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VARIABLE RELUCTANCE PROXIMITY SENSORS FOR CRYOGENIC VALVE POSITION INDICATION

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16. ABSTRACT

This test was conducted to determine the performance of a variable reluctance proximity sensor system when installed in an External Tank vent/relief valve. The sensors were used as position indicators. The valve and sensors were cycled through a series of thermal transients; while the valve was being opened and closed pneumatically, the sensor's performance was being monitored. During these thermal transients, the vent valve was cooled 10 times by liquid nitrogen and 2 times by liquid hydrogen. It was concluded that the sensors were acceptable replacements for the existing mechanical switches. However, the sensors need a mechanical override for the target similar to what is presently used with the mechanical switches. This override could insure contact between sensor and target and eliminate any problems of actuation gap growth caused by thermal gradients.

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

TECHNICAL MEMORANDUM

VARIABLE RELUCTANCE PROXIMITY SENSORS FOR CRYOGENIC VALVE POSITION INDICATION

I. INTRODUCTION

The purpose of this test was to determine the feasibility of installing proximity indicators on the Shuttle External Tank vent and relief valves. Variable reluctance proximity indicators are being considered for replacement of the mechanical position switches currently used in the vent valves. Mechanical switches have demonstrated various malfunctions during the Apollo program such as diaphragm cracks, oxidation of the contacts, internal mechanical failure, and others.

The Eldec proximity indicator was selected because similar Eldec sensors are currently used in multiple Orbiter applications such as landing gear and payload bay doors. The Eldec sensors are also used in diverse applications on the B-1 bomber and other military and civilian aircraft. The latest generation of Eldec sensors has already been tested in cryogenics and successfully met all general requirements for cryogenic service. The intent of this test was to determine the performance reliability of the sensors when operationally installed in a vent and relief valve.

II. APPROACH

A spare External Tank vent and relief valve was acquired for a test bed (Fig. 1). The position indicators, their installation, and all associated functions are identical to valves currently being produced and flown on the External Tank. The existing Honeywell I HM25 mechanical position indicator switches were removed and replaced by Eldec SCD8-020-10 proximity sensors (Figs. 2 through 4). Targets for the sensors were installed on each side of the valve's main piston (Fig. 3). All modifications were made by making as few changes to the original valve as possible so that design and manufacturing impact would be minimized in the event the proximity sensors are adopted for use.

The vent valve was first cooled with liquid nitrogen to simulate conditions on the liquid oxygen tank. Liquid nitrogen is slightly colder than the ullage normally vented through the valve, but was used for safety reasons instead of liquid oxygen. Upon completion of the nitrogen testing, the valve was cooled with liquid hydrogen to simulate conditions during venting of the liquid hydrogen fuel tank.

III. TEST PLAN FOR CRYOGENIC TESTING OF PROXIMITY POSITION INDICATORS

OBJECTIVE: To verify the operation of position indicators in open and closed positions under cryogenic conditions.

REQUIREMENTS:

1. Provide 115 V, 400 ∿ for GFE electronics.
2. Provide gaseous helium for valve actuation (≈ 125 psi operating pressure). Gaseous nitrogen may be used for the tests with liquid nitrogen.
3. Temperature to be maintained within limits specified.
4. Temperature readings obtained at each probe for each valve cycle.
5. Notation of indicator performance for each valve cycle.
6. If there is an indication that the proximity switch failed, verify that the valve did in fact open or close.
7. Provide photographs of test setup.

TEST PROCEDURE:

1. Test is to consist of a total of 12 thermal cycles, 10 cycles using LN_2 (temperature requirement of -300°F maximum) and 2 cycles using LH_2 (temperature requirement of -400°F maximum).
2. Each thermal cycle is to consist of the lowering of temperature from ambient.
3. 500 valve cycles are to be completed during each thermal cycle, broken down as follows:
   a. 50 valve cycles at ambient temperature
   b. 50 valve cycles during the transition
   c. 400 valve cycles at the cryogenic state.
4. Testing of the valve proximity sensor to include reducing the temperature with liquid nitrogen from ambient to approximately -300°F and monitoring the probes and temperature during the test duration.

THERMAL SHOCK TEST

PURPOSE:

This test is being conducted to subject the proximity sensors to a rapid thermal transient shock and to evaluate their performance during this period.

REQUIREMENTS:

The sensors shall be mounted in the vent valve specimen with the boost open piston end cap and actuating piston removed.

A stationary target will be in place under both sensors. The target will be in contact with both sensor faces.

The sensors shall be subjected to a thermal shock by purging with GN_2 @ -300°F directly on their sensing faces.

TEMPERATURE:

The Nos. 1, 2, and 3 thermocouples should be stabilized at their respective lowest temperature and remain there for 1 min (ambient to approximately -300°F).

Monitor temperature and proximity sensor actuation signal during the test.

IV. TEST ARRANGEMENT

A. Thermal Cycle Tests

The test specimen, a modified vent and relief valve, MMC P/N PD4700187-029 was mounted by its inlet to an aluminum plate and then an end cap placed over its outlet. The valve was instrumented with four thermocouples located as shown in Figure 2; there is a thermocouple on each sensor spacer and between the proximity sensors and another on the valve body. The temperature from the four thermocouples were recorded every 15 sec for the duration of the tests. A liquid nitrogen or liquid hydrogen purge from the dewar was routed through the mounting plate and up near the proximity sensors. The liquid was vented down through the mount plate and carried a safe distance and then vented to the atmosphere (Figs. 5 through 7).

The proximity sensors were connected to the Eldec 8-242-09 S/N 4, 10 channel electronics, which outputs either a target near or target far indication. This 10 channel electronics package was modified by Eldec to perform as the recommended package would with these SC08-020-10 proximity sensors. The electronics package used was a qualification test hardware specimen for another type of Eldec sensor for the Space Shuttle and was modified as an economic consideration. The output indication of the electronics package was recorded throughout the test by the oscillograph.

The helium supply, which operates the specimen valve, was manifolded to a 125 psi regulator and routed through a solenoid valve to the helium inlet on the specimen valve (Figs. 1 and 5). The solenoid valve was operated by an electric timer which cycled the valve from the closed to the fully open position every 10 sec. The timer output was recorded by the oscillograph during the thermal cycle tests. There was a pressure transducer, coneected to the helium supply line close to the specimen valve, which served as verification of proper helium pressure. The pressure transducer's output was recorded by the oscillograph during the thermal cycle tests.

B. Thermal Shock Test

The thermal shock test setup was similar to the thermal cycle setup except the main piston and pneumatic actuating piston were removed. Liquid nitrogen from the dewar was purged onto the proximity sensor faces through the new opening made by the removal of the pneumatic actuator (Fig. 8).

A target rod was held in place along the centerline of the sensors by a large "C" clamp. This assured that the target was held fast against the sensors during the vigorous nitrogen purge of the sensor faces (Fig. 9).

The temperatures from the four thermocouples were recorded as before, but were recorded at 3-sec intervals. The oscillograph recorded only the proximity sensor performance during this test.

V. TEST DISCUSSION

A. Thermal Cycle No. 1

The following is a discussion of the first thermal cycle. Since it was typical of the other 12 thermal cycles, they will not be discussed on an individual basis. Any anomalies which occurred in other thermal cycles will be discussed individually.

The test began by cycling the specimen valve open and closed 50 times using pressurized helium. The proximity sensors were monitored for performance during the ambient temperature test. There were no sensor anomalies during the 50 cycle ambient test.

The next phase of the thermal cycle test was 50 valve cycles (minimum) during the thermal transient condition from ambient to cryogenic temperatures. During initial chilldown the No. 2 sensor (nearest valve body, Fig. 2) did not operate for four valve cycles and then began operating properly. The No. 2 sensor signal stopped at 32°F and began again at -77°F; performance throughout the rest of the transient test was nominal.

The temporary loss of signal from sensor No. 2 was due to one of two reasons or a combination of both. The first possibility is rapid localized cooling which created a large thermal gradient and enlarged the gap between the sensor face and target ring on the main piston (Figs. 2 and 3). The gap at ambient temperature is 0.027, which is the recommended gap for this sensor in the slide by mode of operation. To cause sensor failure, the gap would have to open up to approximately 0.054.

The second reason for loss of signal is a large thermal gradient in the proximity sensor itself which could cause the sensor to read target far when actually the target was near. Under normal operation, there are two matched coils in the sensor, one in the sensing face and a reference coil further up in the sensor. When a ferromagnetic target is passed close to the sensor face, the electrical resistance of the coil at the face is lowered relative to the reference coil. The associated electronics monitor the resistance of both coils and give a target near signal when the balance between the two coils is disturbed. This design allows

operation over a wide range of temperature because both coils would be affected equally by surrounding environment. However, during this test the face of the sensor was cooled very rapidly, and the rest of the sensor was somewhat thermally isolated due to the method of mounting with low thermal conductivity flourocarbon seals. This would cause the resistance in the sensing coil to rise and give a target far indication even though the target was actually under the sensor. Then, as the thermal gradient between the two coils decreased, the bridge would be out of balance once again and give the correct target near indication.

The next phase of the thermal cycle was 400 valve cycles at the cryogenic temperature state (lowest temperatures possible with the specimen valve using liquid nitrogen as the cryogen). During this portion of testing the temperature of the valve and sensors were monitored and sensor performance was recorded. During cycle 345, the No. 1 sensor stopped working, the technician realized that the actuating helium pressure had dropped off from a nominal 125 to 90 psi. This was not enough pressure to allow the valve to travel to the fully open position and align the target under the No. 1 sensor. Another helium bottle was added into the manifold which raised the supply pressure to the required level and sensor No. 1 immediately began operating nominally.

B. Thermal Cycle No. 2

During the transient portion of thermal cycle No. 2, the thermal gradient problem again caused a temporary loss of signal from proximity sensor No. 2 at the beginning of chilldown. The signal loss was from 58.7 to 17.1°F. The signal returned and then dropped out again at 13.2°F and returned at -180°F. The sensors operated properly for the rest of the transient cycles and the 400 cryogenic cycles. There were no other irregularities during thermal cycle No. 2.

C. Thermal Cycle Nos. 3 through 6

There were no anomalies during thermal cycle Nos. 3 through 6.

D. Thermal Cycle No. 7

At initial chilldown, the No. 1 proximity sensor lost signal; the temperatures were from 48 to -48°F. This was the first and only time sensor No. 1 was apparently affected by the thermal gradient situation. All other anomalies associated with sensor No. 1 have been due to low helium actuation pressure which was easily detected by a very noticeable change in the pressure transducer curves on the strip charts. However, in this case, the helium pressure was nominal so it was assumed the anomaly was due to the thermal gradient situation.

Sensor No. 2 had a loss of signal during the transient cycles as did No. 1, which was due to the thermal gradient. The No. 2 sensor lost signal at 75°F and returned to service at -209°F.

During the 400 cryogenic cycles, the low helium actuation pressure situation occurred again which resulted in the momentary loss of the No. 1 sensor. The problem was quickly corrected and sensor No. 1 returned to service.

E. Thermal Cycle No. 8

There were no anomalies during thermal cycle No. 8.

F. Thermal Cycle No. 9

The No. 2 proximity sensor again went out of service at the beginning of the transient portion of the test because of the gradient problem. The sensor failed to signal at 40°F and became operational again at -179°F. There were no other anomalies during this thermal cycle.

G. Thermal Cycle No. 10

There were no anomalies during cycle No. 10.

H. LH_2 Thermal Cycle No. 1

The thermal cycle tests run with liquid hydrogen as the coolant were conducted using the same procedure as the other thermal cycles; that is, 50 cycles at ambient, 50 cycles during the transition from ambient to cryogenic, and 400 cycles at approximately -400°F.

There were no sensor anomalies during LH_2 thermal cycle No. 1.

I. LH_2 Thermal Cycle No. 2

There were no proximity sensor anomalies during the 50 cycle ambient test.

Well into the transient cycles there was a loss of signal from sensor No. 1 due to low helium actuation pressure, which was corrected. The signal was interrupted for only one valve cycle at a temperature of -257°F.

There were no sensor anomalies during the 400 valve cycles at the cryogenic temperatures.

J. Thermal Shock Test

The purpose of this test was to evaluate the performance of the Eldec proximity sensors during a thermal shock. The arrangement of the test eliminated the affect of irregular thermal contractions of the internal valve components that would increase the sensor to target gap. The target was mounted directly on the face of both sensors, thus eliminating the gap. Liquid nitrogen was rapidly purged on the sensor faces. The sensors were monitored for output from ambient until the thermocouples had stabilized at their lowest temperatures. The proximity sensors performed flawlessly during this test.

VI. TEST GRAPHICS AND TEMPERATURE DATA

Tables 1 through 10 are a compilation of thermocouple test data from all thermal cycles and the thermal shock test. The temperatures shown in these tables and the accompanying graphs are in Fahrenheit degrees.

The graphs show data from thermocouples 1 and 2 which reflect each proximity sensor's temperature. The graph temperatures are shown in 5-min intervals. The temperature tables are correlated with the graphs by a T-0 indication. The tables show data from all four thermocouples (Fig. 2 gives locations). The temperatures were given in 1-min intervals.

During thermal cycles 1, 7, and LH_2 thermal cycle 2 there was a loss of position indication by the No. 1 proximity sensor due to low helium actuation pressure. This problem was discussed in detail in Section V. The signal interruptions caused by low helium pressure are not shown on the thermal cycle graphs because they were facility problems and did not reflect sensor performance problems.

VII. CONCLUSIONS AND RECOMMENDATION

Throughout the duration of this test there were four cycle sequences - thermal cycles 1, 2, 7, and 9 - in which the proximity sensors did not function properly. However, in each instance, as the thermal cycle progressed the sensors regained their ability to accurately identify the valve position. The anomalies are attributed to a combination of two application design elements which did not place the sensors in their optimum performance environment. The first contributing design element was the inability to control the gap between the sensor and target during rapid thermal transients. The second element is the small target size used for this test. Since the target was small, this enhanced the possibility of a thermal gradient between the two sensor coils temporarily creating a false signal. These test bed design elements were driven by a desire to adapt the sensors to the External Tank vent and relief valves with minimum impact.

It is concluded that the Eldec SC08-020-10 proximity sensor is an acceptable replacement for the Honeywell 1HM25 position indicator switch. However, the need for an improved sensor mount became obvious because of the problems experienced during this test. Such an improvement would be a mechanical override that could control the actuation gap or insure contact between the sensor and target. This contact and larger target worked flawlessly during the thermal shock test. The override device could be similar in design to the existing switch actuation mechanisms, but would increase reliability because the sensor itself is inherently more reliable than the mechanical switch.

For future use, the recommended mounting method would be to incorporate the sensors in the valve design either internally or in a sensing well. This could allow even cooling of the sensor, and the head-on mode of operation could be employed rather than the slide-by mode. Head-on operation of the sensors allows a larger actuation gap. This integral design eliminates any mechanisms other than the valve parts themselves and employs the greatest advantage of the solid state proximity sensor.

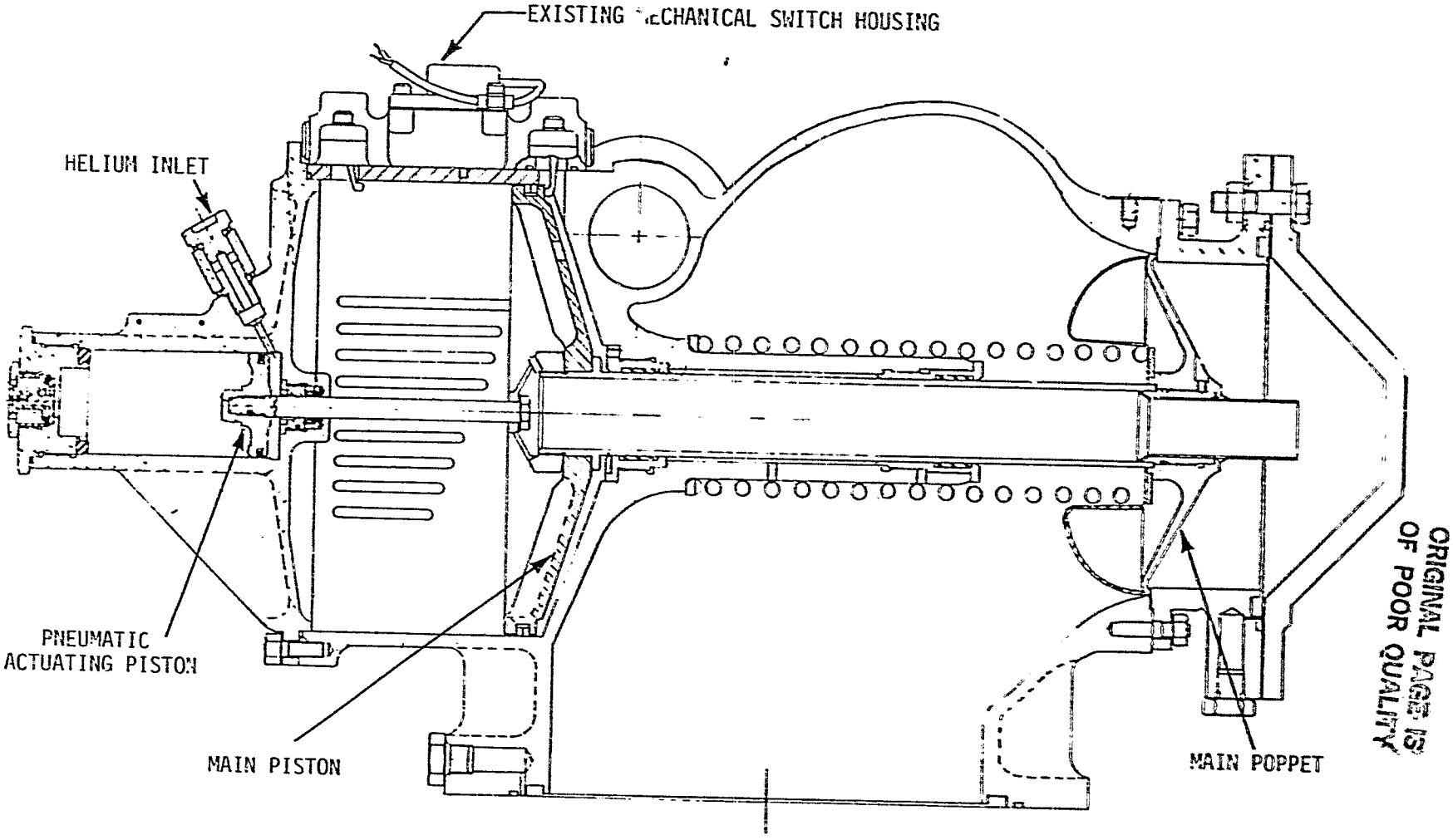

Figure 1. External Tank vent/relief valve.

