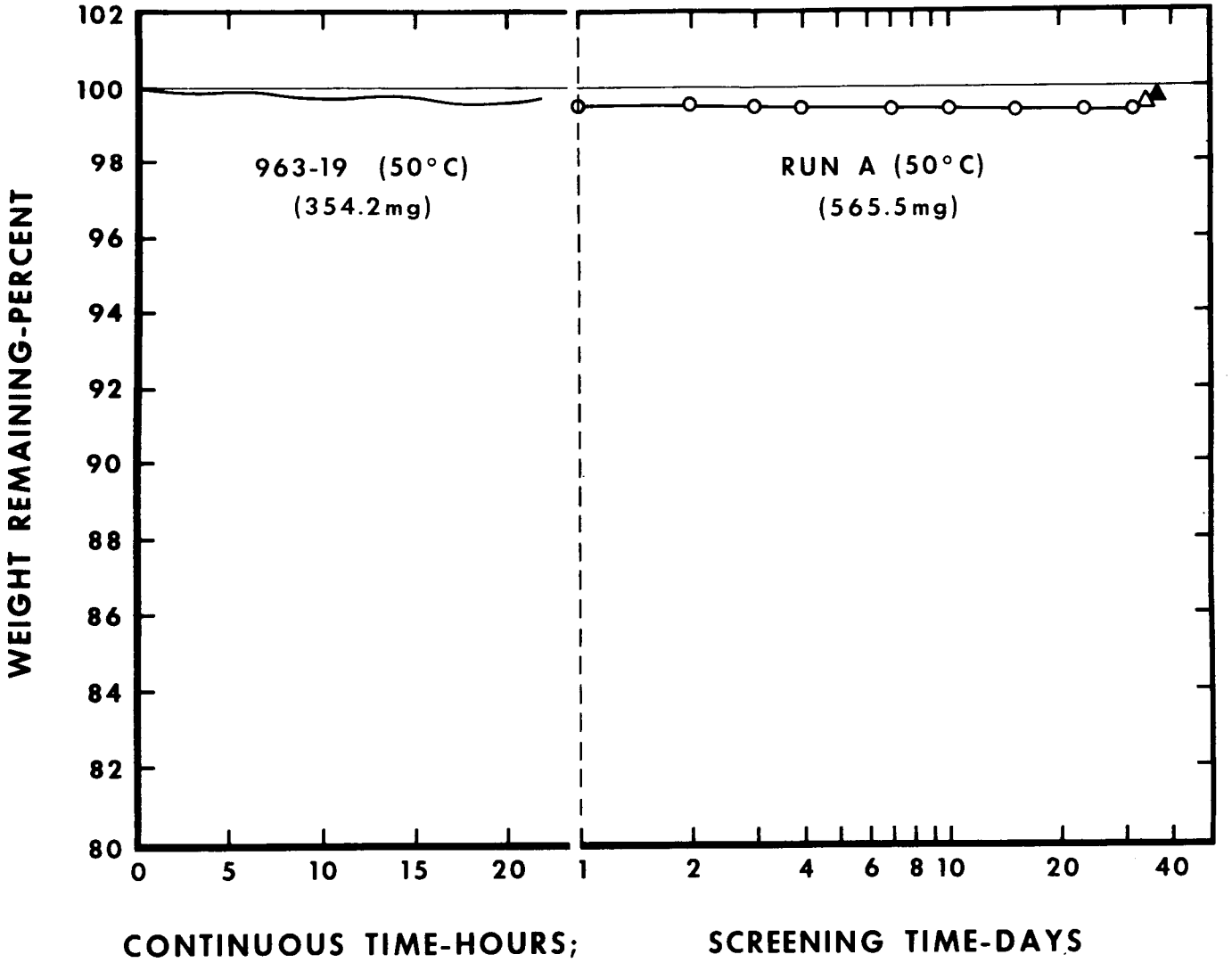

FIGURE 114. - TIME-WEIGHT HISTORIES FOR PR-1538 DURING EXPOSURE TO VACUUM AT 50°C

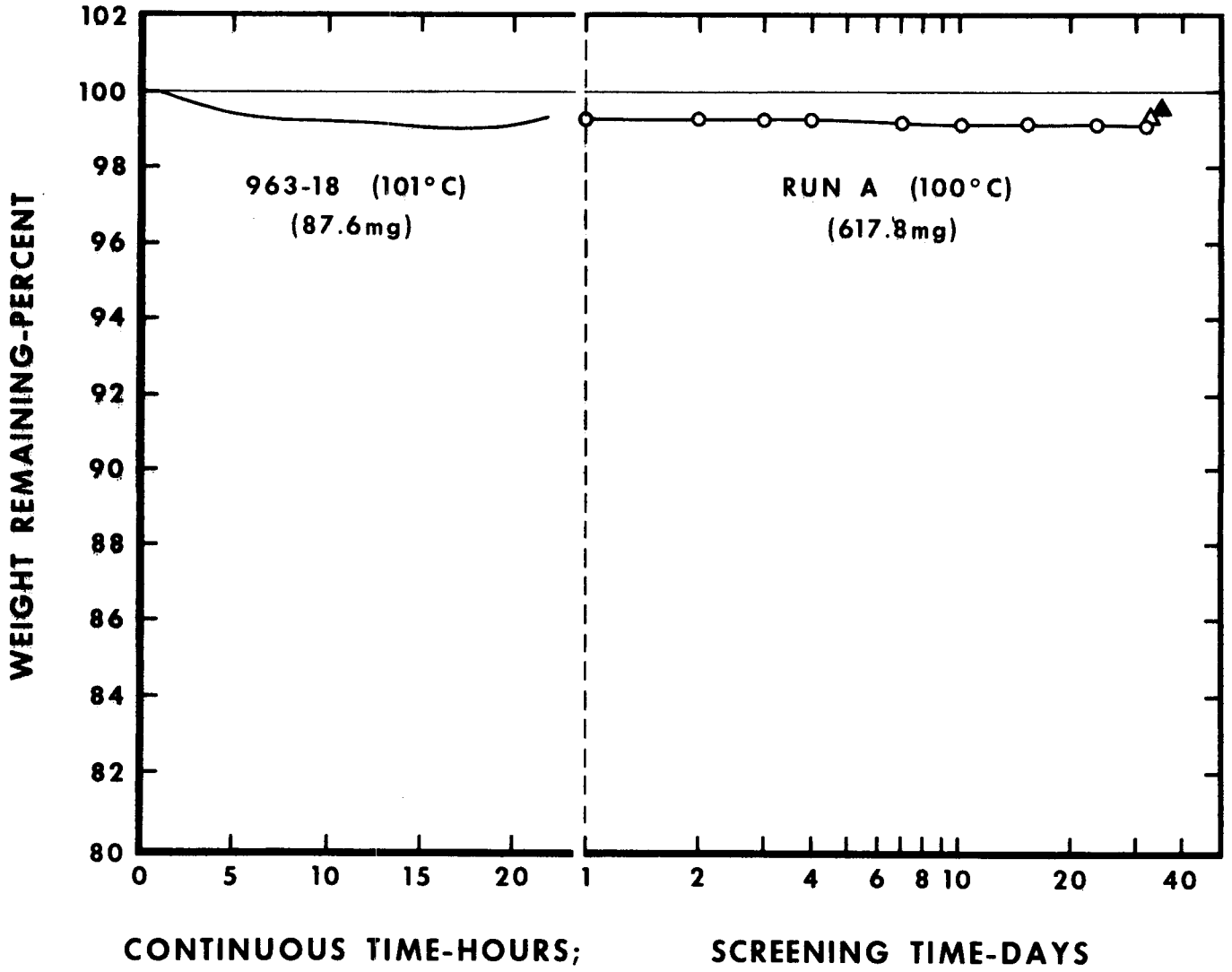

FIGURE 115. - TIME-WEIGHT HISTORIES FOR PR-1538 DURING EXPOSURE TO VACUUM AT 100°C AND 101°C

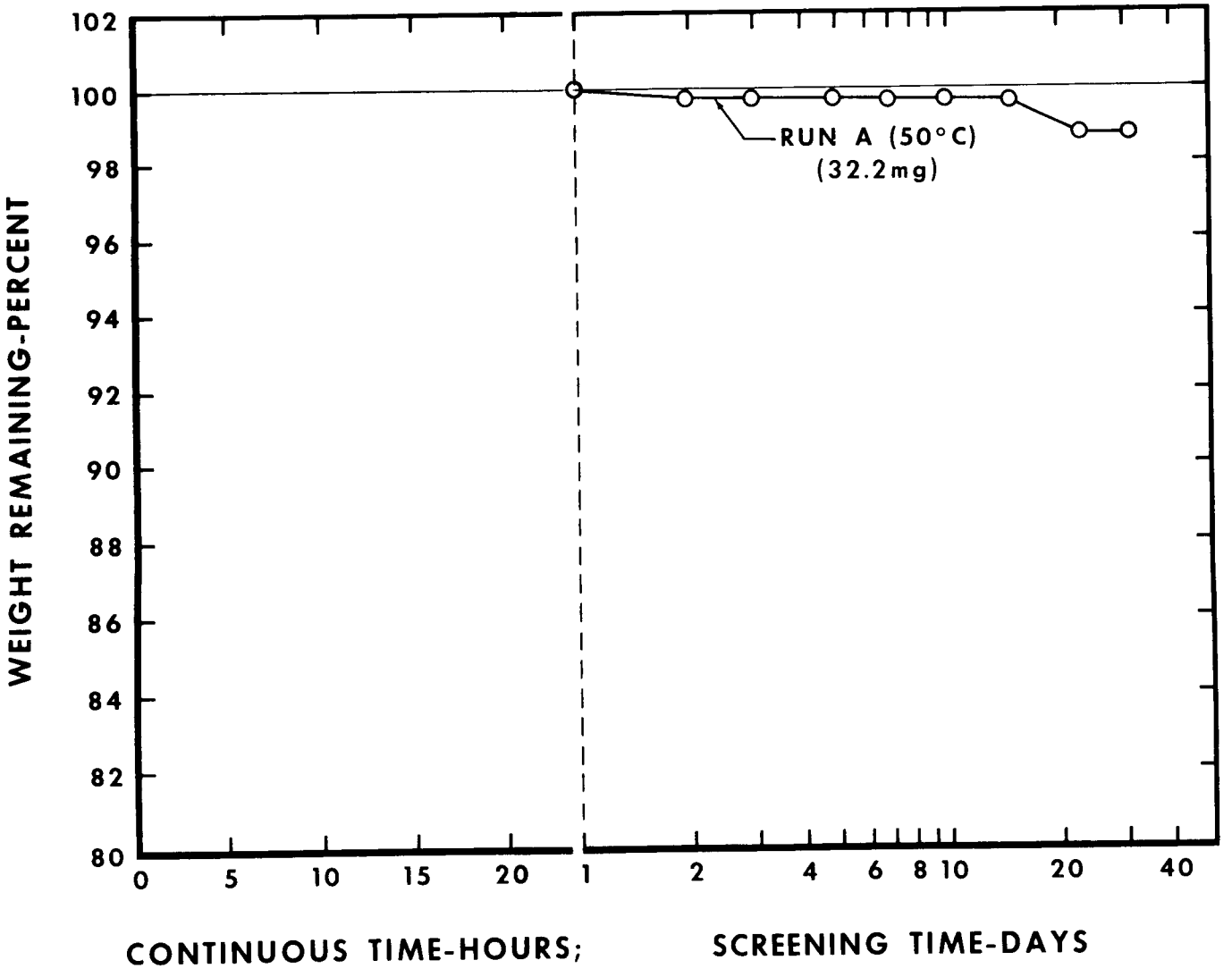

FIGURE 116. - TIME-WEIGHT HISTORIES FOR MOLYKOTE X-15 DURING EXPOSURE TO VACUUM AT 50°C

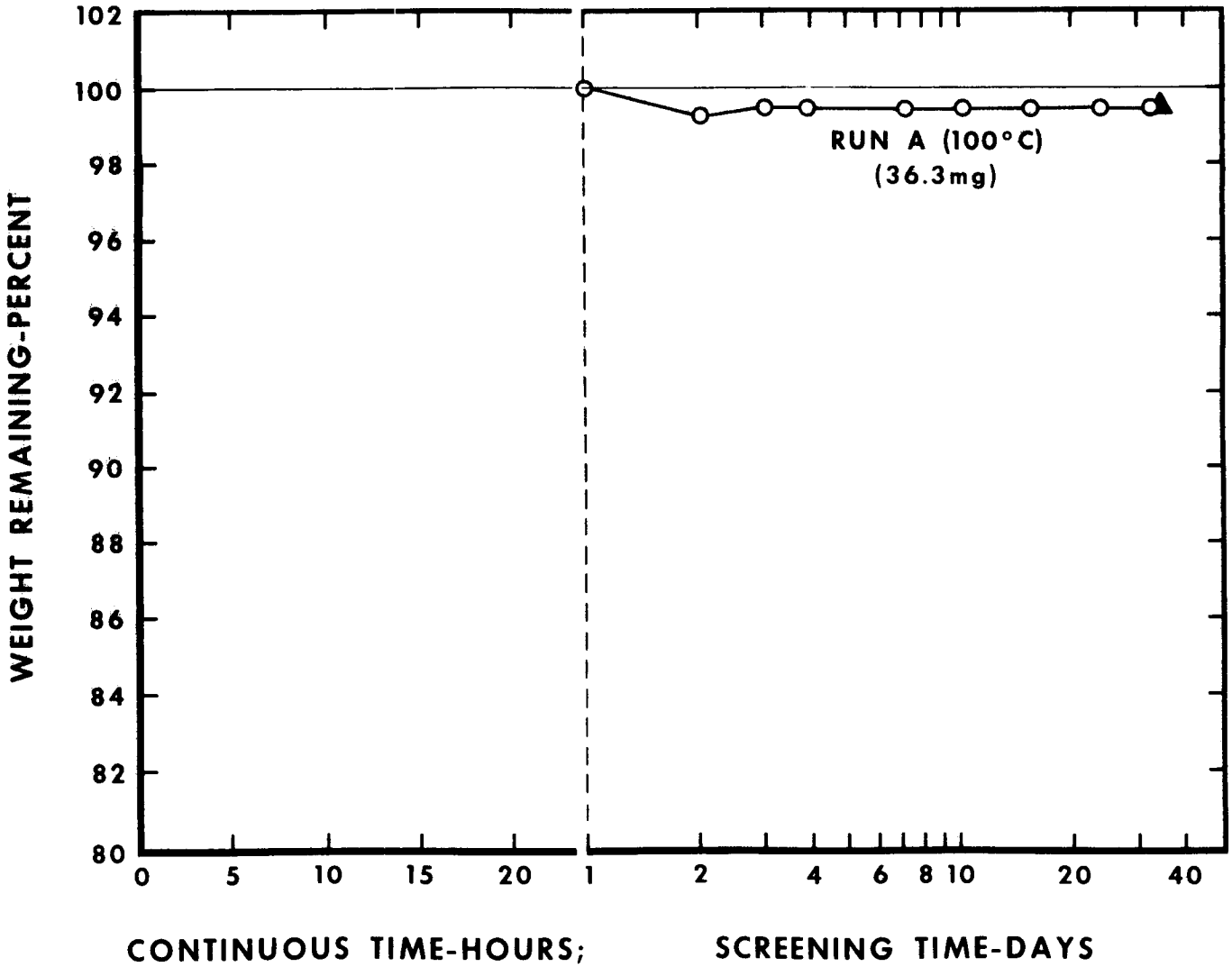

FIGURE 117. - TIME-WEIGHT HISTORIES FOR MOLYKOTE X-15 DURING EXPOSURE TO VACUUM AT 100°C

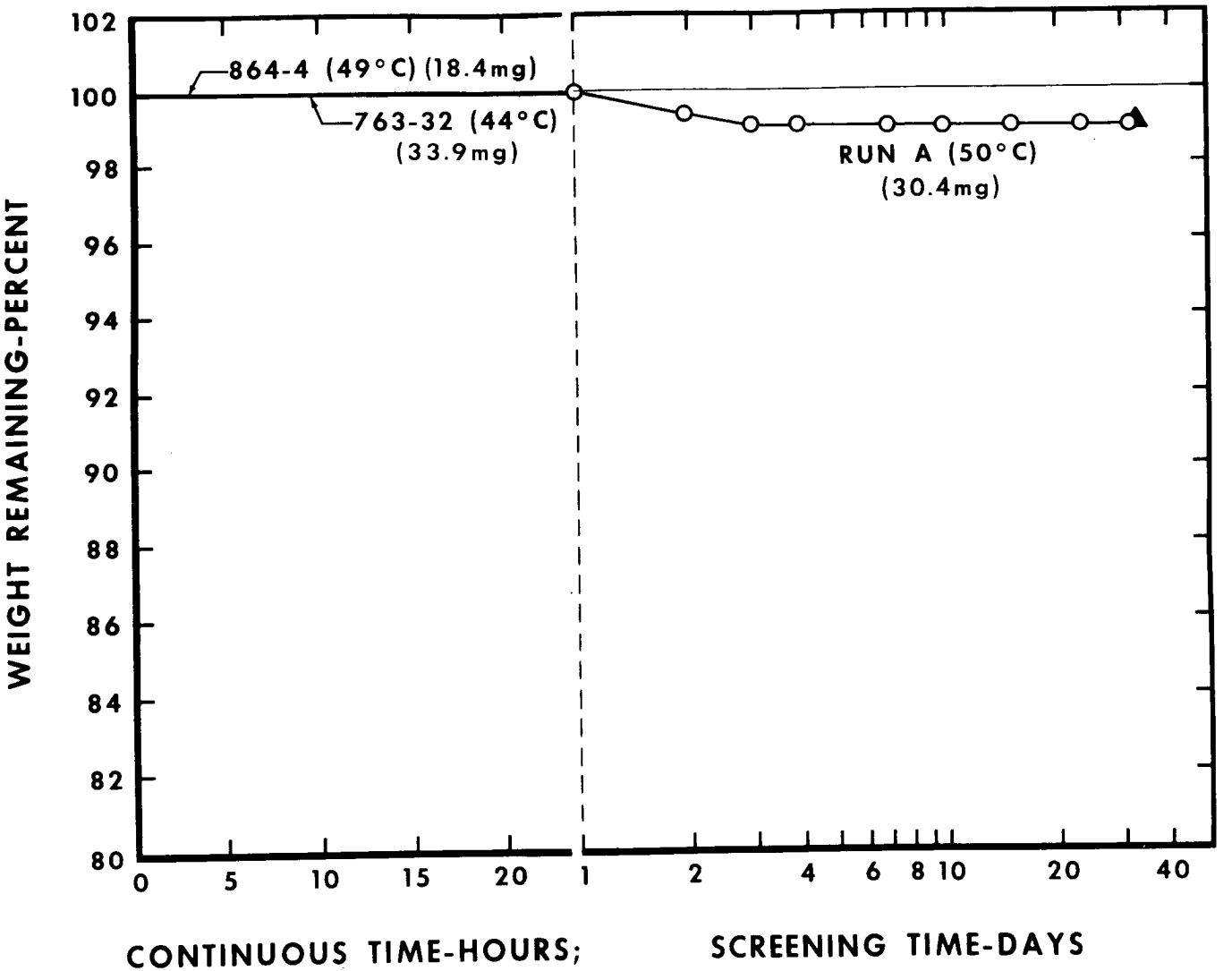

FIGURE 118. - TIME-WEIGHT HISTORIES FOR ELECTROFILM 66-C DURING EXPOSURE TO VACUUM AT 44°C, 49°C, AND 50°C