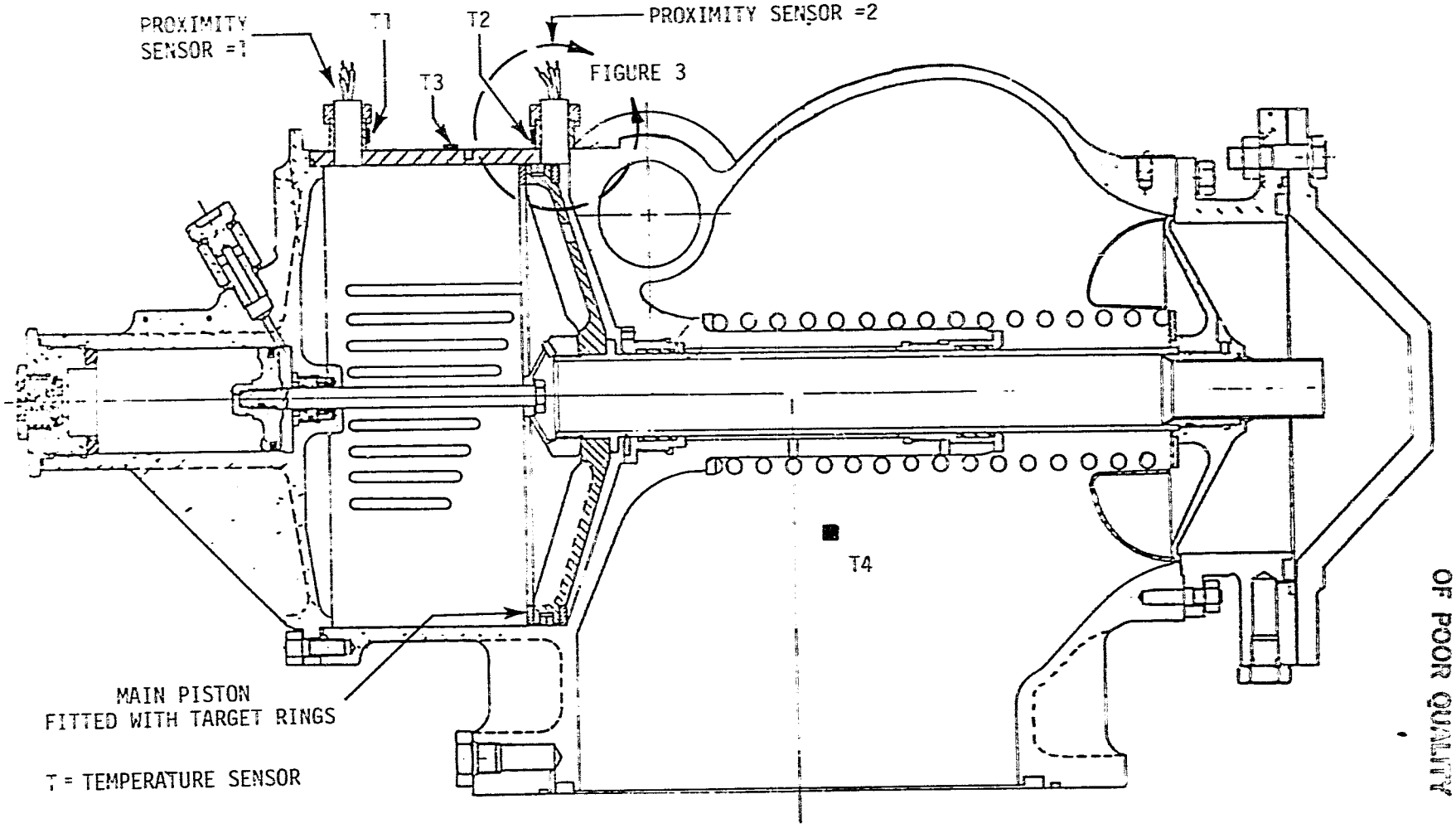

Figure 2. Modified vent/relief valve with proximity sensors.

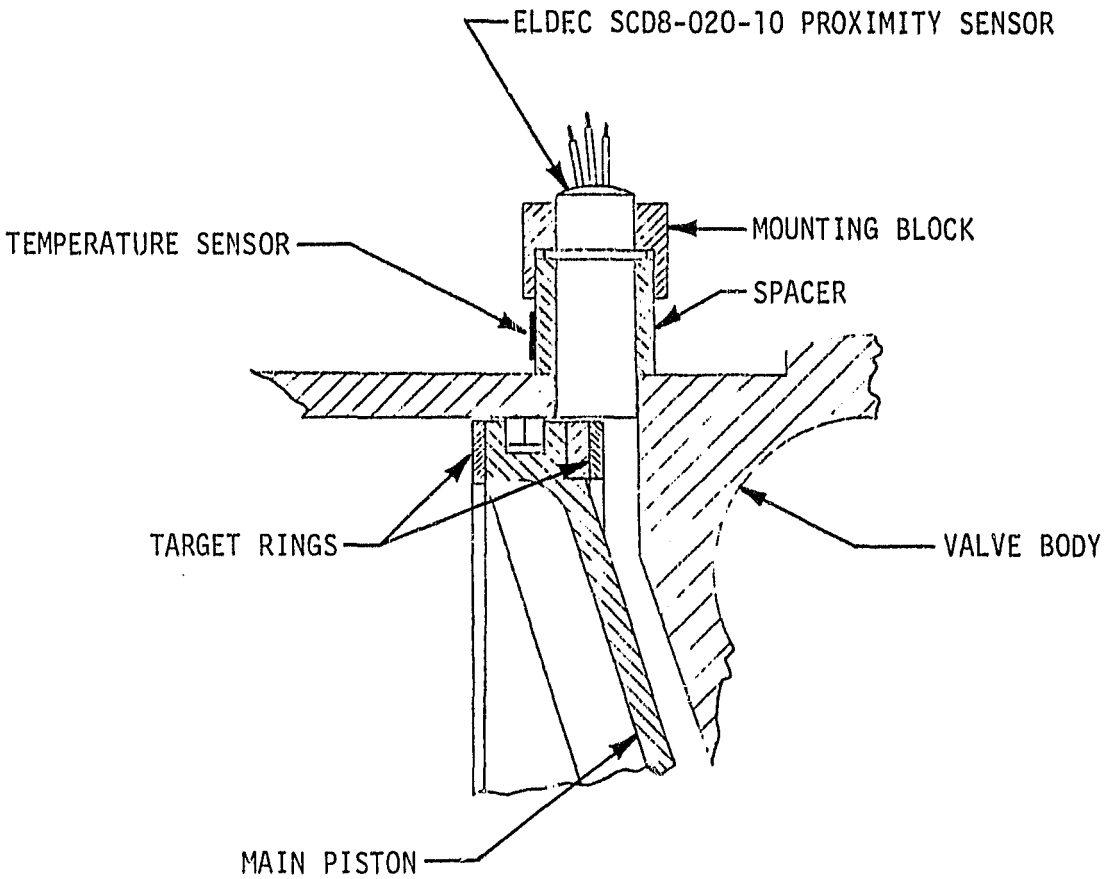

Figure 3. Proximity sensor mounting detail.

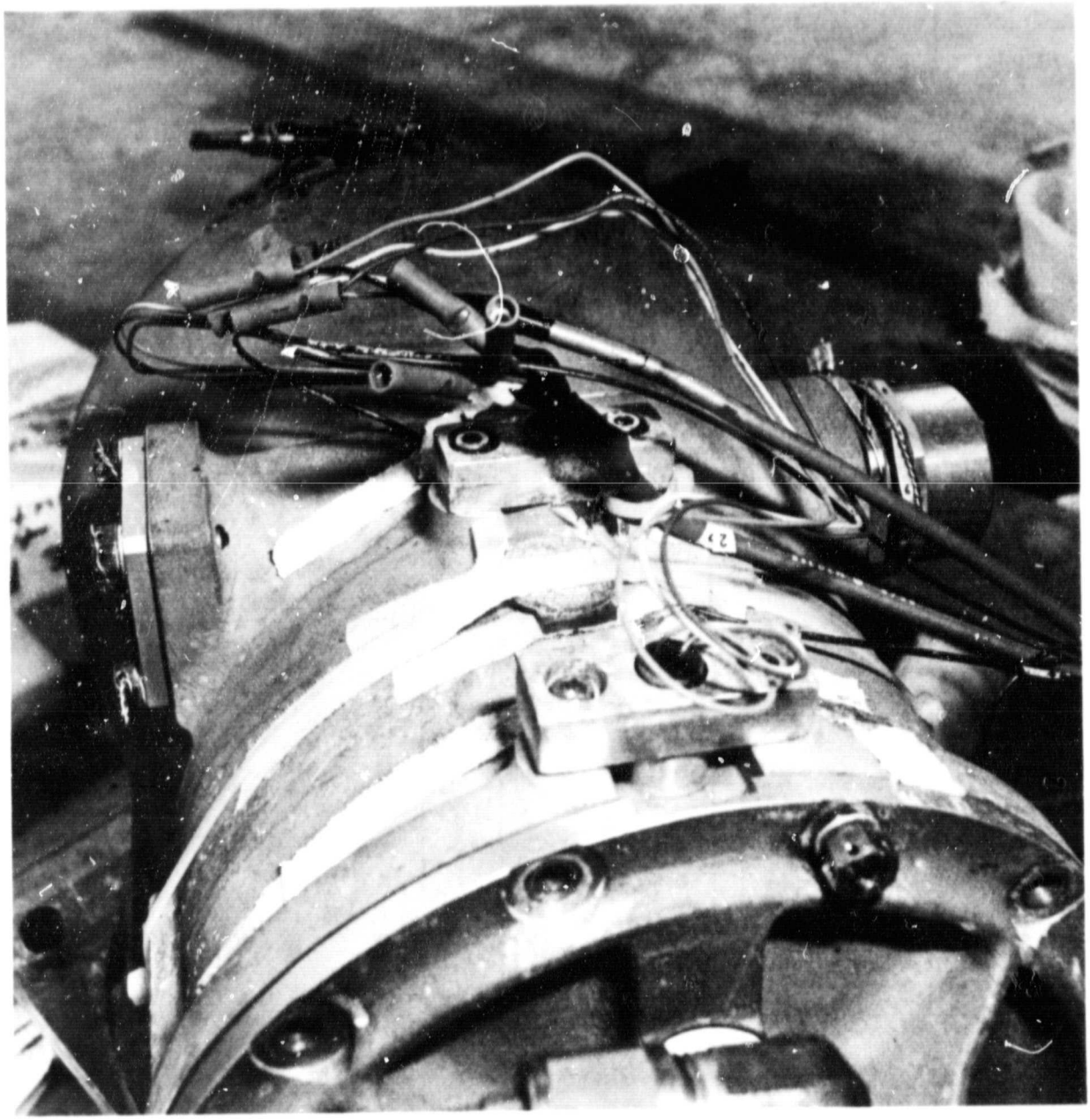

Figure 4. Specimen after thermal cycle test (closeup of sensors and mounting hardware).

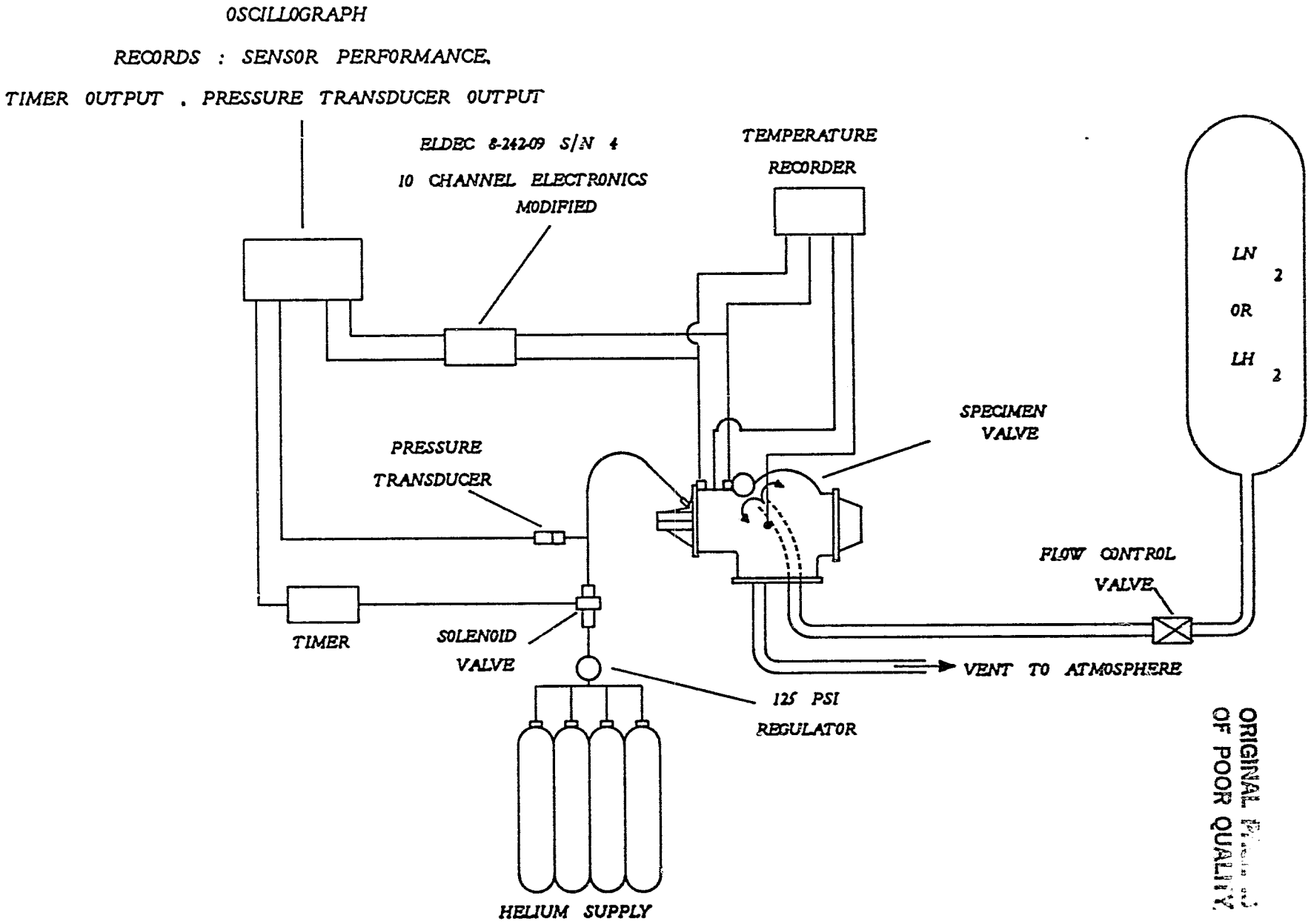

Figure 5. Thermal cycle test schematic.

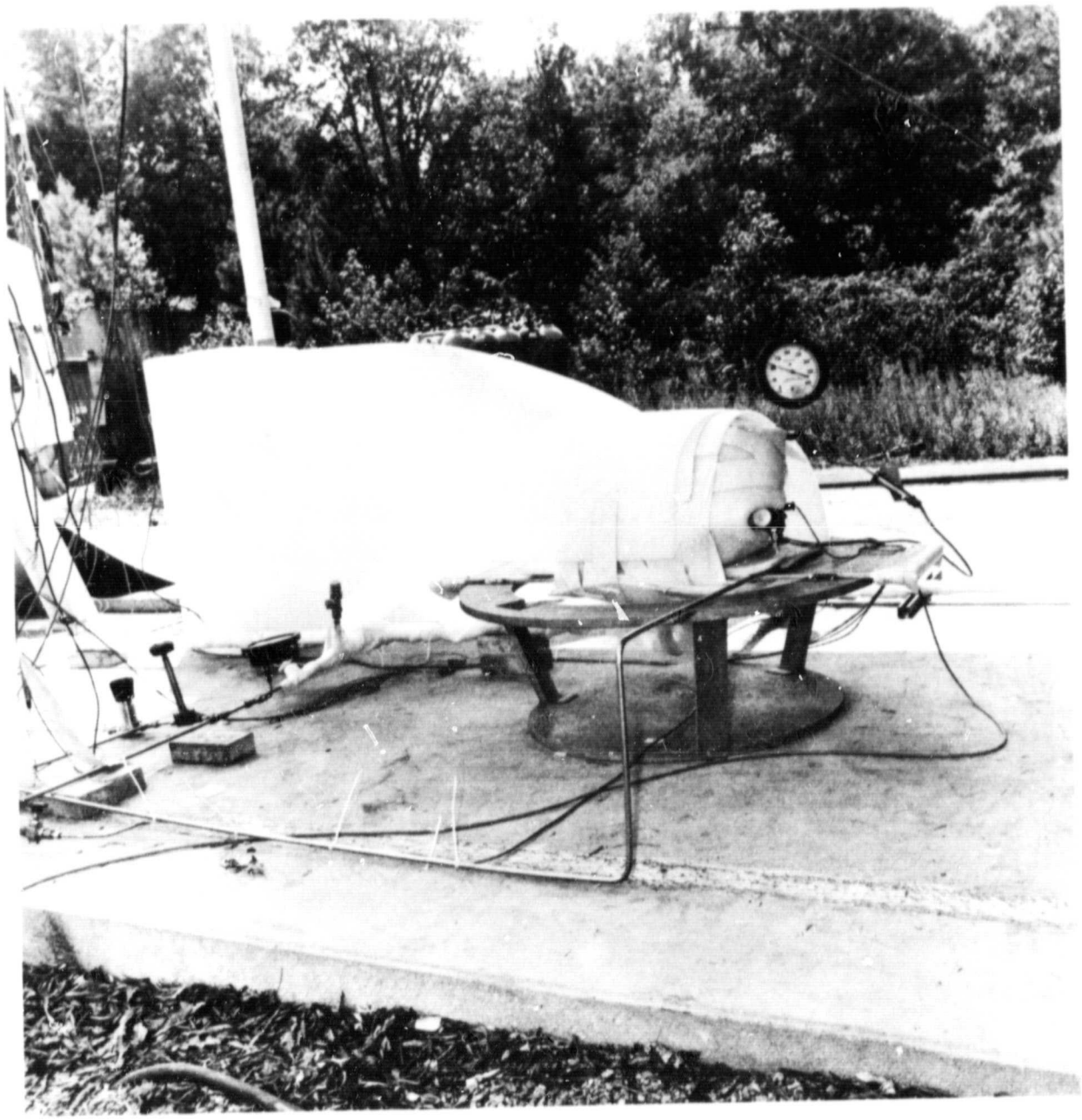

Figure 6. Test specimen during thermal cycle test.