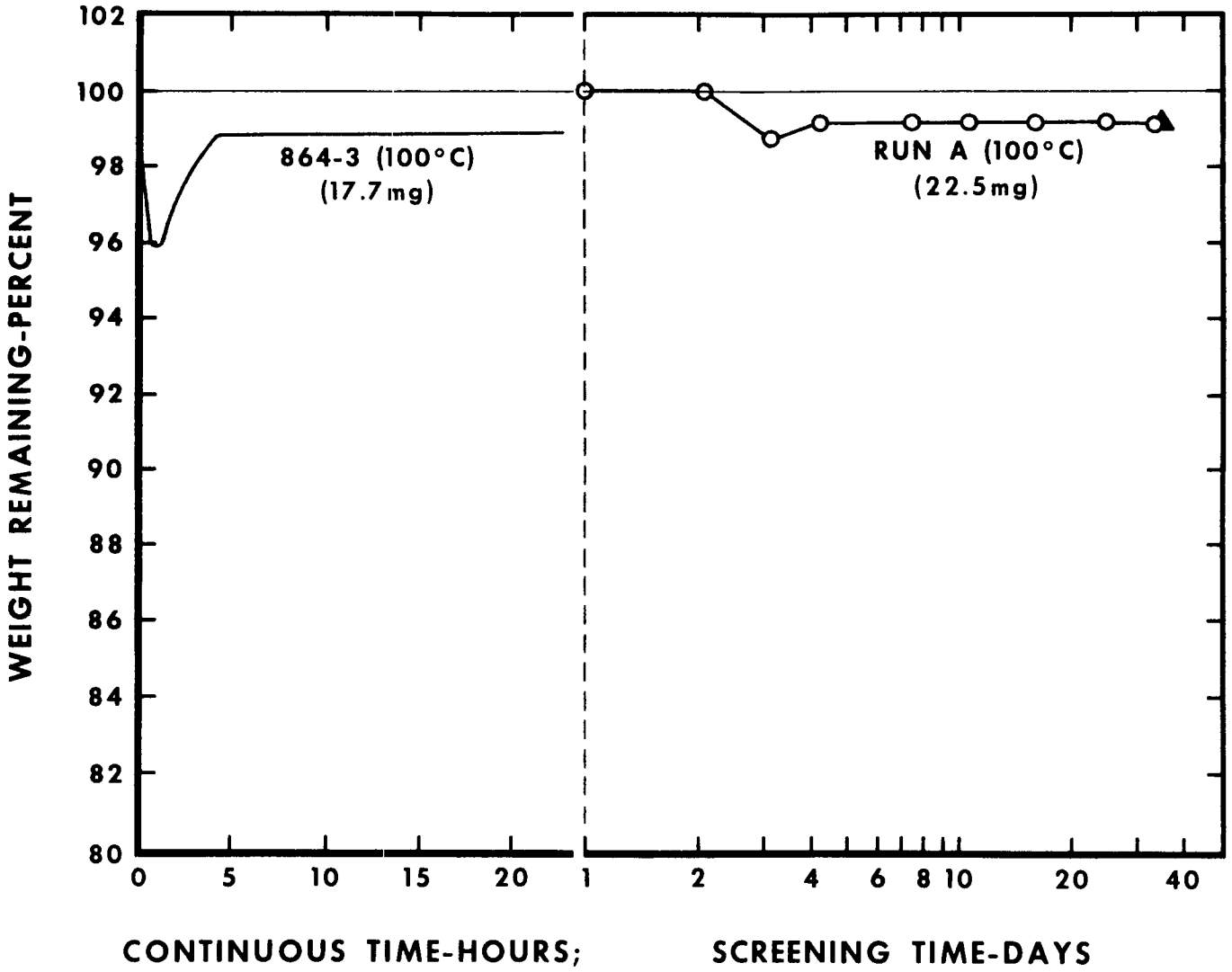

FIGURE 119. - TIME-WEIGHT HISTORIES FOR ELECTROFILM 66-C DURING EXPOSURE TO VACUUM AT 100°C

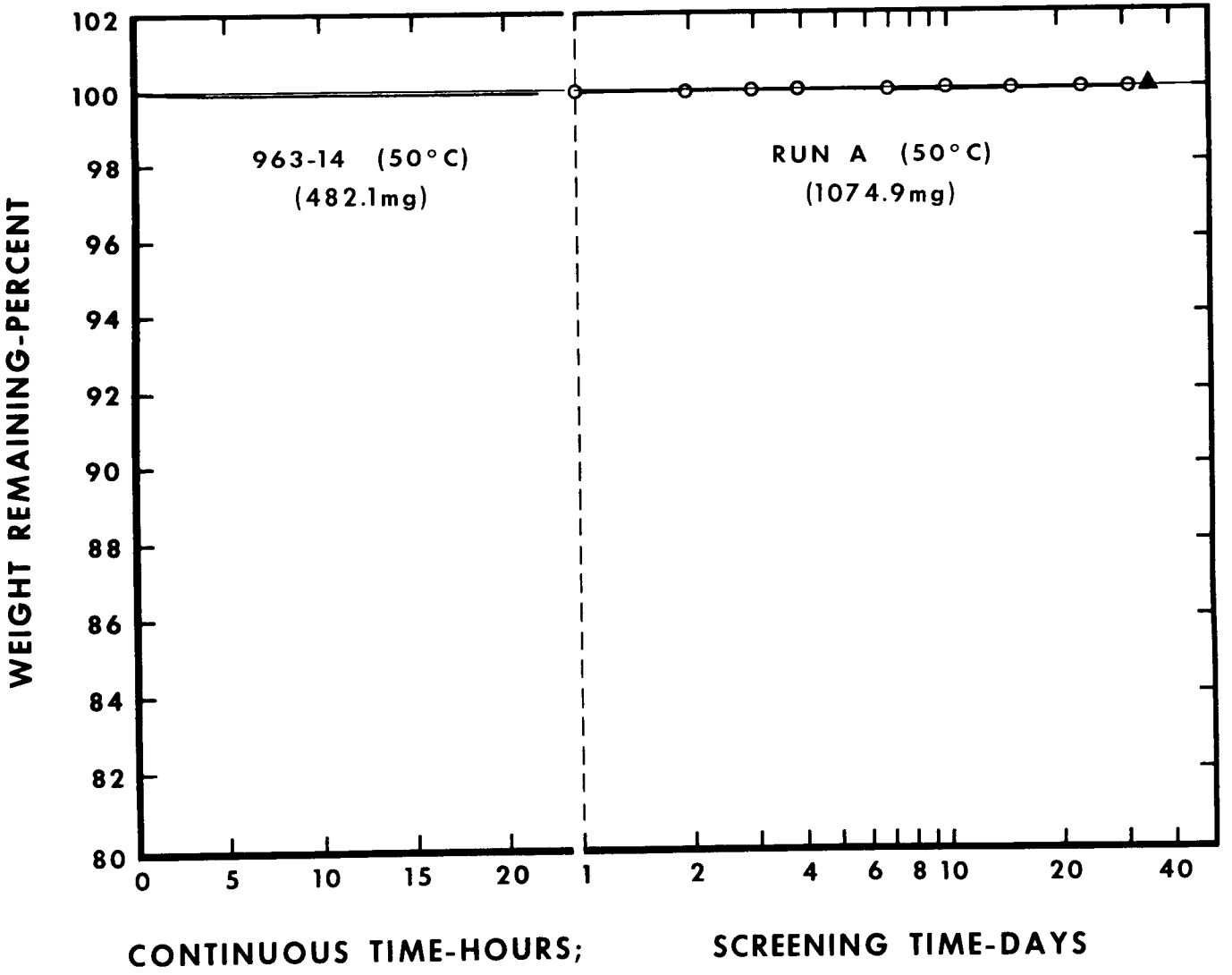

FIGURE 120. - TIME-WEIGHT HISTORIES FOR MLF-5 DURING EXPOSURE TO VACUUM AT 50°C

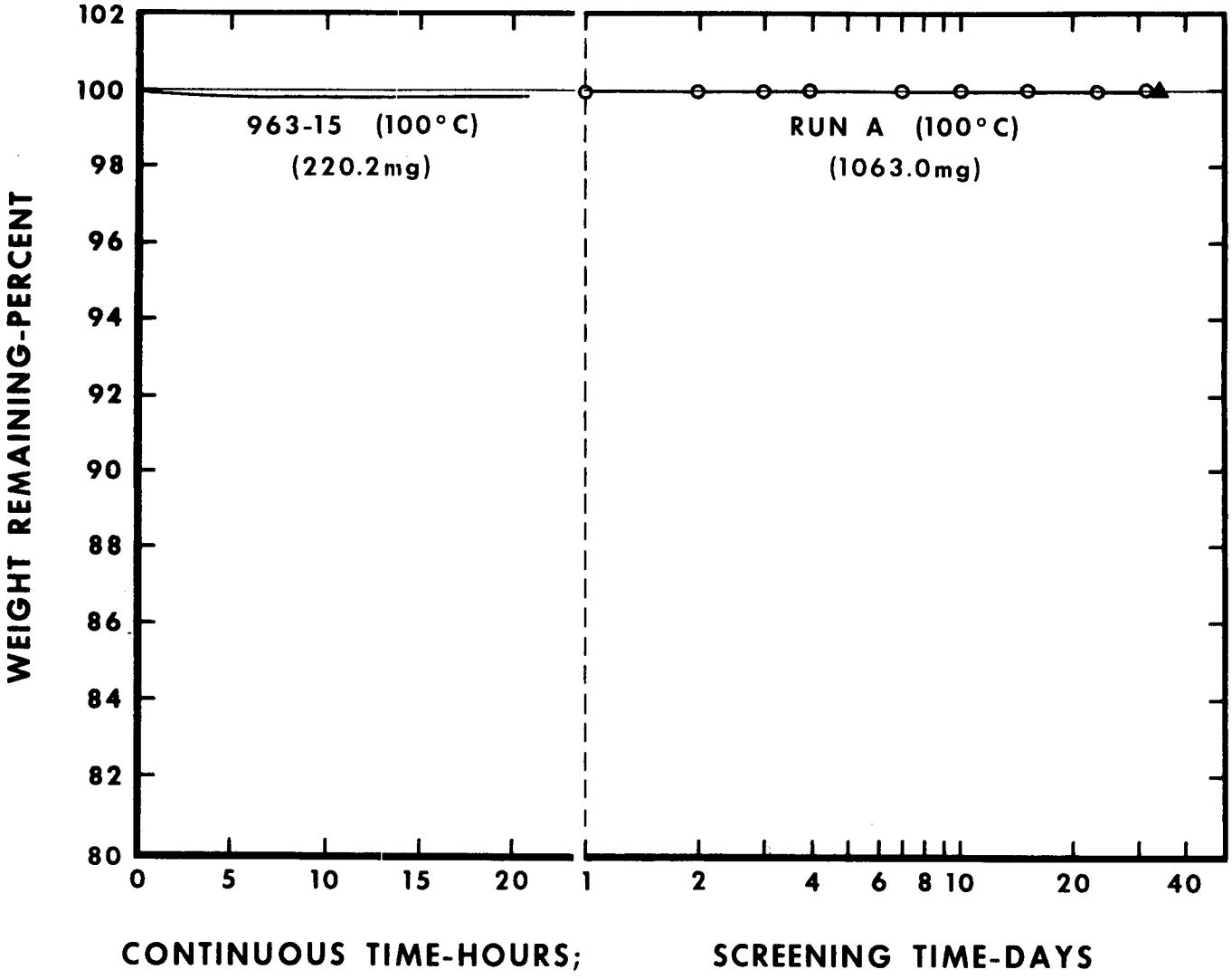

FIGURE 121. - TIME-WEIGHT HISTORIES FOR MLF-5 DURING EXPOSURE TO VACUUM AT 100°C