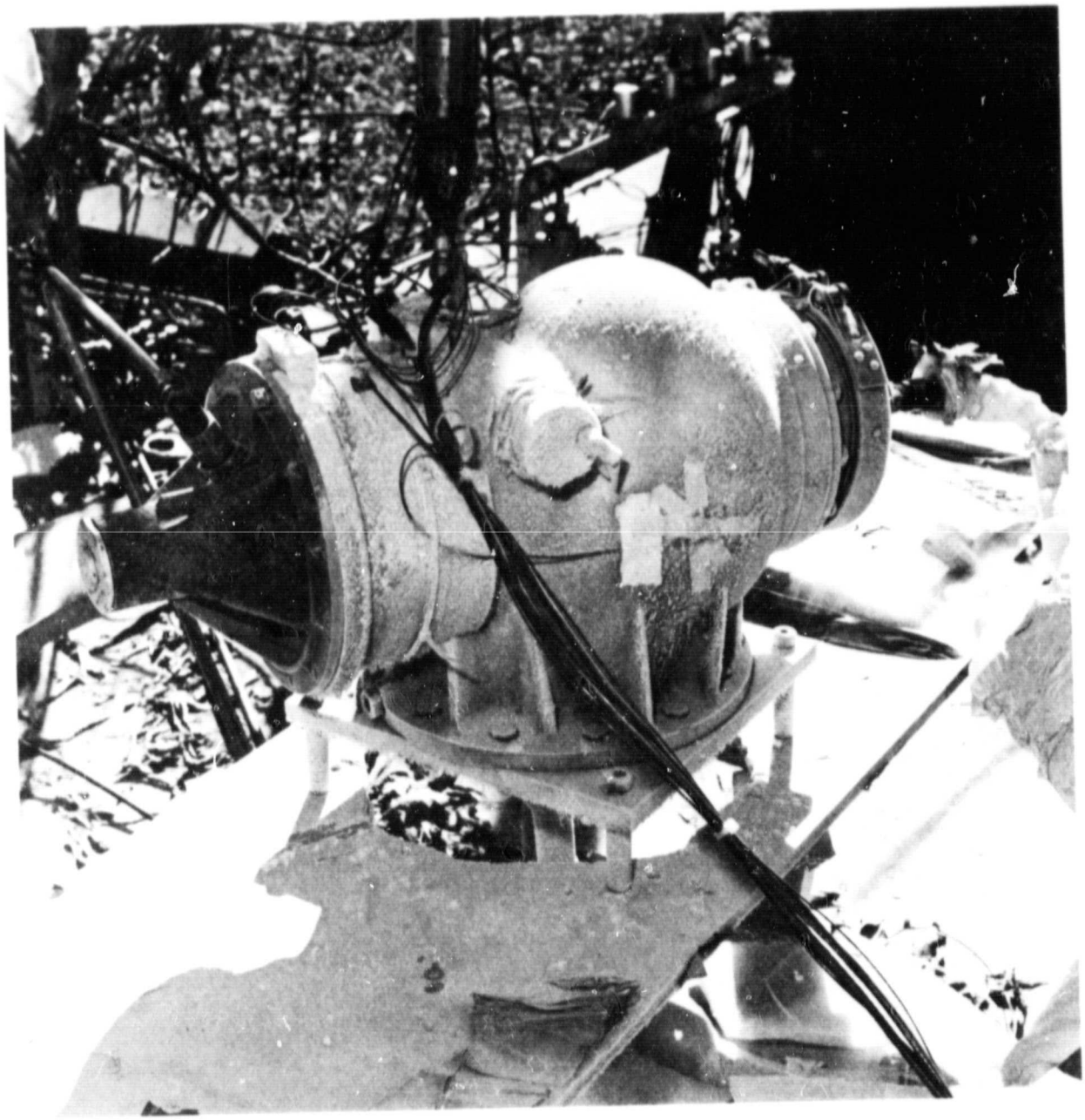

Figure 7. Specimen after thermal cycle test (insulation removed).

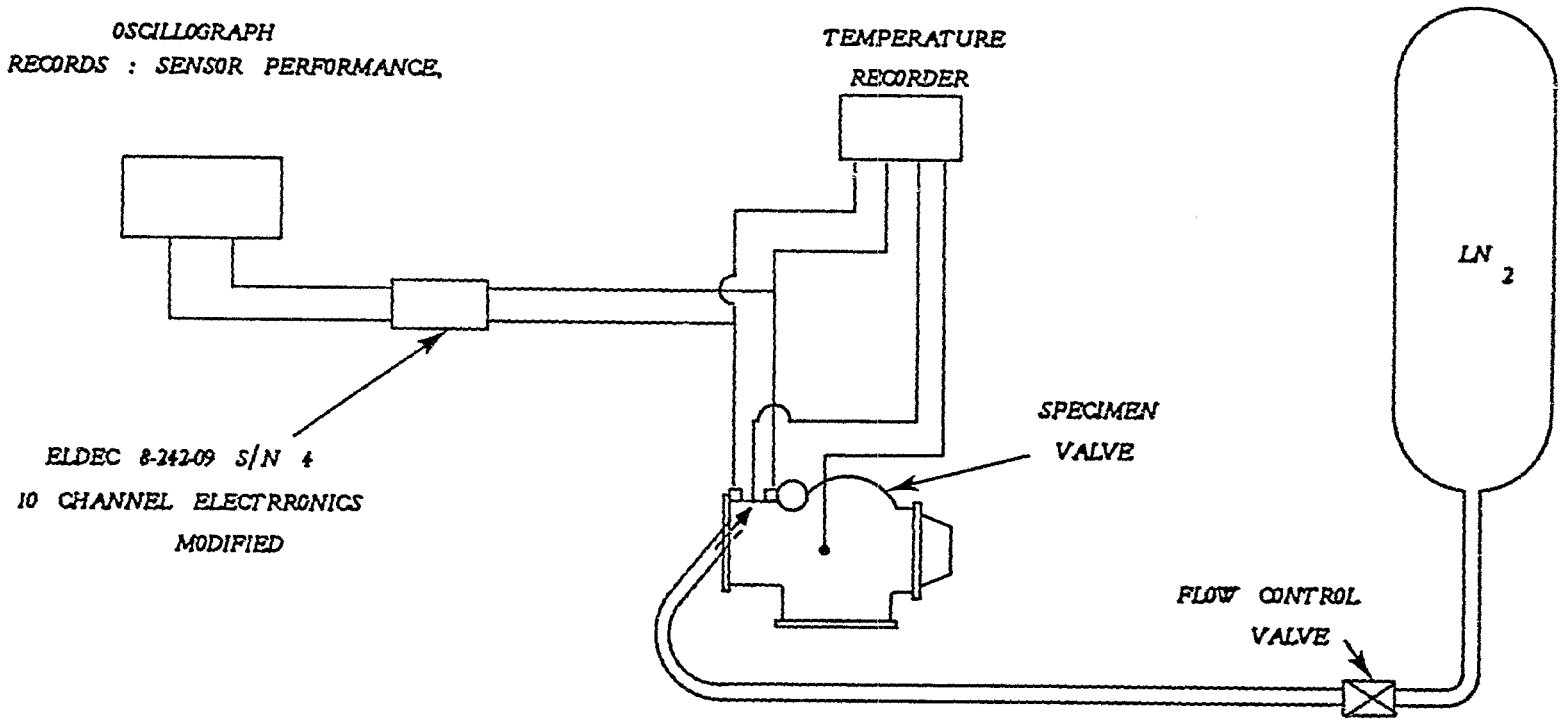

Figure 8. Thermal shock test schematic.

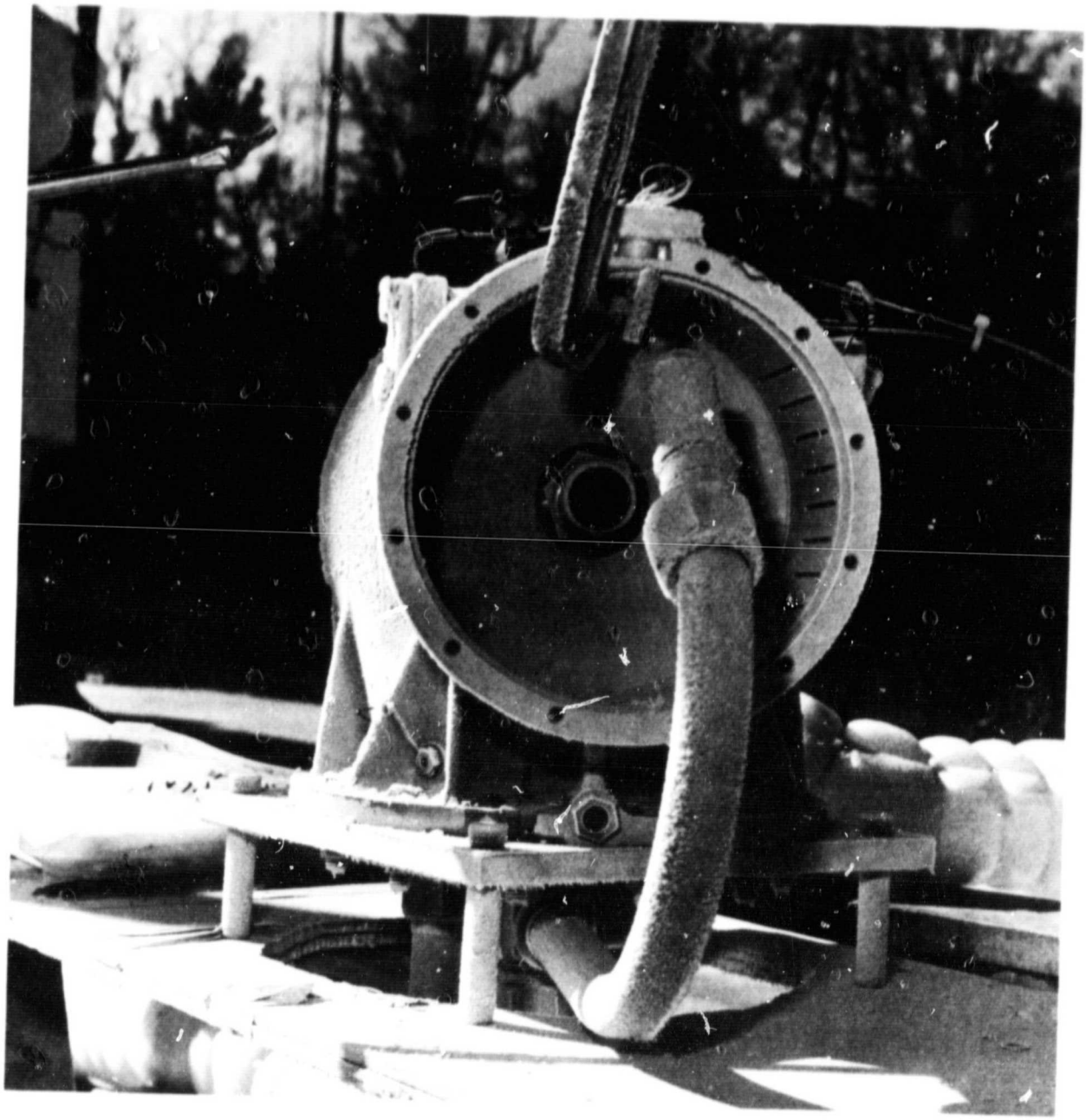

Figure 9. Test specimen after thermal shock test (insulation removed).

GRAPHS AND TEMPERATURE DATA

TABLE 1. THERMAL CYCLE NO. 1 GRAPH AND TEMPERATURE DATA

	TIME	T1	T2	T3	T4
	10:17:55	86.6	86.4	86.3	86.0
	10:18:55	86.8	86.7	86.5	86.1
	10:19:55	86.9	86.8	86.7	86.2
	10:20:55	86.9	86.9	86.8	86.3
	10:21:55	87.1	87.1	86.9	86.5
	10:22:55	87.2	87.2	87.1	86.5
	10:23:55	87.3	87.4	87.2	86.6
	10:24:55	87.4	87.5	87.3	86.8
	10:25:55	87.5	87.6	87.4	86.9
	10:26:55	87.6	87.8	87.5	87.1
	13:23:53	97.0	97.1	97.0	97.0
	13:24:53	97.1	97.2	97.0	97.5
TIME 0 =	13:26:00	97.1	97.7	97.5	98.9
	13:27:00	97.3	98.5	98.2	100.3
	13:28:00	97.5	99.4	98.9	101.5
	13:29:00	97.8	99.8	98.2	83.5
	13:30:00	85.8	32.3	7.1	-157.8
	13:31:00	58.8	-77.7	-64.8	-306.1
	13:32:00	27.7	-150.8	-117.2	-309.6
	13:33:00	-2.3	-193.1	-148.3	-311.7
	13:34:00	-29.5	-201.3	-157.5	-310.9
	13:35:00	-52.1	-201.0	-164.5	-306.9
	13:36:00	-74.6	-201.0	-171.5	-309.0
	13:37:00	-94.0	-210.7	-186.2	-313.8
	13:38:01	-110.3	-230.7	-204.4	-313.8
	13:39:01	-125.8	-242.9	-216.2	-314.0
	13:40:01	-136.3	-245.9	-222.0	-297.9
	13:41:00	-139.1	-238.4	-220.8	-281.9
	13:42:00	-134.4	-227.0	-216.9	-266.0
	13:43:00	-128.0	-219.5	-215.3	-306.7
	13:44:00	-126.6	-234.6	-233.0	-314.8
	13:45:00	-125.3	-240.8	-236.4	-312.8
	13:46:00	-128.5	-241.1	-236.2	-308.3
	13:47:00	-129.7	-239.1	-235.5	-303.5
	13:48:00	-132.7	-237.8	-235.3	-312.8
	13:49:00	-134.0	-242.4	-239.3	-299.5
	13:50:00	-135.7	-240.7	-236.2	-280.0
	13:51:00	-140.5	-246.4	-246.0	-310.7
	13:52:00	-144.6	-256.5	-252.0	-307.4
	13:53:00	-148.7	-259.9	-254.9	-307.5
	13:54:00	-152.9	-261.4	-256.9	-307.9
	13:55:01	-156.2	-262.9	-258.9	-307.4
	13:56:00	-159.8	-264.4	-261.8	-307.5
	13:57:01	-163.5	-266.3	-265.2	-307.6
	13:58:01	-166.9	-268.3	-268.0	-307.6
	13:59:00	-170.6	-269.7	-270.6	-307.9
	14:00:00	-184.5	-271.2	-274.4	-308.4
	14:01:00	-208.4	-282.5	-289.9	-308.8
	14:02:00	-226.2	-289.2	-296.2	-309.1
	14:03:00	-238.9	-292.8	-298,4	-309.2
	14:04:01	-247.7	-295.0	-300.9	-300.4
	14:05:01	-253.9	-296.5	-301.6	-309.4
	14:06:00	-258.6	-297.0	-302.9	-309.5
	14:07:00	-262.4	-297.5	-302.8	-309.2
	14:08:00	-266.3	-298.1	-303.5	-309.5
	14:09:00	-268.8	-298.6	-303.7	-309.5
	14:10:00	-270.4	-298.9	-303.5	-309.5
	14:11:00	-271.9	-299.4	-304.4	-309.5
	14:12:00	-273.1	-299.8	-304.3	-309.5
	14:13:00	-273.7	-299.8	-304.3	-309.5
	14:14:01	-273.8	-299.5	-304.5	-309.6
	14:15:01	-274.6	-299.7	-304.4	-309.8
	14:16:00	-274.9	-299.8	-304.9	-309.9
	14:17:00	-275.9	-299.9	-305.0	-309.9
	14:18:00	-276.7	-300.1	-305.0	-309.8
	14:19:01	-277.3	-300.4	-305.0	-309.9
	14:20:01	-278.2	-301.0	-305.0	-301.1
	14:21:01	-279.0	-301.5	-305.0	-309.9
	14:22:00	-279.9	-301.1	-305.5	-310.1
	14:23:00	-280.5	-301.4	-305.5	-310.1
	14:24:00	-280.9	-301.6	-305.4	-310.3
	14:25:01	-281.2	-301.8	-305.4	-310.5
	14:26:01	-281.1	-301.8	-305.4	-310.2
	14:27:00	-281.0	-301.5	-305.6	-310.2
	14:28:00	-280.8	-301.6	-305.6	-310.2
	14:29:00	-280.9	-302.0	-305.7	-310.2
	14:30:00	-281.1	-302.5	-305.9	-310.3
	14:31:01	-280.8	-302.7	-305.6	-310.5
	14:32:00	-280.8	-302.0	-306.0	-310.3
	14:33:00	-280.3	-302.7	-305.7	-310.3
	14:34:00	-280.6	-302.1	-305.9	-310.5
	14:35:00	-280.6	-302.7	-306.0	-310.6
	14:36:01	-280.8	-302.6	-305.7	-310.5
	14:37:01	-280.8	-302.2	-306.0	-310.6
	14:38:00	-280.8	-302.8	-306.3	-310.6
	14:39:00	-281.2	-302.6	-306.1	-310.6
	14:40:00	-281.0	-302.1	-306.0	-310.7
	14:41:00	-280.2	-301.5	-305.6	-310.6
	14:42:01	-279.3	-301.4	-305.6	-310.7
	14:43:01	-279.1	-301.6	-305.6	-310.9
	14:44:00	-278.5	-301.0	-305.6	-310.6
	14:45:00	-277.9	-300.9	-305.5	-310.6
	14:46:00	-277.7	-300.9	-305.2	-310.7
	14:47:01	-278.0	-301.1	-305.5	-310.9
	14:48:01	-277.7	-300.9	-305.1	-310.7
	14:49:00	-278.0	-300.7	-305.5	-310.7
	14:50:00	-278.1	-301.2	-305.5	-310.9
	14:51:00	-278.0	-301.5	-305.5	-310.9
	14:52:01	-277.7	-301.4	-305.2	-310.9
	14:53:01	-277.5	-301.4	-305.1	-311.1
	14:54:00	-277.5	-301.1	-305.4	-310.9
	14:55:00	-277.1	-300.5	-304.4	-311.1
	14:56:00	-277.5	-300.6	-306.0	-310.7
	14:57:00	-277.4	-301.7	-305.7	-310.7
	14:58:01	-276.7	-301.7	-305.4	-310.9
	14:59:00	-276.3	-301.7	-306.0	-310.7
	15:00:00	-276.3	-301.7	-305.4	-310.7
	15:01:00	-276.8	-302.0	-305.7	-310.9
	15:02:00	-276.9	-302.2	-305.7	-311.0
	15:03:00	-277.1	-302.2	-305.7	-310.7
	15:04:01	-277.3	-302.3	-305.9	-310.9
	15:05:00	-277.3	-302.3	-306.3	-311.0
	15:06:00	-277.7	-302.5	-306.3	-311.0
	15:06:45	-277.9	-302.2	-305.5	-310.9

TABLE 1. (Concluded)

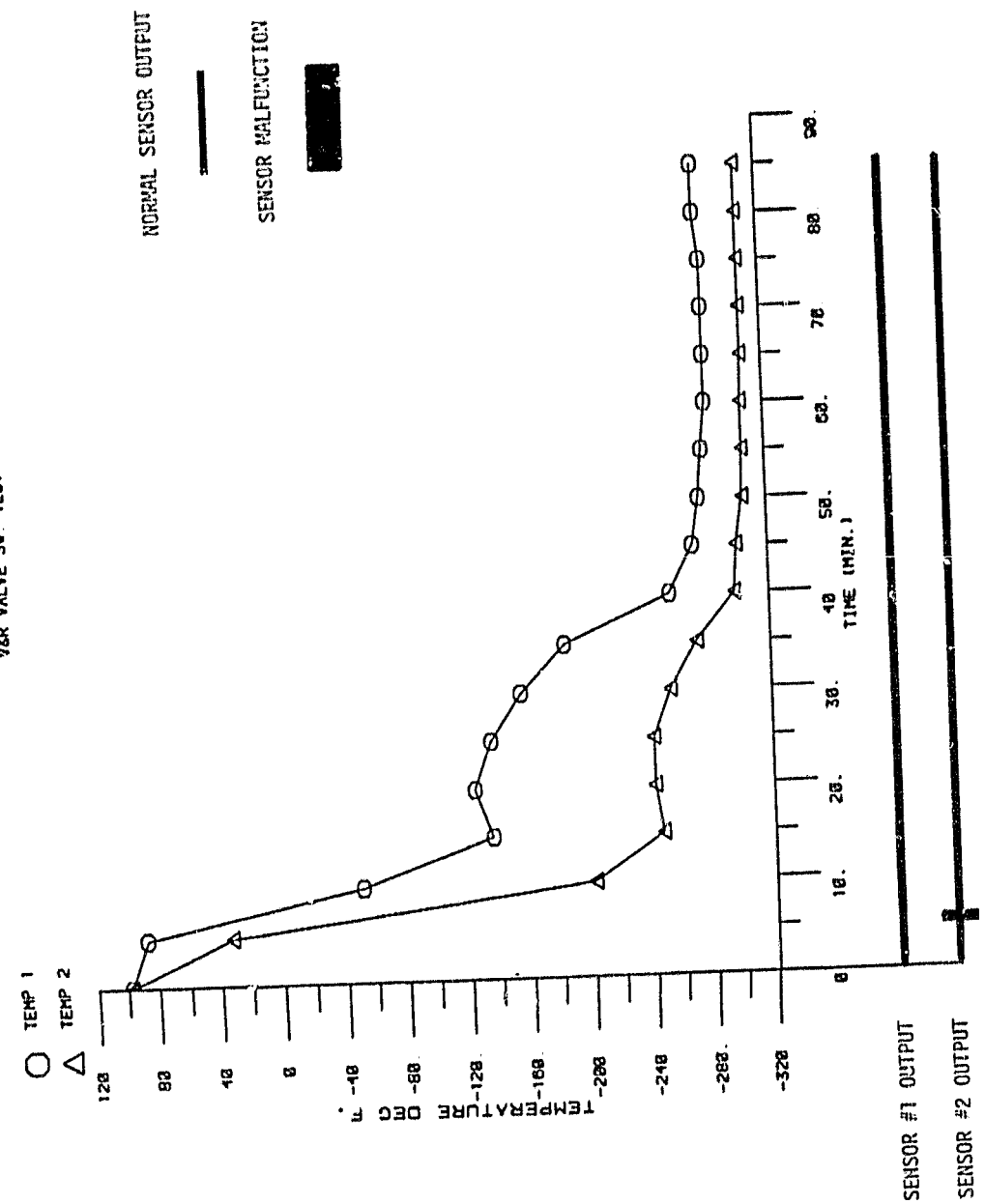

TABLE 2. THERMAL CYCLE NO. 2 GRAPH AND TEMPERATURE DATA

TIME	T1	T2	T3	T4	TIME	T1	T2	T3	T4	TIME	T1	T2	T3	T4
TIME 0 = 09:30:07														
09:30:07	61.6	61.4	61.3		09:30:07	-260.8	-323.8	-334.6	-312.5	10:32:22	-202.2	-224.4	-227.8	-237.8
09:31:07	61.5	61.4	61.4		09:31:07	-285.4	-307.1	-338.4	-315.5	10:33:22	-194.1	-220.9	-229.5	-239.6
09:32:07	61.5	61.4	61.3		09:32:07	-284.0	-306.7	-338.4	-315.5	10:34:22	-196.4	-217.7	-226.9	-235.9
09:33:07	61.3	61.5	61.3		09:33:07	-281.1	-305.2	-336.7	-315.3	10:35:22	-193.2	-213.0	-223.3	-232.7
09:34:07	61.2	61.6	61.4		09:34:07	-277.3	-304.0	-335.2	-315.3	10:36:22	-189.6	-209.2	-219.9	-229.3
09:35:07	61.2	61.5	61.3		09:35:07	-273.6	-302.5	-333.8	-315.3	10:37:22	-186.2	-206.4	-216.5	-226.0
09:36:07	60.3	61.6	61.4		09:36:07	-267.0	-300.0	-333.0	-315.3	10:38:22	-182.4	-202.2	-213.0	-222.4
09:37:07	61.4	61.6	61.4		09:37:07	-259.6	-296.7	-329.7	-315.3	10:39:22	-179.3	-199.4	-209.9	-219.3
09:38:07	61.4	62.1	62.1		09:38:07	-254.4	-294.4	-324.0	-314.9	10:40:22	-176.1	-196.2	-206.4	-216.0
09:39:07	61.6	62.4	62.5		09:39:07	-251.7	-293.2	-322.0	-315.1	10:41:22	-173.2	-193.6	-203.5	-213.3
09:40:07	58.5	62.5	62.5		09:40:07	-249.7	-292.0	-320.1	-314.9	10:42:22	-170.3	-190.4	-200.7	-210.4
09:41:07	23.8	62.5	62.5		09:41:07	-247.4	-291.0	-318.3	-315.1	10:43:22	-167.7	-187.4	-197.8	-207.7
09:42:07	-10.6	62.4	62.5		09:42:07	-245.3	-290.2	-316.9	-314.9	10:44:22	-165.2	-185.5	-195.2	-205.2
09:43:07	-57.4	62.4	62.5		09:43:07	-243.7	-289.6	-315.4	-315.1	10:45:22	-162.8	-182.9	-192.8	-202.8
09:44:07	-89.5	62.4	62.5		09:44:07	-242.5	-289.0	-314.2	-315.1	10:46:22	-160.5	-180.8	-190.5	-200.5
09:45:07	-117.7	62.4	62.5		09:45:07	-242.1	-288.6	-313.2	-315.1	10:47:22	-158.3	-178.3	-188.2	-198.1
09:46:07	-139.0	62.4	62.5		09:46:07	-242.0	-288.3	-312.4	-315.2	10:48:22	-157.0	-176.1	-186.2	-196.1
09:47:07	-157.1	62.4	62.5		09:47:07	-241.7	-288.2	-311.8	-314.9	10:49:22	-155.2	-174.8	-184.7	-194.4
09:48:07	-169.1	62.4	62.5		09:48:07	-241.8	-288.2	-311.4	-315.1	10:50:22	-152.6	-172.2	-182.5	-192.2
09:49:07	-198.5	62.4	62.5		09:49:07	-241.8	-288.4	-311.2	-314.9	10:51:22	-150.0	-169.9	-180.3	-190.0
09:50:07	-223.6	62.4	62.5		09:50:07	-240.8	-288.2	-311.2	-315.1	10:52:22	-147.4	-167.6	-178.2	-187.9
09:51:07	-254.9	62.4	62.5		09:51:07	-239.2	-287.6	-311.2	-315.1	10:53:22	-146.0	-165.5	-176.1	-185.8
09:52:07	-266.3	62.4	62.5		09:52:07	-241.5	-287.2	-311.2	-315.1	10:54:22	-144.2	-163.8	-174.4	-184.2
09:53:07	-269.6	62.4	62.5		09:53:07	-255.7	-286.6	-311.2	-315.1	10:55:22	-142.4	-161.2	-172.2	-182.0
09:54:07	-273.7	62.4	62.5		09:54:07	-271.2	-286.7	-311.2	-315.1	10:56:22	-140.5	-159.4	-170.2	-180.1
09:55:07	-276.1	62.4	62.5		09:55:07	-279.2	-287.1	-311.2	-315.1	10:57:22	-138.9	-157.6	-168.2	-178.1
09:56:07	-276.1	62.4	62.5		09:56:07	-280.4	-287.4	-311.2	-315.1	10:58:22	-137.5	-156.2	-166.8	-176.6
09:57:07	-276.1	62.4	62.5		09:57:07	-281.9	-288.0	-311.2	-315.1	10:59:22	-136.1	-154.8	-165.5	-175.2
09:58:07	-276.1	62.4	62.5		09:58:07	-283.6	-288.6	-311.2	-315.1	11:00:22	-134.7	-153.4	-164.1	-173.8
09:59:07	-276.1	62.4	62.5		09:59:07	-285.9	-289.3	-311.2	-315.1	11:01:22	-133.4	-152.1	-162.8	-172.5
10:00:07	-276.1	62.4	62.5		10:00:07	-286.3	-289.9	-311.2	-315.1	11:02:22	-132.1	-150.8	-161.5	-171.2
10:01:07	-276.1	62.4	62.5		10:01:07	-285.9	-290.4	-311.2	-315.1	11:03:22	-130.8	-149.5	-160.2	-169.9
10:02:07	-276.1	62.4	62.5		10:02:07	-284.8	-290.8	-311.2	-315.1	11:04:22	-129.5	-148.2	-158.9	-168.6
10:03:07	-276.1	62.4	62.5		10:03:07	-283.5	-291.2	-311.2	-315.1	11:05:22	-128.2	-146.9	-157.6	-167.3
10:04:07	-276.1	62.4	62.5		10:04:07	-282.0	-291.7	-311.2	-315.1	11:06:22	-126.9	-145.6	-156.3	-166.0
10:05:07	-276.1	62.4	62.5		10:05:07	-280.7	-292.0	-311.2	-315.1	11:07:22	-125.6	-144.3	-155.0	-164.7
10:06:07	-276.1	62.4	62.5		10:06:07	-279.2	-292.2	-311.2	-315.1	11:08:22	-124.3	-143.0	-153.7	-163.4
10:07:07	-276.1	62.4	62.5		10:07:07	-277.8	-292.3	-311.2	-315.1	11:09:22	-123.0	-141.7	-152.4	-162.1
10:08:07	-276.1	62.4	62.5		10:08:07	-276.4	-292.3	-311.2	-315.1	11:10:22	-121.7	-140.4	-151.1	-160.8
10:09:07	-276.1	62.4	62.5		10:09:07	-275.1	-292.3	-311.2	-315.1	11:11:22	-120.4	-139.1	-149.8	-159.5
10:10:22	-276.1	62.4	62.5		10:10:22	-273.9	-292.3	-311.2	-315.1	11:12:22	-119.1	-137.8	-148.5	-158.2
10:11:22	-276.1	62.4	62.5		10:11:22	-272.8	-292.3	-311.2	-315.1	11:13:22	-117.8	-136.5	-147.2	-156.9
10:12:22	-276.1	62.4	62.5		10:12:22	-271.8	-292.3	-311.2	-315.1	11:14:22	-116.5	-135.2	-145.9	-155.6
10:13:22	-276.1	62.4	62.5		10:13:22	-270.8	-292.3	-311.2	-315.1	11:15:22	-115.2	-133.9	-144.6	-154.3
10:14:22	-276.1	62.4	62.5		10:14:22	-269.9	-292.3	-311.2	-315.1	11:16:22	-113.9	-132.6	-143.3	-153.0
10:15:22	-276.1	62.4	62.5		10:15:22	-269.1	-292.3	-311.2	-315.1	11:17:22	-112.6	-131.3	-142.0	-151.7
10:16:22	-276.1	62.4	62.5		10:16:22	-268.3	-292.3	-311.2	-315.1	11:18:22	-111.3	-130.0	-140.7	-150.4
10:17:22	-276.1	62.4	62.5		10:17:22	-267.6	-292.3	-311.2	-315.1	11:19:22	-110.0	-128.7	-139.4	-149.1
10:18:22	-276.1	62.4	62.5		10:18:22	-267.0	-292.3	-311.2	-315.1	11:20:22	-108.7	-127.4	-138.1	-147.8
10:19:22	-276.1	62.4	62.5		10:19:22	-266.4	-292.3	-311.2	-315.1	11:21:22	-107.4	-126.1	-136.8	-146.5
10:20:22	-276.1	62.4	62.5		10:20:22	-265.9	-292.3	-311.2	-315.1	11:22:22	-106.1	-124.8	-135.5	-145.2
10:21:22	-276.1	62.4	62.5		10:21:22	-265.4	-292.3	-311.2	-315.1	11:23:22	-104.8	-123.5	-134.2	-143.9
10:22:22	-276.1	62.4	62.5		10:22:22	-265.0	-292.3	-311.2	-315.1	11:24:22	-103.5	-122.2	-132.9	-142.6
10:23:22	-276.1	62.4	62.5		10:23:22	-264.6	-292.3	-311.2	-315.1	11:25:22	-102.2	-120.9	-131.6	-141.3
10:24:22	-276.1	62.4	62.5		10:24:22	-264.2	-292.3	-311.2	-315.1	11:26:22	-100.9	-119.6	-130.3	-140.0
10:25:22	-276.1	62.4	62.5		10:25:22	-263.9	-292.3	-311.2	-315.1	11:27:22	-99.6	-118.3	-129.0	-138.7
10:26:22	-276.1	62.4	62.5		10:26:22	-263.6	-292.3	-311.2	-315.1	11:28:22	-98.3	-117.0	-127.7	-137.4
10:27:22	-276.1	62.4	62.5		10:27:22	-263.3	-292.3	-311.2	-315.1	11:29:22	-97.0	-115.7	-126.4	-136.1
10:28:22	-276.1	62.4	62.5		10:28:22	-263.1	-292.3	-311.2	-315.1	11:30:22	-95.7	-114.4	-125.1	-134.8
10:29:22	-276.1	62.4	62.5		10:29:22	-262.9	-292.3	-311.2	-315.1	11:31:22	-94.4	-113.1	-123.8	-133.5
10:30:22	-276.1	62.4	62.5		10:30:22	-262.7	-292.3	-311.2	-315.1	11:32:22	-93.1	-111.8	-122.5	-132.2
10:31:22	-276.1	62.4	62.5		10:31:22	-262.5	-292.3	-311.2	-315.1	11:33:22	-91.8	-110.5	-121.2	-130.9
10:32:22	-276.1	62.4	62.5		10:32:22	-262.4	-292.3	-311.2	-315.1	11:34:22	-90.5	-109.2	-119.9	-129.6
10:33:22	-276.1	62.4	62.5		10:33:22	-262.3	-292.3	-311.2	-315.1	11:35:22	-89.2	-107.9	-118.6	-128.3
10:34:22	-276.1	62.4	62.5		10:34:22	-262.2	-292.3	-311.2	-315.1	11:36:22	-87.9	-106.6	-117.3	-127.0
10:35:22	-276.1	62.4	62.5		10:35:22	-262.1	-292.3	-311.2	-315.1					
10:36:22	-276.1	62.4	62.5		10:36:22	-262.0	-292.3	-311.2	-315.1					
10:37:22	-276.1	62.4	62.5		10:37:22	-261.9	-292.3	-311.2	-315.1					
10:38:22	-276.1	62.4	62.5		10:38:22	-261.8	-292.3	-311.2	-315.1					
10:39:22	-276.1	62.4	62.5		10:39:22	-261.7	-292.3	-311.2	-315.1					
10:40:22	-276.1	62.4	62.5		10:40:22	-261.6	-292.3	-311.2	-315.1					
10:41:22	-276.1	62.4	62.5		10:41:22	-261.5	-292.3	-311.2	-315.1					
10:42:22	-276.1	62.4	62.5		10:42:22	-261.4	-292.3	-311.2	-315.1					
10:43:22	-276.1	62.4	62.5		10:43:22	-261.3	-292.3	-311.2	-315.1					
10:44:22	-276.1	62.4	62.5		10:44:22	-261.2	-292.3	-311.2	-315.1					
10:45:22	-276.1	62.4	62.5		10:45:22	-261.1	-292.3	-311.2	-315.1					
10:46:22	-276.1	62.4	62.5		10:46:22	-261.0	-292.3	-311.2	-315.1					
10:47:22	-276.1	62.4	62.5		10:47:22	-260.9	-292.3	-311.2	-315.1					
10:48:22	-276.1	62.4	62.5		10:48:22	-260.8	-292.3	-311.2	-315.1					
10:49:22	-276.1	62.4	62.5		10:49:22	-260.7	-292.3	-311.2	-315.1					
10:50:22	-276.1	62.4	62.5		10:50:22	-260.6	-292.3	-311.2	-315.1					
10:51:22	-276.1	62.4	62.5		10:51:22	-260.5	-292.3	-311.2	-315.1					
10:52:22	-276.1	62.4	62.5		10:52:22	-260.4	-292.3	-311.2	-315.1					
10:53:22	-276.1	62.4	62.5		10:53:22	-260.3	-292.3	-311.2	-315.1					
10:54:22	-276.1	62.4	62.5		10:54:22	-260.2	-292.3	-311.2	-315.1					
10:55:22	-276.1	62.4	62.5		10:55:22	-260.1	-292.3	-311.2	-315.1					
10:56:22	-276.1	62.4	62.5		10:56:22	-260.0	-292.3	-311.2	-315.1					
10:57:22	-276.1	62.4	62.5		10:57:22	-259.9	-292.3	-311.2	-315.1					
10:58:22	-276.1	62.4	62.5		10:58:22	-259.8	-292.3	-311.2	-315.1					
10:59:22	-276.1	62.4	62.5		10:59:22	-259.7	-292.3	-311.2	-315.1					
11:00:22	-276.1	62.4	62.5		11:00:22	-259.6	-292.3	-311.2	-315.1					
11:01:22	-276.1	62.4	62.5		11:01:22	-259.5	-292.3	-311.2	-315.1					
11:02:22	-276.1	62.4	62.5		11:02:22	-259.4	-292.3	-311.2	-315.1					
11:03:22	-276.1	62.4	62.5		11:03:22	-259.3	-292.3	-311.2	-315.1					
11:04:22	-276.1	62.4	62.5		11:04:22	-259.2	-292.3	-311.2	-315.1					
11:05:22	-276.1	62.4	62.5		11:05:22	-259.1	-292.3	-311.2	-315.1					
11:06:22	-276.1	62.4	62.5		11:06:22	-259.0	-292.3	-311.2	-315.1					
11:07:22	-276.1	62.4	62.5		11:07:22	-258.9	-292.3	-311.2	-315.1					
11:08:22	-276.1	62.4	62.5		11:08:22	-258.8	-292.3	-311.2	-315.1					
11:09:22	-276.1	62.4	62.5		11:09:22	-258.7	-292.3	-311.2	-315.1					
11:10:22	-276.1	62.4	62.5		11:10:22	-258.6	-292.3	-311.2	-315.1					
11:11:22	-276.1	62.4	62.5		11:11:22	-258.5	-292.3	-311.2	-315.1					
11:12:22	-276.1	62.4	62.5		11:12:22	-258.4	-292.3	-311.2	-315.1					
11:13:22	-276.1	62.4	62.5		11:13:22	-258.3	-292.3	-311.2	-315.1					
11:14:22	-276.1	62.4	62.5		11:14:22	-258.2	-292.3	-311.2	-315.1					
11:15:22	-276.1	62.4	62.5		11:15:22	-258.1	-292.3	-311.2	-315.1					
11:16:22	-276.1	62.4	62.5		11:16:22	-258.0	-292.3	-311.2	-315.1					
11:17:22	-276.1	62.4	62.5		11:17:22	-257.9	-292.3	-311.2	-315.1					
11:18:22	-276.1	62.4	62.5		11:18:22	-257.8	-292.3	-311.2	-315.1					
11:19:22	-276.1	62.4	62.5		11:19:22	-257.7	-292.3	-311.2	-315.1					
11:20:22	-276.1	62.4	62.5		11:20:22	-257.6	-292.3	-311.2	-315.1					
11:21:22	-276.1	62.4	62.5		11:21:22	-257.5	-292.3	-311.2	-315.1					
11:22:22	-276.1	62.4	62.5		11:22:22	-257.4	-292.3	-311.2	-315.1					
11:23:22	-276.1	62.4	62.5		11:23:22	-257.3	-292.3	-311.2	-315.1					
11:24:22	-276.1	62.4	62.5		11:24:22	-257.2	-292.3	-311.2	-315.1					
11:25:22	-276.1	62.4	62.5		11:25:22	-257.1	-292.3	-311.2	-315.1					
11:26:22	-276.1	62.4	62.5		11:26:22	-257.0	-292.3	-311.2	-315.1					
11:27:22	-276.1	62.4	62.5		11:27:22	-256.9	-292.3	-311.2	-315.1					
11:28:22	-276.1	62.4	62.5		11:28:22	-256.8	-292.3	-311.2	-315.1					
11:29:22	-276.1	62.4	62.5		11:29:22	-256.7	-292.3	-311.2	-315.1					
11:30:22	-276.1	62.4	62.5		11:30:22	-256.6	-292.3	-311.2	-315.1					
11:31:22	-276.1	62.4	62.5		11:31:22	-256.5	-292.3	-311.2	-315.1					
11:32:22	-276.1	62.4	62.5		11:32:22	-256.4	-292.3	-311.2	-315.1					