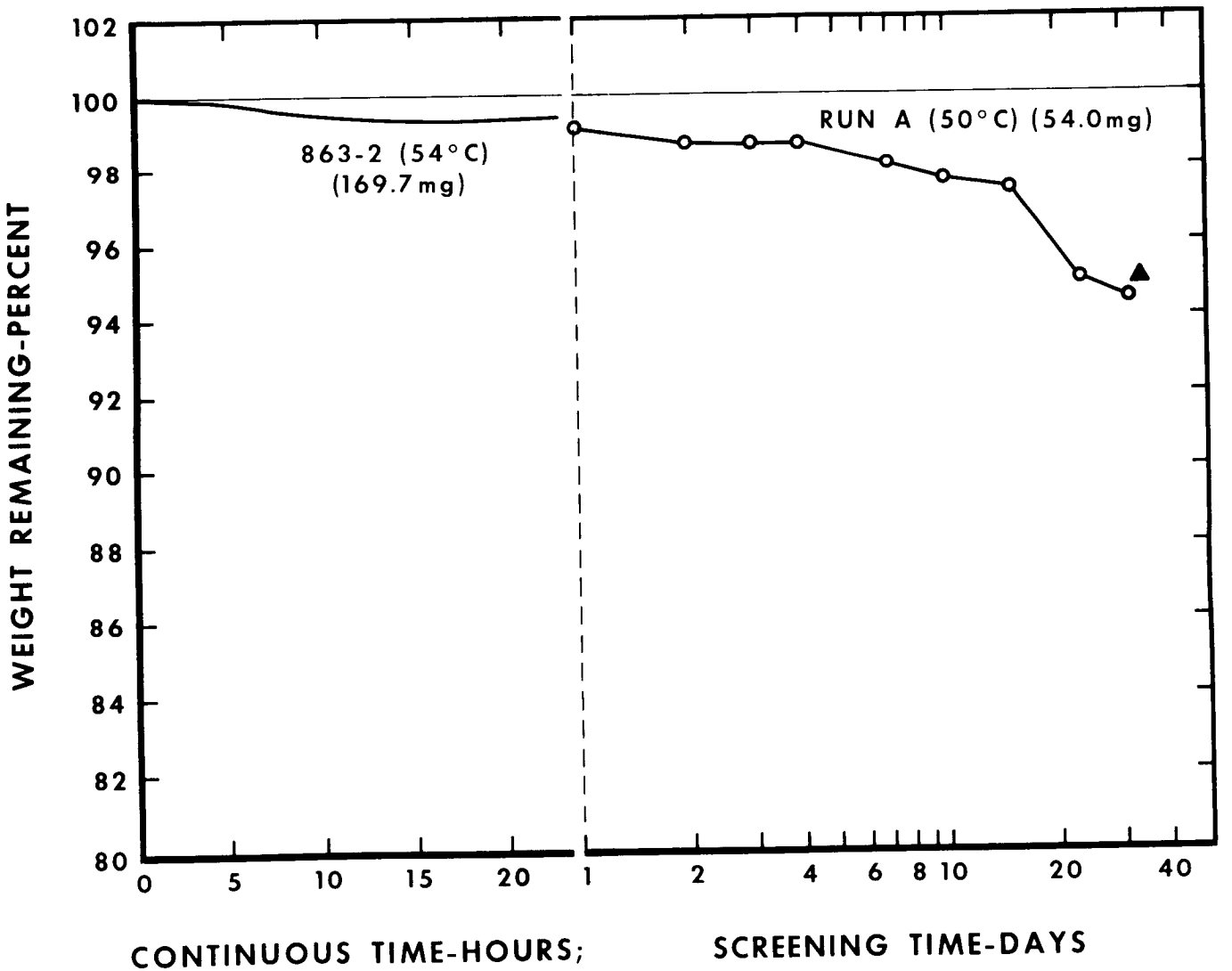

FIGURE 122. - TIME-WEIGHT HISTORIES FOR ETR-H DURING EXPOSURE TO VACUUM AT 50°C AND 54°C

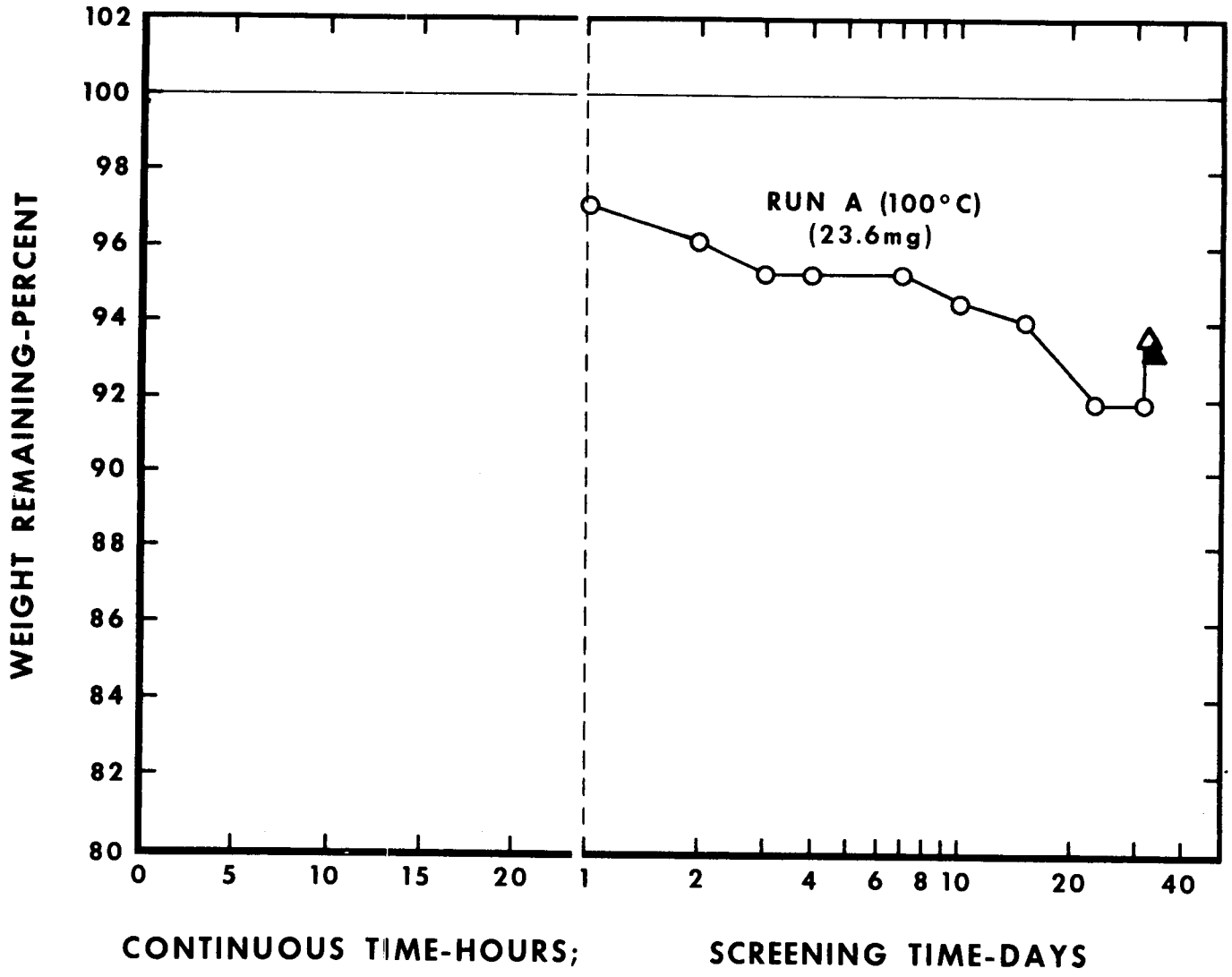

FIGURE 123. - TIME-WEIGHT HISTORIES FOR ETR-H DURING EXPOSURE TO VACUUM AT 100°C

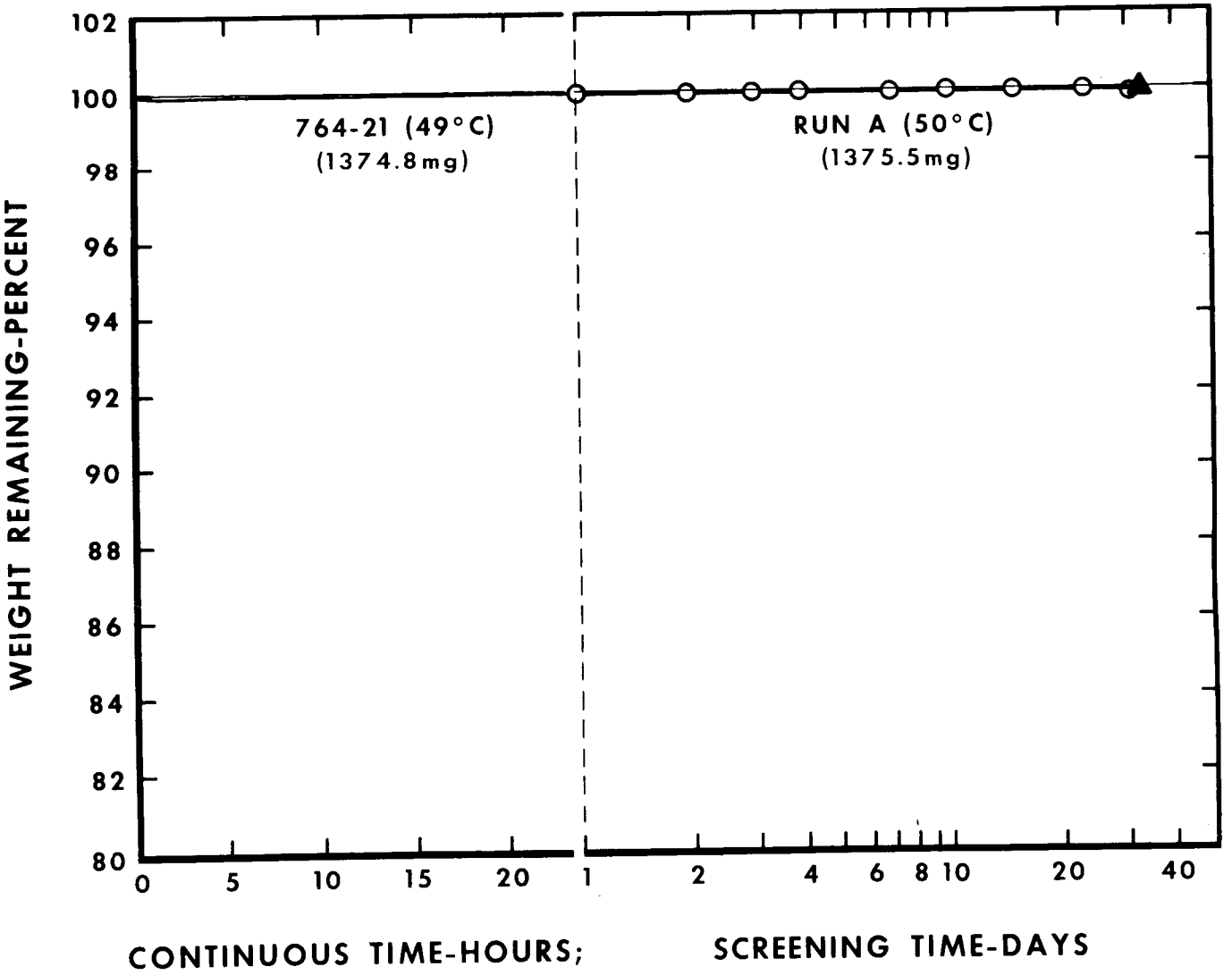

FIGURE 124. - TIME-WEIGHT HISTORIES FOR EPOXY COATING ON ALUMINUM DURING EXPOSURE TO VACUUM AT 49°C AND 50°C

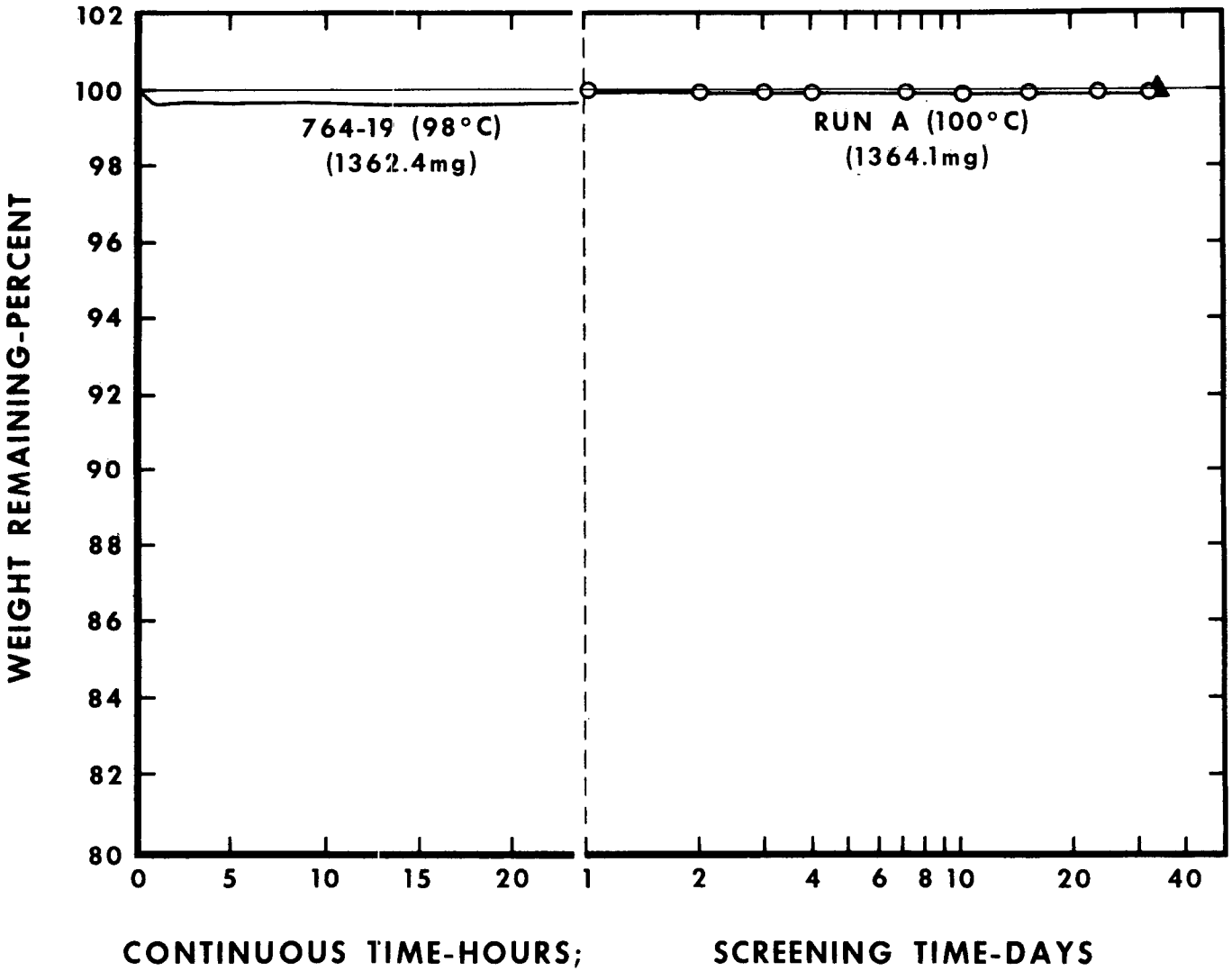

FIGURE 125. - TIME-WEIGHT HISTORIES FOR EPOXY COATING ON ALUMINUM DURING EXPOSURE TO VACUUM AT 98°C AND 100°C

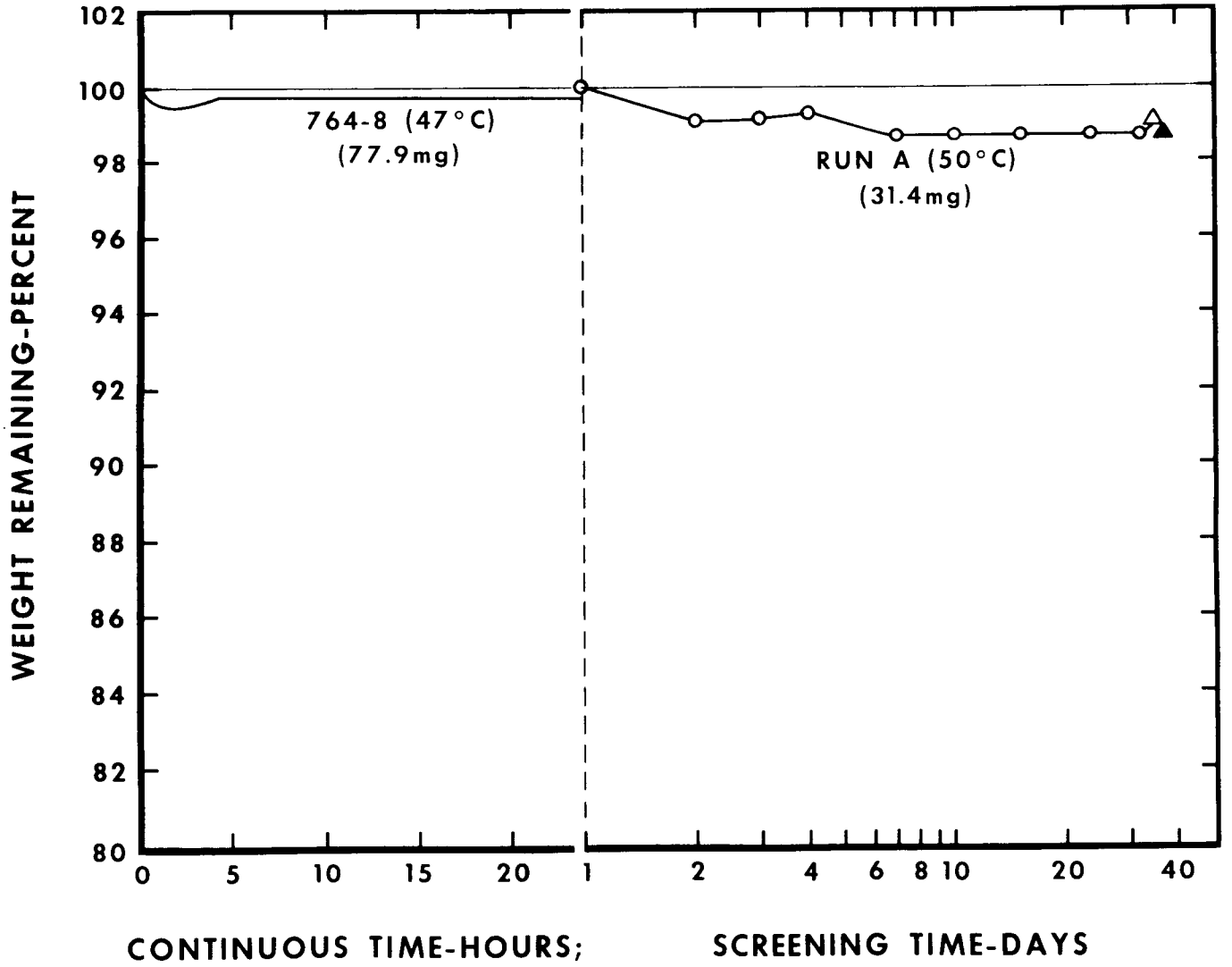

FIGURE 126. - TIME-WEIGHT HISTORIES FOR EPOXY COATING PEELED