TABLE 2. (Concluded)

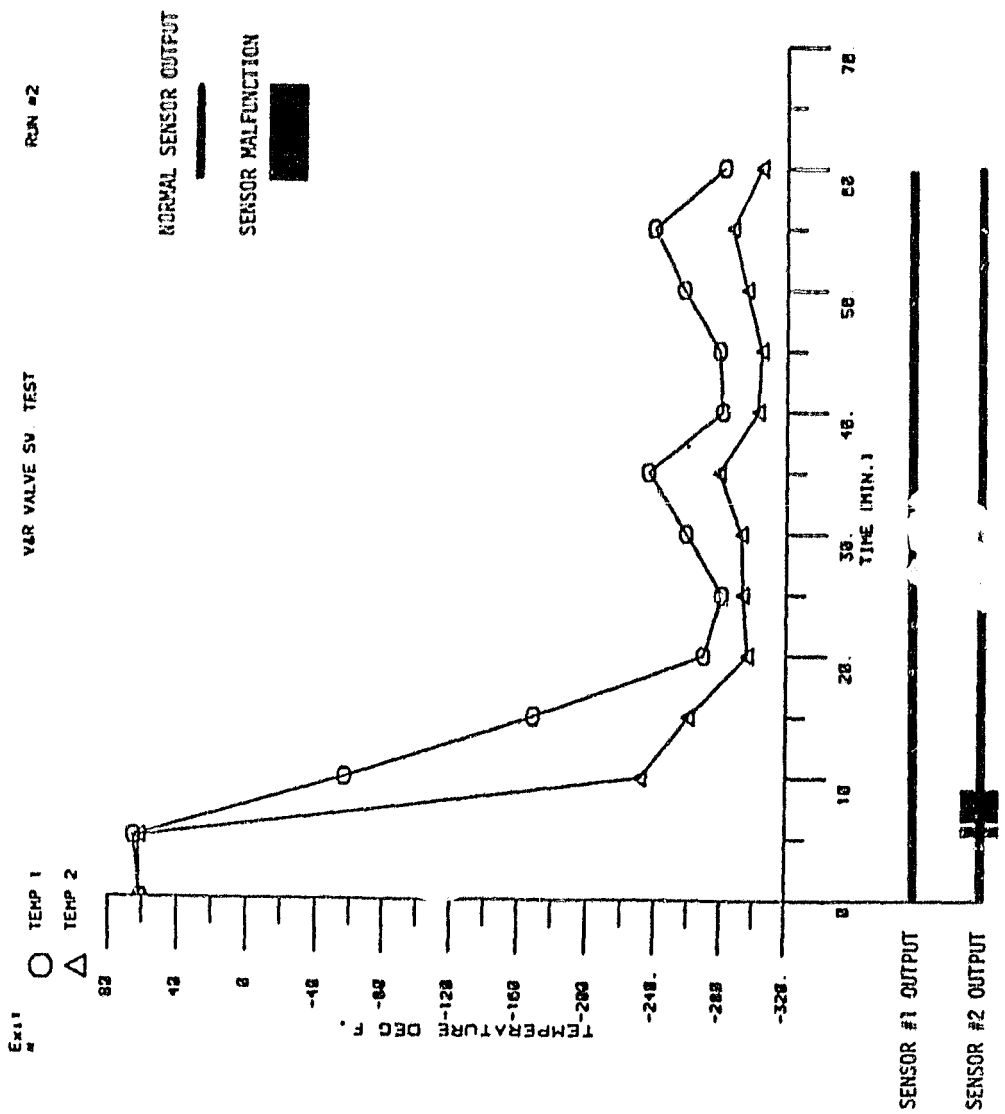

TABLE 3. THERMAL CYCLE NO. 3 GRAPH AND TEMPERATURE DATA

	TIME	T1	T2	T3	T4
TIME 0 =	[illegible]	24.1	32.3	29.3	[illegible]
	[illegible]	25.5	35.4	31.6	[illegible]
	[illegible]	27.1	36.1	32.3	[illegible]
	[illegible]	28.5	36.6	33.0	[illegible]
	[illegible]	29.6	36.7	33.4	[illegible]
	[illegible]	30.6	37.7	34.5	[illegible]
	[illegible]	31.6	38.0	35.7	[illegible]
	13:12:31	32.1	40.1	36.9	[illegible]
	13:13:32	32.2	41.2	37.9	[illegible]
	13:14:31	32.4	41.8	38.5	[illegible]
	13:15:31	32.5	41.9	39.0	[illegible]
	13:16:32	32.6	42.1	39.5	44.9
	13:17:31	32.8	42.4	40.1	45.2
	13:18:31	33.3	42.9	40.6	45.6
	13:19:32	33.9	43.3	41.2	46.2
	13:20:31	34.7	43.9	41.8	46.4
	13:21:31	36.0	44.3	42.4	46.9
	13:22:32	37.4	44.8	43.0	46.6
	13:23:31	38.4	44.8	43.2	46.5
	13:24:31	38.4	44.7	43.5	46.4
	13:25:32	38.7	44.8	43.6	46.3
	13:26:32	39.5	44.8	43.8	46.3
	13:27:32	39.4	45.2	44.3	47.8
	13:28:31	40.7	46.4	45.2	49.1
	13:29:31	41.8	47.6	46.3	50.5
	13:30:31	43.8	48.9	47.4	51.7
	13:31:31	44.8	50.1	48.4	52.8
	13:32:31	45.9	51.3	49.5	53.9
	13:33:31	46.9	52.4	50.5	53.8
	13:34:31	47.8	53.3	51.3	55.6
	13:35:31	48.7	54.2	52.3	56.5
	13:36:31	49.6	55.0	53.1	57.2
	13:37:32	50.5	55.8	53.9	58.0
	13:38:31	51.4	56.5	54.7	58.7
	13:39:32	52.1	57.1	55.2	58.4
	13:40:31	52.9	57.1	55.5	58.1
	13:41:32	53.5	57.0	55.6	57.9
	13:42:32	54.1	56.9	55.8	57.8
	13:43:32	54.5	56.8	55.9	57.7
	13:44:31	54.8	56.8	56.0	57.6
	13:45:31	55.2	56.8	56.1	57.6
	13:46:31	55.4	56.8	56.2	57.6
	13:51:32	56.7	57.6	57.3	58.3
	13:52:31	56.9	57.8	57.4	58.4
	13:53:31	57.0	57.9	57.5	58.4
	13:54:31	57.2	58.0	57.6	58.5
	13:55:31	57.3	58.1	57.8	58.5
	13:56:31	57.4	58.2	57.9	58.7
	13:57:32	57.6	58.3	58.0	58.7
	13:58:32	57.7	58.4	58.1	58.7
	13:59:32	57.8	58.4	58.1	58.8

TIME	T1	T2	T3	T4
14:00:32	58.0	58.9	59.6	63.3
14:01:32	58.5	62.2	61.2	[illegible]
14:02:32	59.3	66.0	64.0	[illegible]
14:03:32	59.1	51.2	48.9	[illegible]
14:04:32	54.2	-87.2	[illegible]	-196.2
14:05:32	42.1	-86.3	-46.0	-272.4
14:06:32	27.0	-119.6	-72.3	-311.9
14:07:32	6.3	-129.0	-85.8	-310.8
14:08:31	-17.7	-134.8	-94.2	-313.7
14:09:31	-37.7	-140.6	-103.6	-260.7
14:10:31	-53.1	-141.5	-109.4	-224.1
14:11:31	-68.3	-170.1	-137.8	-310.6
14:12:32	-81.8	-276.6	-175.6	-312.5
14:13:32	-103.3	-234.0	-192.2	-313.3
14:14:31	-122.2	-244.3	-205.0	-313.4
14:15:31	-138.5	-251.3	-215.4	-313.8
14:16:31	-149.5	-255.0	-225.3	-313.6
14:17:31	-153.7	-256.1	-232.9	-313.7
14:18:31	-159.0	-257.2	-239.4	-313.4
14:19:32	-164.3	-260.6	-244.9	-314.4
14:20:32	-169.8	-263.6	-249.4	-314.2
14:21:32	-176.1	-266.4	-255.5	-314.1
14:22:32	-180.8	-266.7	-256.9	-314.4
14:23:31	-185.6	-270.4	-260.0	-314.4
14:24:31	-188.9	-272.2	-262.6	-314.9
14:25:31	-192.4	-273.5	-264.4	-314.4
14:26:31	-196.4	-274.9	-266.3	-314.6
14:27:31	-207.1	-277.2	-264.5	-314.9
14:28:31	-219.4	-279.4	-266.0	-314.9
14:29:31	-226.2	-282.0	-267.5	-315.1
14:30:31	-228.5	-283.0	-267.8	-314.6
14:31:32	-229.1	-283.2	-267.9	-314.6
14:32:32	-229.7	-283.5	-268.6	-314.6
14:33:31	-230.0	-283.1	-269.3	-314.6
14:34:31	-230.9	-283.7	-269.9	-314.8
14:35:31	-232.3	-284.4	-270.7	-314.9
14:36:31	-232.8	-284.6	-271.4	-314.9
14:37:31	-233.7	-285.4	-271.9	-314.6
14:38:31	-234.3	-285.9	-272.6	-314.6
14:39:31	-234.8	-286.1	-272.8	-314.9
14:40:31	-234.0	-284.1	-275.2	-312.6
14:41:31	-246.5	-291.5	-298.3	-310.9
14:42:32	-273.0	-302.0	-308.3	-310.5
14:44:32	-277.1	-303.1	-308.6	-310.7
14:45:32	-277.3	-303.8	-308.8	-310.1
14:46:33	-276.9	-303.9	-308.8	-310.1
14:47:32	-277.1	-304.2	-309.0	-309.9
14:48:33	-277.9	-305.0	-309.9	-313.4
14:49:33	-277.8	-305.4	-309.2	-314.0
14:50:33	-278.0	-305.2	-309.2	-314.1
14:51:32	-277.3	-305.2	-310.2	-313.8
14:52:32	-277.7	-305.7	-310.9	-315.2
14:53:32	-279.8	-306.7	-311.3	-315.3
14:54:32	-279.2	-306.1	-310.5	-314.9
14:55:32	-278.[illegible]	-305.5	-310.2	-315.3

TIME	T1	T2	T3	T4
14:56:33	-276.[illegible]	[illegible]	[illegible]	[illegible]
14:57:33	[illegible]	[illegible]	[illegible]	[illegible]
14:58:33	[illegible]	[illegible]	[illegible]	[illegible]
14:59:33	[illegible]	[illegible]	[illegible]	[illegible]
15:00:33	[illegible]	[illegible]	[illegible]	[illegible]
15:01:33	[illegible]	[illegible]	[illegible]	[illegible]
15:02:33	[illegible]	[illegible]	[illegible]	[illegible]
15:03:33	[illegible]	[illegible]	[illegible]	[illegible]
15:04:33	[illegible]	[illegible]	[illegible]	[illegible]
15:05:33	[illegible]	[illegible]	[illegible]	[illegible]
15:06:33	[illegible]	[illegible]	[illegible]	[illegible]
15:07:33	[illegible]	[illegible]	[illegible]	[illegible]
15:08:32	[illegible]	[illegible]	[illegible]	[illegible]
15:09:33	[illegible]	[illegible]	[illegible]	[illegible]
15:10:33	[illegible]	[illegible]	[illegible]	[illegible]
15:11:33	[illegible]	[illegible]	[illegible]	[illegible]
15:12:33	[illegible]	[illegible]	[illegible]	[illegible]
15:13:33	[illegible]	[illegible]	[illegible]	[illegible]
15:14:33	[illegible]	[illegible]	[illegible]	[illegible]
15:15:33	[illegible]	[illegible]	[illegible]	[illegible]
15:16:33	[illegible]	[illegible]	[illegible]	[illegible]
15:17:33	[illegible]	[illegible]	[illegible]	[illegible]
15:18:33	[illegible]	[illegible]	[illegible]	[illegible]
15:19:33	[illegible]	[illegible]	[illegible]	[illegible]
15:20:33	[illegible]	[illegible]	[illegible]	[illegible]
15:21:33	[illegible]	[illegible]	[illegible]	[illegible]
15:22:33	[illegible]	[illegible]	[illegible]	[illegible]
15:23:32	[illegible]	[illegible]	[illegible]	[illegible]
15:24:33	[illegible]	[illegible]	[illegible]	[illegible]
15:25:33	[illegible]	[illegible]	[illegible]	[illegible]
15:26:33	[illegible]	[illegible]	[illegible]	[illegible]
15:27:33	[illegible]	[illegible]	[illegible]	[illegible]
15:28:32	[illegible]	[illegible]	[illegible]	[illegible]
15:29:33	[illegible]	[illegible]	[illegible]	[illegible]
15:30:33	[illegible]	[illegible]	[illegible]	[illegible]
15:31:32	[illegible]	[illegible]	[illegible]	[illegible]
15:32:33	[illegible]	[illegible]	[illegible]	[illegible]
15:33:33	[illegible]	[illegible]	[illegible]	[illegible]
15:34:33	[illegible]	[illegible]	[illegible]	[illegible]
15:35:33	[illegible]	[illegible]	[illegible]	[illegible]
15:36:34	[illegible]	[illegible]	[illegible]	[illegible]

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OF POOR QUALITY

TABLE 3. (Concluded)

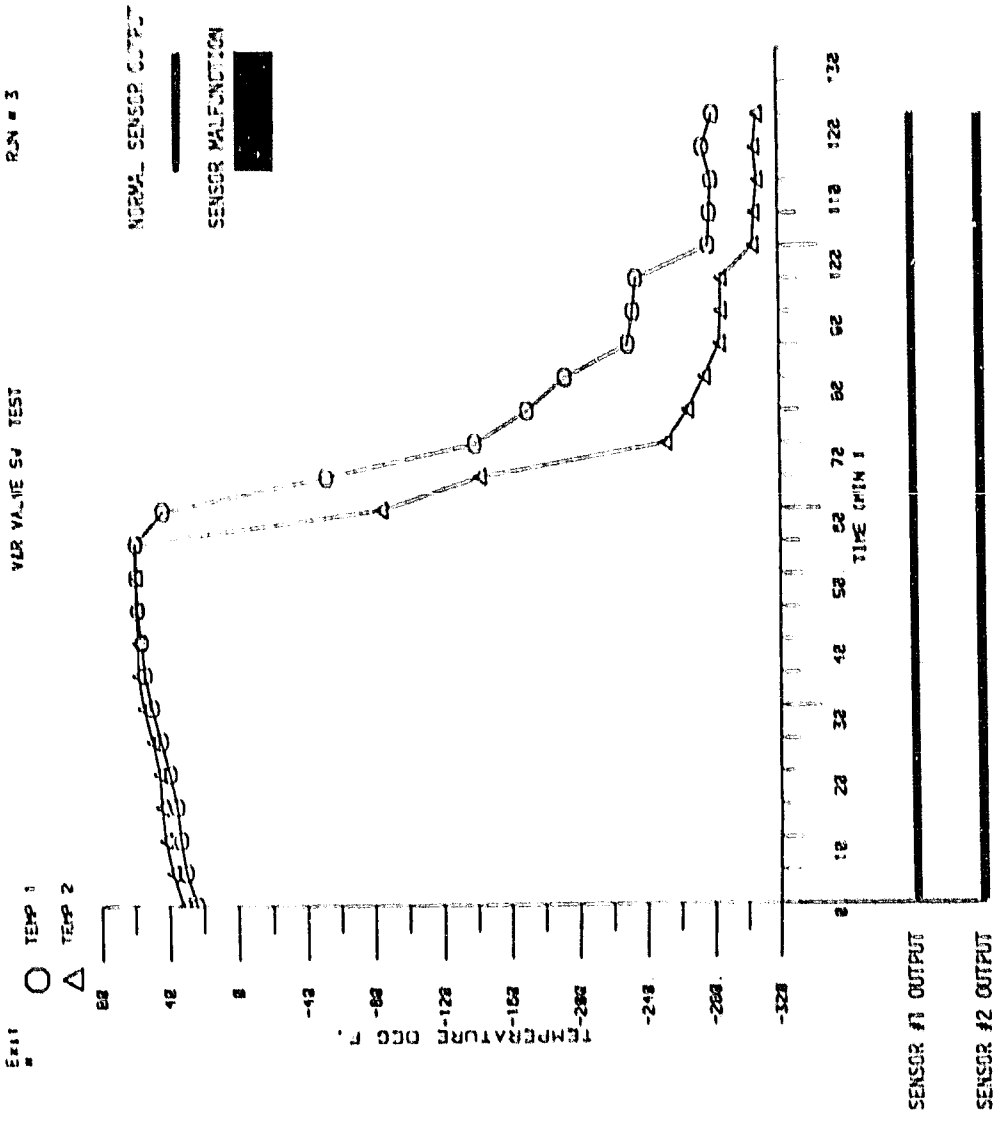


TABLE 4. THERMAL CYCLE NO. 4 GRAPH AND TEMPERATURE DATA

	TIME	T1	T2	T3	T4
	07:27:06	54.2	53.8	53.9	54.1
TIME 0 =	08:10:06	56.4	56.2	56.3	56.2
	08:11:06	56.4	56.4	56.3	56.3
	08:12:06	56.4	56.4	56.4	56.4
	08:13:06	56.3	56.4	56.3	56.4
	08:14:06	56.4	56.5	56.4	56.5
	08:15:06	56.3	56.5	56.4	56.5
	08:16:06	56.3	56.6	56.5	56.6
	08:17:06	56.3	56.7	56.5	56.7
	08:18:06	56.4	57.1	56.9	59.9
	08:19:06	56.5	59.1	58.4	63.3
	08:20:06	56.9	60.6	59.3	56.4
	08:21:06	51.9	22.8	29.5	-91 3
	08:22:06	38.0	-51.8	-25.2	-297.3
	08:23:06	12.8	-112.1	-69.1	-305.9
	08:24:06	-21.9	-167.8	-117.6	-306.5
	08:25:06	-57.1	-201.4	-150.8	-307.5
	08:26:06	-88.6	-218.9	-174.5	-307.9
	08:27:06	-116.7	-230.5	-194.3	-308.7
	08:28:06	-142.3	-241.4	-213.1	-309.1
	08:29:07	-166.1	-252.5	-230.9	-313.7
	08:30:07	-193.4	-261.4	-244.0	-314.2
	08:31:06	-212.0	-266.7	-252.6	-314.4
	08:32:06	-224.8	-272.1	-259.2	-314.4
	08:33:06	-230.6	-275.[illegible]	-262.6	-314.1
	08:34:06	-232.7	-277.9	-264.8	-314.4
	08:35:06	-232.9	-278.[illegible]	-265.1	-314.4
	08:36:06	-234.1	-279.1	-266.0	-314.1
	08:37:06	-234.4	-279.0	-266.4	-314 0
	08:38:06	-235.3	-279.3	-266.9	-314.1
	08:39:06	-235.9	-279.8	-267.4	-314.1
	08:40:06	-237.2	-280.2	-268.0	-314.4
	08:41:06	-238.1	-280.9	-268.6	-314.4
	08:42:06	-238.5	-280.[illegible]	-268.8	-314.0
	08:43:06	-238.8	-280.8	-269.3	-314.1
	08:44:06	-236.6	-280.5	-269.4	-313.8
	08:45:06	-229.3	-282.1	-269.5	-314.1
	08:46:07	-232.[illegible]	-282.0	-270.0	-313.8
	08:47:07	-236.1	-282.0	-270.4	-314.0
	08:48:06	-237.8	-281.4	-270.7	-314.1
	08:49:06	-241.4	-282.4	-271.5	-314.2
	08:50:06	-242.2	-281.7	-271.8	-314.0
	08:51:06	-241.6	-282.1	-271.8	-313.7
	08:52:06	-242.1	-282.4	-272.0	-313.8
	08:53:06	-242.7	-282.7	-272.5	-313.8
	08:54:06	-243.1	-283.3	-272.9	-314.0
	08:55:06	-243.8	-283.6	-273.2	-314.0
	08:56:06	-244.1	-283.7	-273.5	-313.7
	08:57:06	-244.2	-283.6	-273.8	-313.2
	08:58:06	-246.5	-284.6	-276.9	-313.0
	08:59:06	-257.9	-290.3	-288.8	-313.4
	09:00:06	-273.0	-295.6	-298.9	-313.2
	09:01:07	-283.0	-299.0	-303.2	-313.4
	09:02:07	-288.1	-301.5	-305.7	-313.3
	09:03:06	-291.0	-302.7	-307.4	-313.6
	09:04:06	-292.8	-303.4	-308.2	-313.7
	09:05:06	-293.3	-303.7	-307.8	-313.6
	09:06:06	-294.2	-304.2	-308.2	-314.2
	09:07:07	-294.5	-304.4	-307.6	-314.9
	09:08:07	-293.6	-303.9	-306.5	-314.5
	09:09:07	-293.1	-303.9	-306.3	-314.6
	09:10:06	-292.1	-303.5	-305.6	-314.8
	09:11:06	-289.3	-303.1	-303.1	-314 8
	09:12:06	-284.7	-301.8	-299.9	-314.8
	09:13:06	-279.4	-299.8	-295.8	-314.4
	09:14:07	-280.0	-297.1	-300.1	-309.0
	09:15:06	-291.7	-301.4	-307.1	-310.1
	09:16:06	-295.0	-303.2	-308.2	-310.7
	09:17:06	-296.2	-304.2	-308.6	-311.1
	09:18:06	-296.5	-304.6	-308.8	-311.5
	09:19:07	-297.0	-305.1	-309.2	-311.9
	09:20:07	-297.5	-305.6	-309.6	-312.5
	09:21:07	-298.6	-306.8	-310.3	-314.9
	09:22:06	-301.2	-308.8	-311.7	-315.5
	09:23:06	-301.7	-308.4	-311.3	-315.3
	09:24:06	-300.9	-308.2	-310.7	-315.5
	09:25:07	-299.2	-306.0	-309.6	-315.1
	09:26:07	-296.2	-305.6	-307.2	-313.8
	09:27:07	-293.1	-304.5	-305.4	-312.9
	09:28:06	-294.9	-304.5	-308.0	-312.5
	09:29:06	-300.3	-308.0	-311.3	-315.6
	09:30:06	-302.2	-308.7	-311.4	-315.6
	09:31:06	-302 3	-308.6	-311.3	-315.6
	09:32:07	-300 5	-308.0	-310.3	-315.3
	09:33:06	-299.9	-307.6	-309.9	-315.5
	09:34:06	-298 2	-307.1	-308.3	-315.5
	09:35:06	-295 1	-306.1	-305.2	-315.5
	09:36:06	-290.2	-304.4	-301.8	-315.2
	09:37:07	-284.3	-302.2	-298.3	-313.8
	09:38:07	-278.7	-298.4	-294.4	-314.0
	09:39:06	-275.6	-298.3	-293.6	-313.6
	09:40:06	-282.9	-301.4	-302.1	-315.3
	09:41:06	-292.5	-304.6	-305.9	-315.5
	09:42:06	-295.9	-306.0	-307.9	-315.5
	09:43:06	-295.4	-306.1	-306.5	-315.6
	09:44:06	-292.2	-305.1	-303.5	-315.5
	09:45:07	-287 2	-303.3	-300.3	-314.8
	09:46:06	-281.9	-301.7	-297.0	-315.2
	09:47:06	-275.1	-300.3	-294.9	-313.2
	09:48:06	-278.5	-297.0	-301.4	-311.1
	09:49:06	-293.6	-304.2	-309.1	-315.1
	09:50:07	-299.9	-307.1	-310.9	-315.5
	09:51:06	-300.5	-307.6	-310.7	-315.5
	09:52:07	-299.4	-307.8	-310.4	-315.6
	09:53:07	-298.6	-307.6	-309.8	-315.3
	09:54:07	-296.5	-307.2	-307.6	-315.5
	09:55:06	-292.6	-305.7	-304.5	-314.9
	09:56:06	-287.2	-303.1	-300.1	-315.2
	09:57:06	-282.0	-301.2	-296.7	-314.5
	09:58:06	-277.5	-298.9	-293.6	-314.5
	09:59:07	-277.2	-297.7	-298.1	-313.7
	10:00:07	-288.8	-303.4	-305.2	-315.6
	10:01:06	-294.7	-305.6	-308.3	-315.5
	10:02:06	-296.4	-306.8	-309.5	-315.5
	10:03:06	-295.5	-306.5	-308.3	-314.6
	10:04:06	-292.1	-304.5	-304.2	-315.1
	10:05:06	-288.1	-303.3	-301.0	-315.5
	10:06:06	-282.6	-301.6	-297.2	-314.9
	10:07:06	-277.9	-299.3	-293.9	-314.5

TABLE 4. (Concluded)