OFF GLASS DURING EXPOSURE TO VACUUM AT 47°C AND 50°C

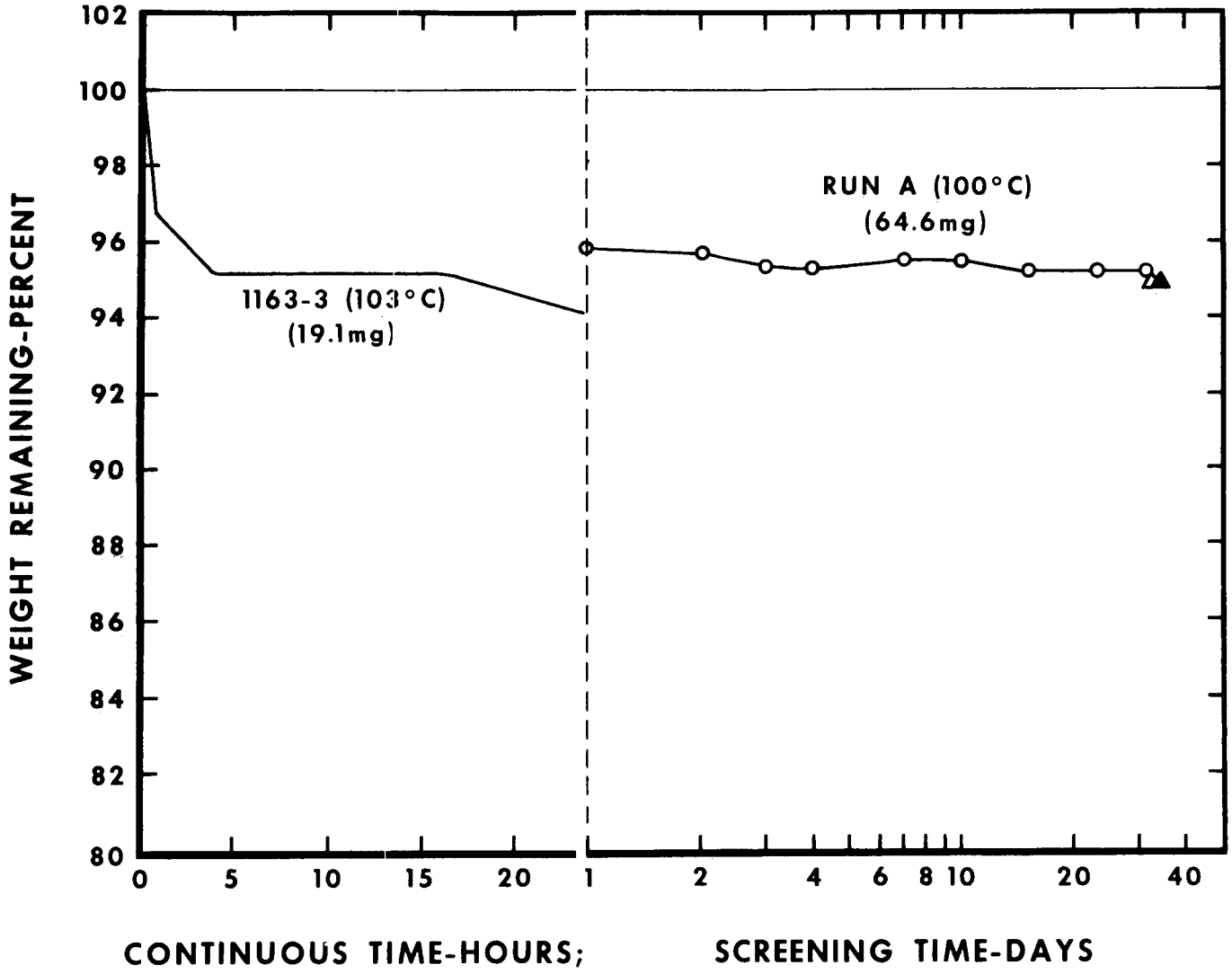

FIGURE 127. - TIME-WEIGHT HISTORIES FOR EPOXY COATING PEELED OFF GLASS DURING EXPOSURE TO VACUUM AT 100°C AND 103°C

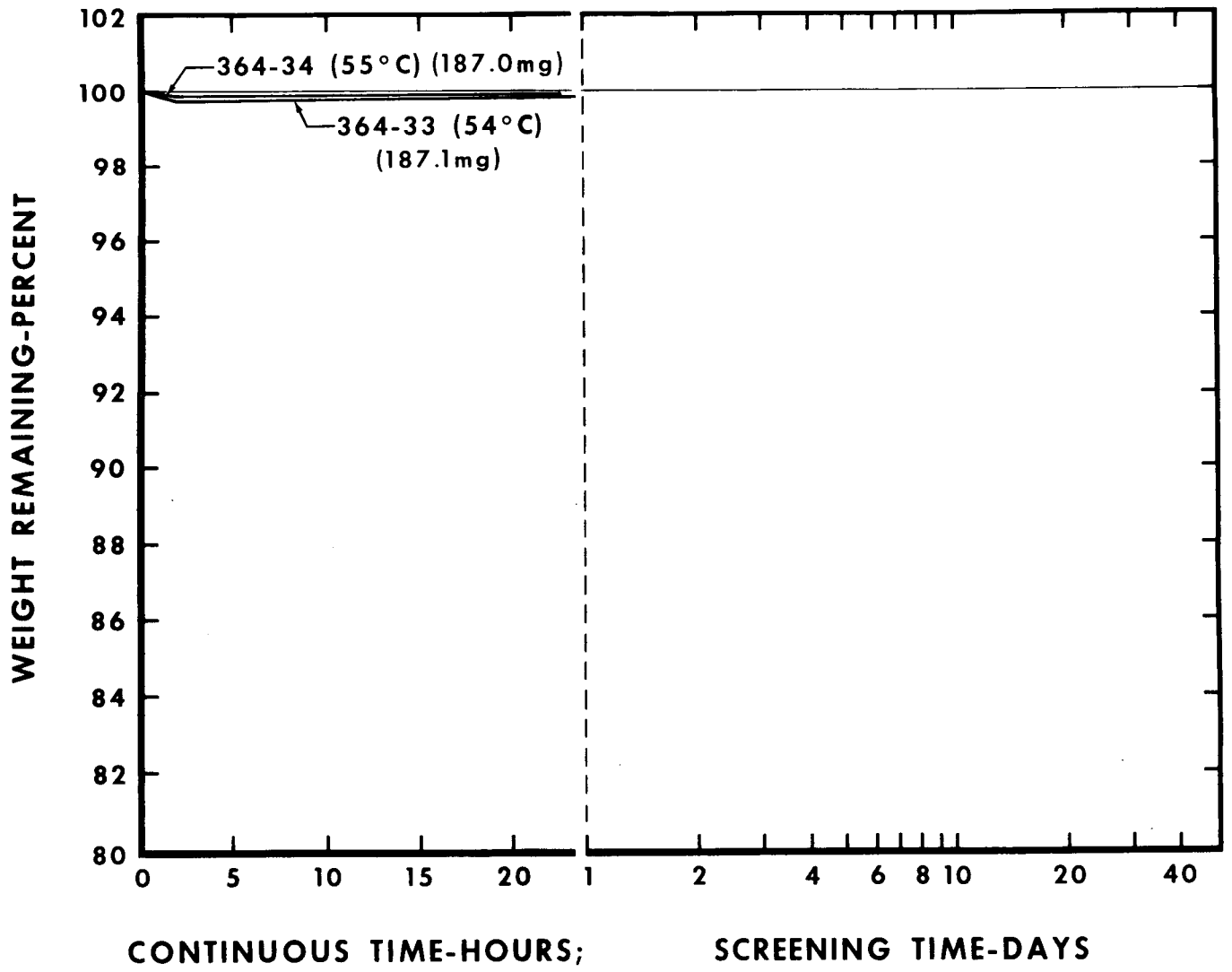

FIGURE 128. - TIME-WEIGHT HISTORIES FOR MERLON DURING EXPOSURE TO VACUUM AT 54°C AND 55°C