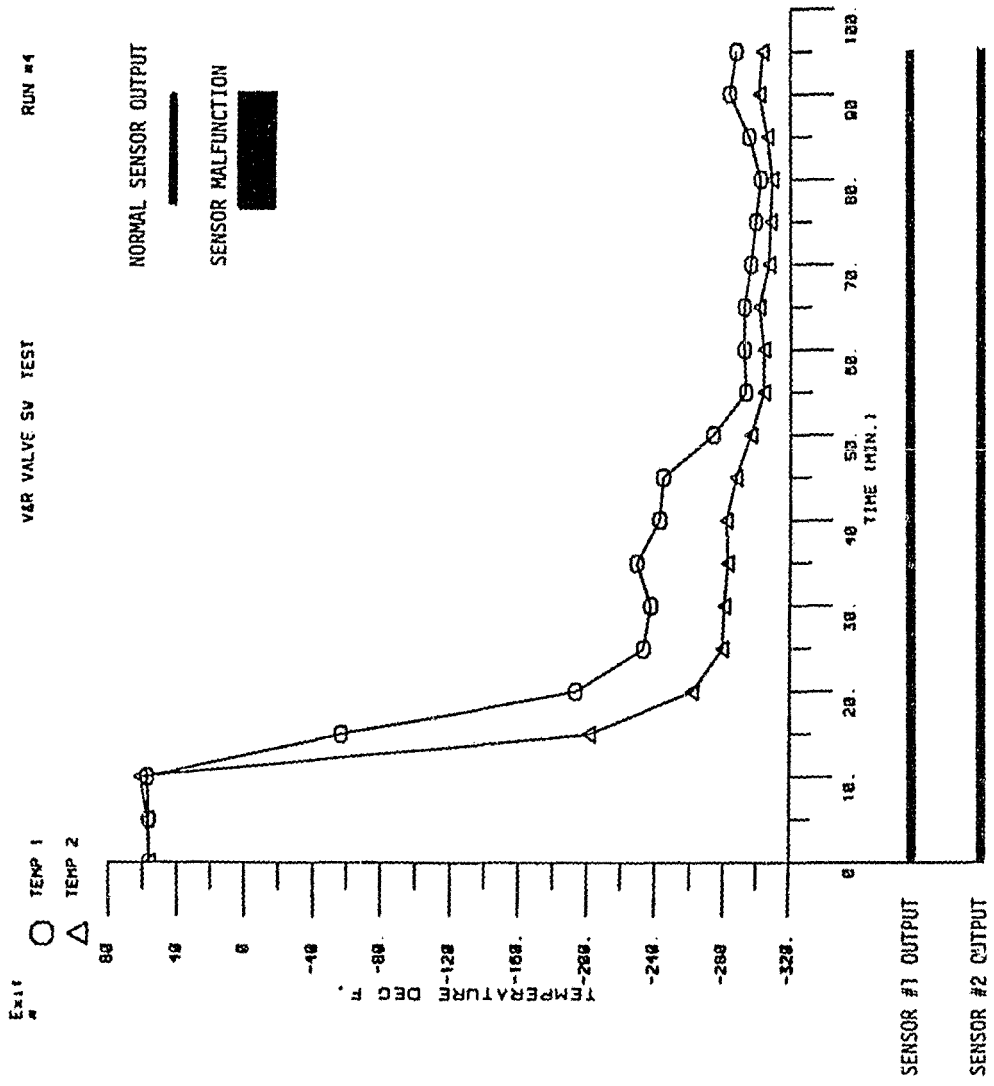


TABLE 5. THERMAL CYCLE NO. 5 GRAPH AND TEMPERATURE DATA

	TIME	T1	T2	T3	T4
	12:41:33	62.4	62.1	62.0	62.0
	12:42:33	62.2	62.2	62.0	62.2
	12:43:33	62.2	62.3	62.2	62.2
TIME 0 =	12:44:33	62.2	62.4	62.2	62.3
	12:46:34	62.0	62.4	62.2	62.5
	12:47:33	62.0	62.4	62.2	62.5
	12:48:18	62.2	62.6	62.4	62.7
	12:49:18	62.0	63.6	63.2	67.7
	12:50:18	62.0	65.7	64.7	69.1
	12:51:18	62.0	63.2	60.5	22.3
	12:52:18	56.7	18.5	30.8	-82.8
	12:53:18	44.1	-53.0	-23.6	-296.4
	12:54:18	20.8	-119.0	-73.7	-305.0
	12:55:19	-21.4	-175.7	-122.9	-305.2
	12:56:18	-58.7	-203.0	-153.6	-307.1
	12:57:18	-89.6	-219.4	-177.1	-307.8
	12:58:19	-119.4	-231.2	-197.3	-308.0
	12:59:19	-47.4	-242.7	-217.8	-308.4
	13:00:19	-174.8	-253.7	-237.8	-308.6
	13:01:19	-204.3	-266.3	-258.2	-313.2
	13:02:18	-299.0	-275.2	-274.1	-314.4
	13:03:18	-244.8	-282.2	-280.1	-314.6
	13:04:18	-248.5	-283.8	-280.5	-314.6
	13:05:18	-251.2	-285.4	-279.4	-314.4
	13:06:18	-250.8	-285.4	-278.2	-314.5
	13:07:18	-250.7	-285.8	-277.3	-314.1
	13:08:18	-247.5	-282.7	-275.8	-310.5
	13:09:18	-255.4	-285.7	-294.1	-308.8
	13:10:18	-278.8	-293.2	-302.7	-309.1
	13:11:18	-284.9	-296.0	-304.4	-313.2
	13:12:18	-285.5	-296.1	-305.4	-313.3
	13:13:18	-285.8	-296.9	-305.1	-313.6
	13:14:18	-285.9	-297.2	-306.3	-313.6
	13:15:18	-287.2	-297.6	-306.4	-313.4
	13:16:19	-287.2	-298.4	-307.5	-313.4
	13:17:19	-286.6	-299.5	-307.4	-313.6
	13:18:18	-288.6	-300.6	-309.0	-313.6
	13:19:18	-288.6	-301.5	-308.7	-313.4
	13:20:18	-287.1	-301.4	-307.9	-313.6
	13:21:18	-288.5	-302.0	-308.8	-313.6
	13:22:18	-288.3	-301.8	-308.8	-313.4
	13:23:18	-288.1	-302.1	-308.3	-313.6
	13:24:19	-288.3	-302.3	-309.4	-313.7
	13:25:18	-287.0	-302.2	-309.2	-313.7
	13:26:19	-288.9	-302.1	-309.5	-313.6
	13:27:19	-289.6	-302.5	-309.4	-313.7
	13:28:18	-287.5	-302.1	-309.8	-313.4
	13:29:18	-288.1	-302.5	-309.8	-313.6
	13:30:18	-286.4	-302.7	-309.0	-313.7
	13:31:18	-287.7	-302.7	-309.6	-313.6
	13:32:19	-282.7	-303.7	-309.4	-313.8
	13:33:19	-282.1	-303.3	-309.5	-313.8
	13:34:18	-282.2	-302.9	-310.2	-313.7
	13:35:18	-290.6	-303.9	-309.8	-313.6

TIME	T1	T2	T3	T4
13:36:18	-291.9	-304.6	-310.9	-313.8
13:37:18	-292.0	-304.5	-310.6	-314.0
13:38:19	-292.0	-304.3	-310.5	-313.7
13:39:19	-291.5	-304.5	-310.5	-313.6
13:40:18	-291.3	-304.3	-310.1	-313.6
13:41:18	-291.3	-304.4	-309.9	-313.6
13:42:18	-291.5	-304.6	-310.6	-313.6
13:43:19	-291.9	-304.8	-310.6	-313.6
13:44:18	-292.5	-304.8	-310.3	-313.7
13:45:18	-292.6	-305.0	-310.7	-313.8
13:46:18	-292.4	-304.8	-310.5	-313.6
13:47:19	-292.8	-305.0	-310.6	-313.7
13:48:18	-293.1	-305.1	-309.6	-313.6
13:49:18	-293.2	-305.1	-310.3	-313.7
13:50:18	-293.1	-305.2	-310.2	-313.7
13:51:18	-293.3	-305.6	-310.7	-313.6
13:52:18	-293.1	-305.4	-310.3	-313.6
13:53:19	-293.1	-305.7	-311.0	-313.6
13:54:18	-293.7	-305.9	-310.1	-313.7
13:55:18	-293.2	-306.0	-309.6	-313.7
13:56:18	-292.7	-305.9	-309.9	-313.7
13:57:18	-292.6	-305.7	-310.1	-313.7
13:58:18	-292.2	-306.1	-310.7	-313.6
13:59:18	-292.5	-306.1	-310.7	-313.6
14:00:19	-292.4	-306.4	-310.7	-313.6
14:01:18	-292.6	-306.5	-309.8	-313.7
14:02:18	-293.1	-306.5	-309.9	-313.8
14:03:18	-292.6	-306.5	-309.9	-313.7
14:04:18	-293.0	-306.7	-310.2	-313.8
14:05:18	-293.1	-306.4	-310.3	-313.6
14:06:19	-292.6	-306.4	-310.9	-313.6
14:07:18	-293.3	-306.8	-309.8	-313.8
14:08:18	-293.9	-307.1	-310.5	-313.7
14:09:18	-294.3	-306.9	-310.5	-313.8
14:10:19	-293.6	-306.7	-310.5	-313.7
14:11:18	-293.6	-306.7	-310.2	-313.6
14:12:19	-293.2	-306.5	-310.6	-313.4
14:13:18	-294.5	-306.9	-309.8	-313.7
14:14:18	-294.9	-307.1	-310.5	-313.8
14:15:18	-294.9	-307.4	-310.2	-314.0
14:16:19	-294.8	-307.1	-310.5	-313.8
14:17:18	-294.9	-307.5	-310.7	-313.7

TABLE 5. (Concluded)

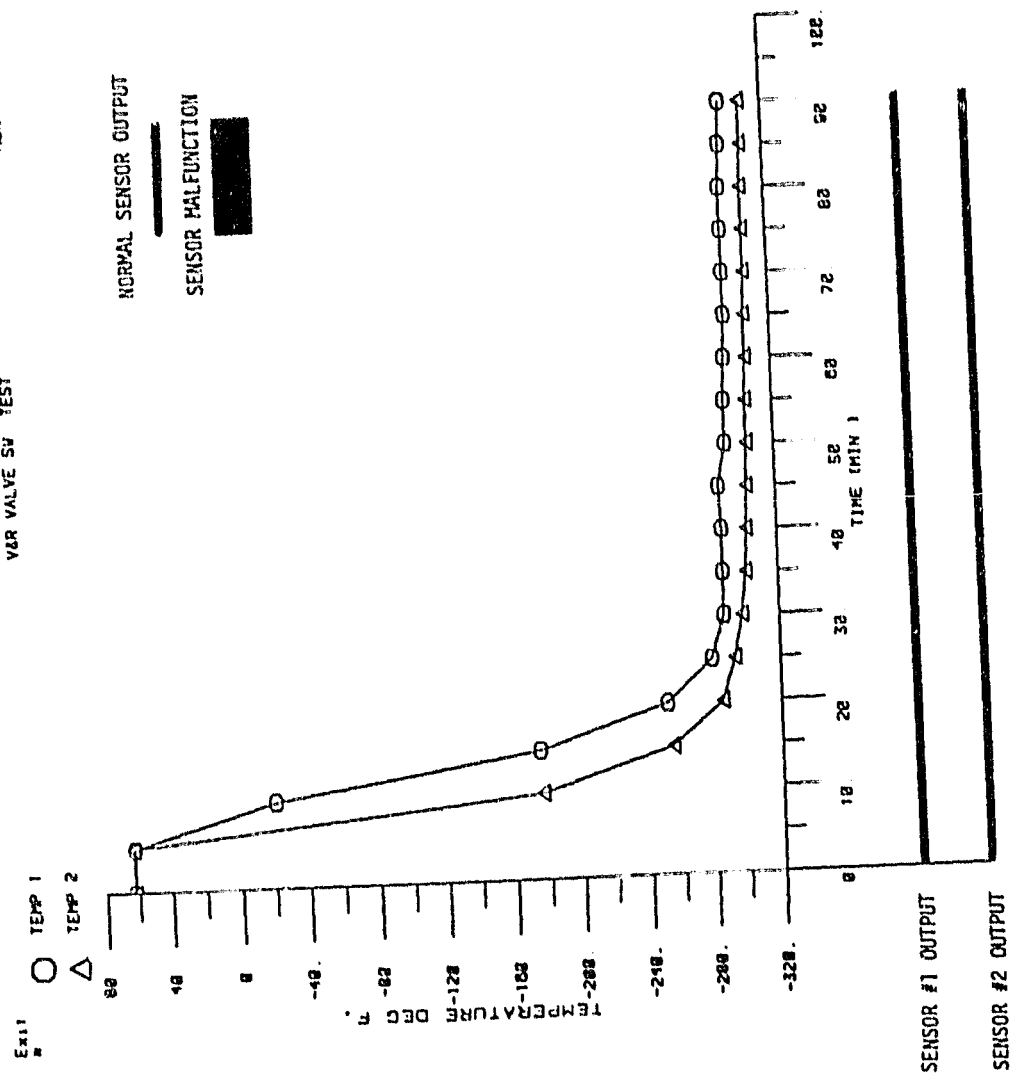


TABLE 6. THERMAL CYCLE NO. 6 GRAPH AND TEMPERATURE DATA

	TIME	T1	T2	T3	T4
	15:37:04	53.6	60.5	57.9	64.0
	15:38:06	54.5	60.9	58.5	63.1
	15:39:05	55.1	60.7	58.6	62.5
TIME 0 =	15:40:05	55.5	60.2	58.5	62.0
	15:41:05	55.9	60.1	58.5	61.6
	15:42:05	56.2	59.9	58.5	61.3
	15:43:05	56.5	59.7	58.5	61.6
	15:44:05	56.7	59.7	58.6	60.9
	15:45:05	57.0	59.6	58.6	60.7
	15:46:05	57.2	59.6	58.8	60.7
	15:47:05	57.4	59.6	58.8	60.5
	15:48:05	57.6	59.6	58.8	60.8
	15:49:05	57.6	59.9	59.1	60.8
	15:50:05	57.4	59.3	58.7	58.0
	15:51:05	57.1	57.8	57.6	55.2
	15:52:06	54.9	41.9	42.8	-32.7
	15:53:06	47.0	-24.8	- 6.9	-280.2
	15:54:05	28.4	-110.3	-73.6	-299.8
	15:55:05	-26.3	-175.5	-128.3	-300.9
	15:56:05	-69.5	-206.4	-161.0	-303.1
	15:57:05	-105.5	-223.4	-185.4	-306.5
	15:58:05	-135.9	-237.3	-207.6	-305.4
	15:59:06	-164.7	-249.8	-229.2	-305.9
	16:00:06	-197.2	-262.8	-255.5	-307.4
	16:01:05	-237.2	-277.0	-281.3	-307.9
	16:02:05	-266.2	-288.0	-296.4	-308.0
	16:03:05	-276.7	-292.6	-301.7	-313.2
	16:04:05	-278.3	-296.2	-302.5	-314.0
	16:05:05	-277.7	-297.0	-302.2	-314.5
	16:06:06	-277.8	-296.2	-301.6	-314.2
	16:07:05	-277.7	-294.3	-300.9	-314.1
	16:08:05	-276.7	-294.3	-301.5	-313.6
	16:09:05	-280.4	-294.8	-303.2	-311.9
	16:10:06	-285.0	-297.0	-305.0	-311.5
	16:11:06	-286.6	-298.1	-305.6	-311.7
	16:12:06	-286.9	-298.7	-305.7	-311.8
	16:13:05	-288.0	-298.7	-306.3	-311.7
	16:14:05	-288.1	-298.7	-306.5	-311.8
	16:15:05	-289.1	-298.6	-306.8	-311.8
	16:16:05	-289.3	-299.2	-306.9	-311.8
	16:17:06	-289.7	-299.4	-306.7	-311.8
	16:18:06	-290.0	-300.1	-306.7	-311.9
	16:19:06	-290.4	-300.7	-306.8	-311.7
	16:20:06	-291.3	-301.4	-307.2	-311.9
	16:21:05	-291.9	-301.5	-307.9	-311.6
	16:22:05	-289.7	-302.5	-307.9	-311.8
	16:23:05	-290.2	-302.8	-308.4	-311.7
	16:24:05	-289.8	-303.3	-308.6	-311.9
	16:25:06	-289.3	-303.3	-308.6	-311.9
	16:26:06	-289.2	-303.9	-308.8	-311.9
	16:27:06	-288.6	-303.9	-309.0	-311.9
	16:28:06	-289.2	-303.9	-309.2	-312.1
	16:29:05	-288.9	-303.5	-309.8	-311.9

TIME	T1	T2	T3	T4
16:30:05	-289.1	-303.7	-309.8	-312.1
16:31:05	-289.7	-304.2	-309.9	-312.1
16:32:06	-289.3	-304.2	-309.6	-311.9
16:33:05	-289.2	-304.0	-310.3	-311.9
16:34:05	-289.4	-304.0	-310.2	-311.8
16:35:05	-289.2	-304.3	-310.2	-311.8
16:36:05	-288.0	-304.4	-310.3	-311.9
16:37:06	-287.8	-304.4	-310.3	-311.8
16:38:05	-287.5	-304.3	-310.6	-311.8
16:39:05	-287.5	-304.4	-310.7	-311.8
16:40:05	-288.3	-304.4	-310.6	-311.5
16:41:05	-289.3	-304.5	-310.6	-311.7
16:42:06	-289.2	-304.6	-310.6	-311.5
16:43:06	-288.9	-304.9	-310.9	-311.7
16:44:05	-289.1	-304.8	-310.7	-311.5
16:45:06	-290.0	-304.9	-311.0	-311.7
16:46:06	-290.9	-305.2	-311.0	-311.7
16:47:06	-291.3	-305.1	-310.7	-311.5
16:48:05	-292.4	-305.0	-310.2	-311.5
16:49:05	-292.2	-305.1	-310.2	-311.7
16:50:05	-293.8	-304.9	-310.2	-311.4
16.51:05	-294.3	-305.2	-310.2	-311.5
16:52:05	-294.8	-305.1	-310.2	-311.7
16:53:05	-293.9	-305.4	-310.3	-311.7
16:54:05	-294.5	-305.2	-310.5	-311.7
16:55:05	-294.7	-305.5	-310.3	-311.5
16:56:06	-294.8	-305.1	-310.2	-311.3
16:57:05	-295.5	-305.1	-309.8	-311.4
16:58:05	-296.4	-305.2	-309.9	-311.5
16:59:05	-296.7	-305.2	-309.9	-311.5
17:00:05	-296.4	-305.4	-309.9	-311.4
17:01:05	-296.5	-305.5	-310.1	-311.5
17:02:06	-296.5	-305.2	-309.9	-311.4
17:03:05	-297.3	-305.5	-309.8	-311.7
17:04:05	-297.8	-305.5	-309.8	-311.7
17:05:05	-297.6	-305.6	-309.9	-311.7
17:06:05	-297.6	-305.5	-309.9	-311.7
17:07:06	-297.5	-305.5	-309.9	-311.5
17:08:05	-297.6	-305.7	-309.8	-311.7
17:09:05	-297.2	-305.9	-309.8	-311.7
17:10:05	-297.9	-305.9	-309.9	-311.7
17:11:05	-298.1	-306.0	-310.1	-311.7
17:12:06	-298.2	-305.9	-310.1	-311.7
17:13:05	-297.6	-306.3	-309.9	-311.8
17:14:05	-297.3	-306.3	-309.9	-311.7
17:15:05	-297.6	-306.3	-310.1	-311.7
17:16:06	-297.8	-307.9	-311.4	-312.1
17:17:06	-287.2	-302.9	-304.8	-315.5

TABLE 6. (Concluded)