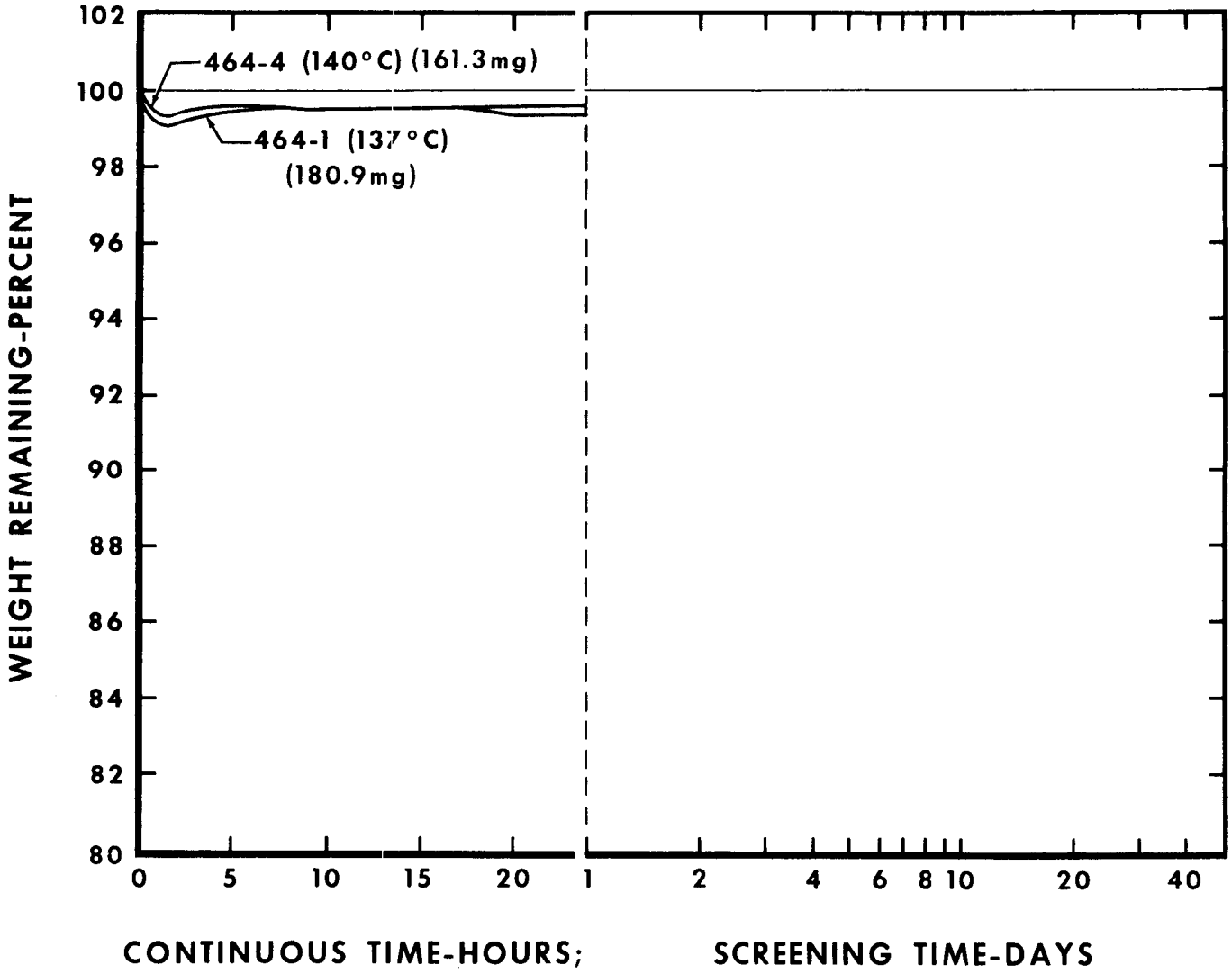

FIGURE 129. - TIME-WEIGHT HISTORIES FOR MERLON DURING EXPOSURE TO VACUUM AT 137°C AND 140°C

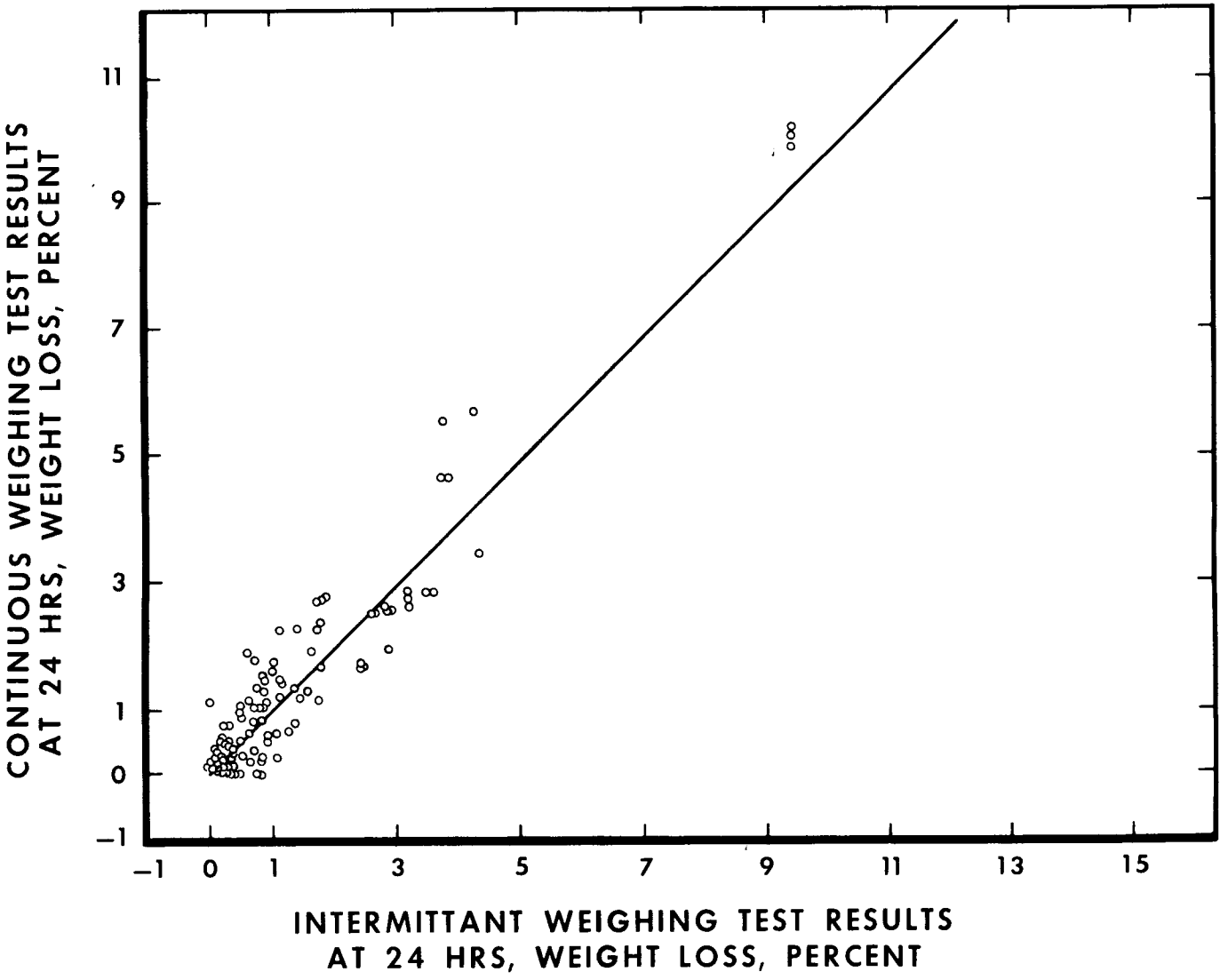

FIGURE 130. - COMPARISON OF RESULTS FROM CONTINUOUS WEIGHING TEST AND INTERMITTENT WEIGHING TEST

VACUUM COMPATIBILITY OF ENGINEERING MATERIALS (SOLIDS) II

By J. G. Austin and J. B. Gayle

The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

This document has also been reviewed and approved for technical accuracy.

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for F. B. CLINE
Acting Director, Propulsion and Vehicle Engineering Laboratory

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