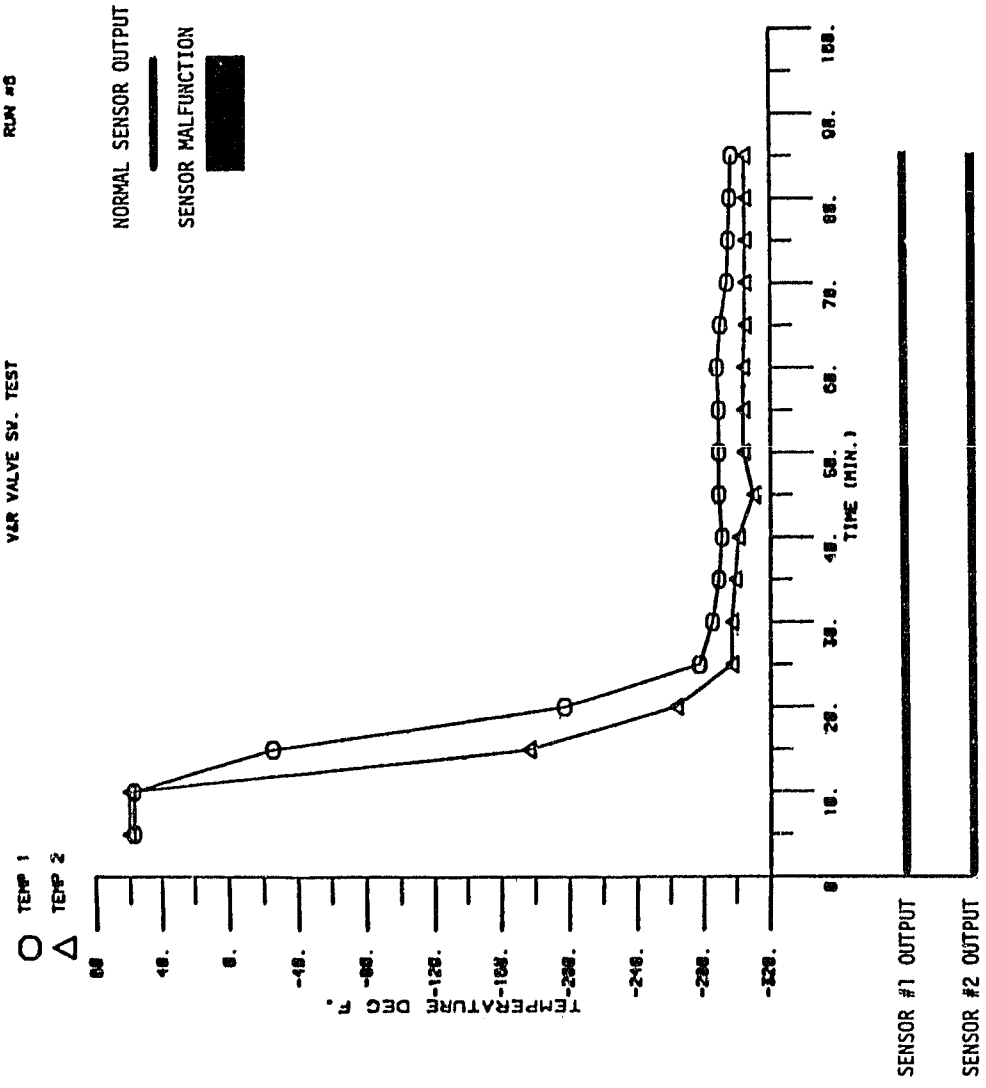


TABLE 7. THERMAL CYCLE NO. 7 GRAPH AND TEMPERATURE DATA

	TIME	T1	T2	T3	T4
	08:12:13	76.9	77.0	77.0	77.1
	08:13:13	76.7	77.1	77.0	77.1
	08:14:13	76.6	77.1	76.9	77.1
TIME 0 =	08:15:13	76.4	77.2	76.9	77.2
	08:16:13	76.1	77.1	76.1	77.1
	08:17:13	76.0	77.2	76.7	77.2
	08:18:13	75.8	77.1	76.6	77.2
	08:19:12	75.7	77.0	76.7	77.1
	08:20:12	75.5	77.0	76.5	77.1
	08:20:28	75.5	77.0	76.5	77.2
	08:21:28	75.0	77.0	76.3	77.2
	08:22:28	74.0	73.3	69.9	24.7
	08:23:27	56.7	-2.2	-19.0	-241.5
	08:24:27	-26.3	-209.8	-192.0	-290.3
	08:25:27	-105.4	-247.8	-213.9	-304.9
	08:26:27	-152.1	-253.9	-236.0	-306.1
	08:27:27	-186.9	-264.7	-259.6	-310.5
	08:28:27	-216.2	-277.3	-277.3	-311.4
	08:29:27	-241.3	-287.2	-291.1	-305.1
	08:30:27	-262.3	-292.4	-296.4	-304.0
	08:31:27	-265.2	-294.4	-299.7	-310.1
	08:32:27	-268.3	-297.3	-301.5	-311.0
	08:33:27	-270.5	-298.2	-301.7	-308.6
	08:34:27	-282.0	-302.3	-297.1	-299.8
	08:35:27	-275.7	-296.2	-299.2	-306.8
	08:36:27	-276.9	-298.2	-301.1	-304.3
	08:37:27	-280.3	-296.5	-297.8	-301.1
	08:38:27	-281.2	-296.1	-297.9	-301.4
	08:39:27	-282.6	-296.5	-298.1	-301.4
	08:40:27	-283.5	-296.7	-298.7	-301.4
	08:41:28	-284.0	-297.1	-298.4	-301.2
	08:42:28	-284.3	-297.2	-298 2	-301.4
	08:43:27	-284.0	-298.3	-299.3	-301.4
	08:44:27	-284.9	-298.2	-298.6	-301.6
	08:45:27	-285.9	-298.6	-299.4	-301.7
	08:46:27	-285.9	-298.1	-299.2	-301.7
	08:47:27	-283.6	-298.3	-299.9	-301.6
	08:48:28	-282.2	-298.9	-300.1	-301.8
	08:49:28	-282.1	-298.6	-300.3	-302.0
	08:50:27	-285.0	-299.4	-300.7	-302.1
	08:51:27	-285.8	-299.3	-300.3	-302.2
	08:52:27	-285.9	-299.2	-300.6	-302.2
	08:53:27	-286.3	-299.4	-300.4	-302.2
	08:54:28	-286.5	-299.7	-300.5	-302.2
	08:55:28	-286.9	-299.5	-300.5	-302.5
	08:56:27	-288.0	-299.9	-300.6	-302.5
	08:57:27	-288.3	-300.3	-300.9	-302.6
	08:59:27	-288.0	-300.0	-300.7	-302.6
	08:59:27	-288.0	-300.5	-300.7	-302.5
	09:00:27	-288.2	-300.3	-300.7	-302.6
	09:01:27	-288.0	-300.3	-300.9	-302.7
	09:02:28	-288.3	-300.5	-300.7	-302.7
	09:03:27	-288.6	-300.7	-300.7	-302.9
	09:04:27	-288.7	-300.7	-300.7	-302.7
	09:05:27	-289.3	-300.6	-301.0	-302.9
	09:06:27	-289.6	-300.6	-300.9	-302.9
	09:07:27	-289.8	-300.9	-301.1	-302.9
	09:08:28	-290.2	-300.9	-301.2	-303.3
	09:09:28	-290.2	-301.0	-301.6	-303.3
	09:10:27	-290.4	-301.0	-301.4	-303.4
	09:11:27	-290.4	-301.0	-301.5	-303.4
	09:12:27	-290.6	-301.4	-301.5	-303.4
	09:13:27	-290.6	-301.2	-301.6	-303.5
	09:14:27	-290.9	-301.5	-301.8	-303.7
	09:15:28	-290.9	-301.6	-302.1	-303.7
	09:16:27	-291.0	-301.6	-302.3	-303.9
	09:17:27	-290.6	-301.7	-302.2	-303.7
	09:18:28	-290.5	-301.8	-302.6	-290.5
	09:19:28	-291.0	-301.8	-302.8	-303.9
	09:21:28	-290.6	-302.0	-302.8	-303.8
	09:22:28	-291.3	-302.0	-303.1	-304.0
	09:23:27	-291.3	-301.8	-302.3	-303.9
	09:24:27	-291.5	-302.0	-302.5	-303.9
	09:25:27	-291.3	-302.0	-302.7	-304.0
	09:26:27	-291.3	-302.2	-302.8	-304.2
	09:27:27	-291.3	-301.8	-302.7	-304.2
	09:28:27	-291.1	-302.1	-302.8	-304.2
	09:29:27	-291.4	-302.2	-302.8	-304.3
	09:30:27	-291.4	-302.3	-303.1	-304.3
	09:31:27	-291.4	-302.3	-303.2	-304.4
	09:32:27	-291.3	-302.6	-303.4	-304.3
	09:33:27	-289.3	-302.6	-303.7	-304.5
	09:34:27	-289.6	-302.6	-304.0	-304.5
	09:35:27	-290.4	-302.9	-304.2	-304.5
	09:36:28	-291.4	-302.8	-304.3	-304.6
	09:37:27	-290.8	-302.9	-304.2	-304.6
	09:38:28	-291.1	-303.1	-304.4	-304.6
	09:39:27	-290.5	-303.2	-304.4	-304.8
	09:40:28	-292.2	-303.1	-304.4	-304.9
	09:41:28	-292.4	-303.3	-304.4	-304.8
	09:42:28	-289.8	-302.7	-304.2	-304.9
	09:43:27	-289.6	-303.1	-305.1	-305.6
	09:44:27	-285.3	-304.2	-305.0	-315.5
	09:45:27	-275.1	-296.1	-299.8	-315.1
	09:46:27	-283.6	-305.2	-304.6	-315.5

TABLE 7. (Concluded)

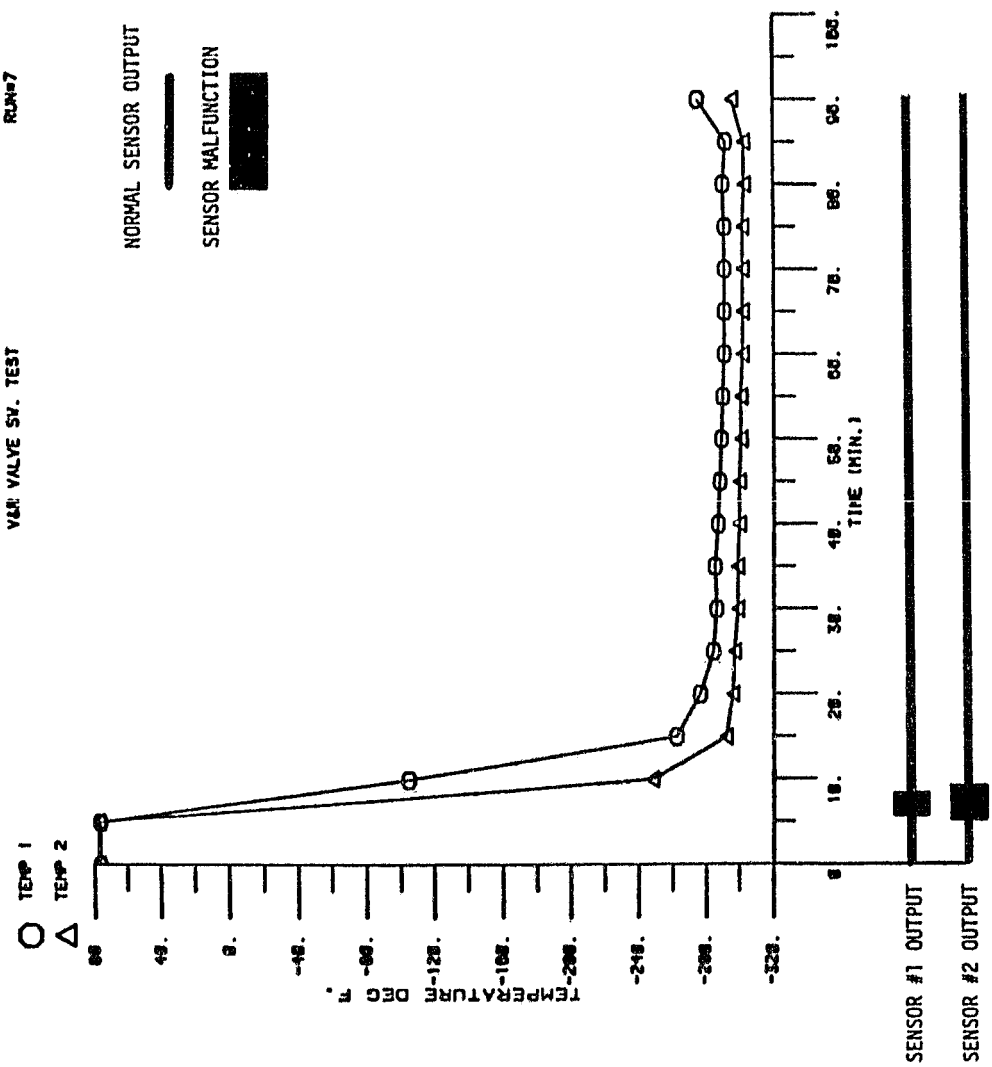


TABLE 8. THERMAL CYCLE NO. 8 GRAPH AND TEMPERATURE DATA

	TIME	T1	T2	T3	T4
	12:52:52	52.0	51.0	51.1	50.9
	12:53:52	51.7	51.7	51.2	51.0
	12:54:52	51.6	51.2	51.2	51.0
TIME 0 =	12:55:52	51.6	51.3	51.3	51.1
	12:56:53	51.5	51.3	51.3	51.2
	12:57:53	51.7	51.5	51.5	51.5
	12:58:53	51.7	51.6	51.5	51.5
	12:59:52	51.7	51.7	51.6	51.6
	13:00:52	51.7	51.8	51.7	52.6
	13:01:52	51.6	53.0	52.7	56.8
	13:02:52	51.9	55.1	54.2	56.8
	13:03:52	48.0	31.2	22.9	-83.9
	13:04:52	29.8	-73.2	-57.1	-292.2
	13:05:52	-22.2	-173.6	-134.4	-297.5
	13:06:53	-77.4	-218.8	-175.7	-299.9
	13:07:53	-120.0	-233.6	-202.0	-307.9
	13:08:52	-154.1	-246.3	-225.3	-309.0
	13:09:52	-185.5	-258.6	-248.9	-309.2
	13:10:52	-216.2	-271.6	-271.8	-309.2
	13:11:52	-244.9	-281.9	-290.8	-309.5
	13:12:52	-262.7	-289.1	-299.3	-309.8
	13:13:53	-269.0	-291.5	-300.6	-311.8
	13:14:53	-270.9	-294.1	-301.6	-312.4
	13:15:52	-272.2	-293.9	-301.8	-312.2
	13:16:52	-273.8	-294.5	-302.7	-311.7
	13:17:52	-276.3	-295.4	-303.8	-310.9
	13:18:52	-277.3	-296.6	-303.7	-310.7
	13:19:53	-277.5	-297.8	-304.0	-311.0
	13:20:53	-278.2	-298.4	-303.9	-310.6
	13:21:52	-280.1	-298.1	-304.5	-310.2
	13:22:52	-280.6	-298.4	-304.6	-310.1
	13:23:52	-280.6	-299.0	-304.4	-309.4
	13:24:52	-280.5	-298.7	-304.3	-309.4
	13:25:52	-281.9	-299.5	-304.6	-309.4
	13:26:53	-282.5	-300.0	-304.5	-309.2
	13:27:53	-283.7	-300.6	-304.6	-309.2
	13:28:53	-285.2	-300.9	-304.8	-309.2
	13:29:52	-285.3	-300.6	-305.4	-309.2
	13:30:52	-286.1	-300.6	-305.2	-309.1
	13:31:52	-285.7	-300.9	-305.4	-309.2
	13:32:53	-285.8	-300.9	-305.5	-309.4
	13:33:53	-286.0	-301.1	-305.7	-309.0
	13:34:53	-285.7	-301.4	-305.9	-309.4
	13:35:52	-284.9	-301.0	-306.4	-309.5
	13:36:52	-285.5	-301.4	-306.4	-309.5
	13:37:52	-285.9	-301.6	-306.5	-309.5
	13:38:52	-286.4	-302.0	-306.5	-309.6
	13:39:52	-287.5	-302.2	-306.5	-309.5
	13:40:53	-287.5	-302.1	-306.3	-309.4
	13:41:53	-287.7	-302.1	-306.5	-309.4
	13:42:53	-287.6	-302.0	-306.5	-309.4
	13:43:52	-282.5	-304.2	-306.9	-309.2
	13:44:52	-283.1	-304.0	-307.4	-309.2
	13:45:37	-283.3	-304.3	-307.4	-309.4

TIME	T1	T2	T3	T4
13:46:52	-283.7	-304.4	-307.2	-309.2
13:47:52	-283.8	-304.4	-307.2	-309.1
13:48:53	-284.3	-304.5	-307.1	-309.2
13:49:53	-283.7	-304.6	-307.1	-283.7
13:50:53	-283.2	-304.6	-307.2	-309.4
13:51:53	-283.0	-304.8	-307.4	-309.4
13:52:52	-285.5	-304.5	-307.5	-309.2
13:53:52	-285.9	-304.8	-307.5	-309.4
13:54:52	-286.6	-304.8	-307.4	-309.1
13:55:52	-287.0	-304.8	-307.6	-309.2
13:56:52	-288.5	-304.9	-307.5	-309.1
13:57:52	-289.6	-304.9	-307.8	-309.4
13:58:52	-291.6	-305.0	-307.6	-309.1
13:59:52	-291.4	-305.1	-308.0	-309.1
14:00:52	-292.7	-305.7	-309.1	-310.0
14:01:52	-293.2	-306.5	-309.4	-310.9
14:02:52	-293.6	-306.1	-309.1	-310.6
14:03:52	-293.4	-306.4	-309.2	-310.7
14:04:53	-294.1	-306.5	-309.6	-311.8
14:05:53	-294.9	-307.4	-310.1	-312.1
14:06:53	-295.1	-307.4	-310.2	-312.1
14:07:52	-295.5	-307.6	-310.6	-312.2
14:08:52	-295.3	-307.6	-310.5	-312.1
14:09:52	-295.5	-307.6	-310.5	-312.1
14:10:53	-295.3	-307.9	-310.6	-312.2
14:11:53	-295.4	-307.8	-310.6	-312.1
14:12:52	-296.1	-307.5	-310.6	-312.1
14:13:52	-296.0	-307.6	-310.6	-312.2
14:14:52	-296.0	-307.6	-310.6	-312.1
14:15:52	-295.9	-307.6	-310.7	-312.2
14:16:52	-296.1	-307.8	-310.6	-312.1
14:17:53	-295.4	-307.8	-310.6	-312.2
14:18:53	-296.4	-308.2	-310.6	-312.2
14:19:53	-296.0	-307.8	-310.7	-312.1
14:20:53	-295.5	-307.8	-310.9	-312.4
14:21:53	-295.6	-307.6	-310.6	-312.2
14:22:53	-295.9	-307.8	-310.6	-312.4
14:23:52	-297.9	-307.8	-310.6	-312.4
14:24:52	-297.9	-307.8	-310.7	-312.2
14:25:52	-297.5	-308.0	-310.9	-312.4
14:26:53	-297.2	-308.2	-311.0	-312.4
14:27:52	-297.8	-308.0	-311.5	-313.7
14:28:52	-297.9	-309.0	-312.1	-314.8
14:29:52	-299.7	-309.2	-312.8	-315.3
14:30:52	-300.8	-310.2	-309.4	-315.6

TABLE 8. (Concluded)

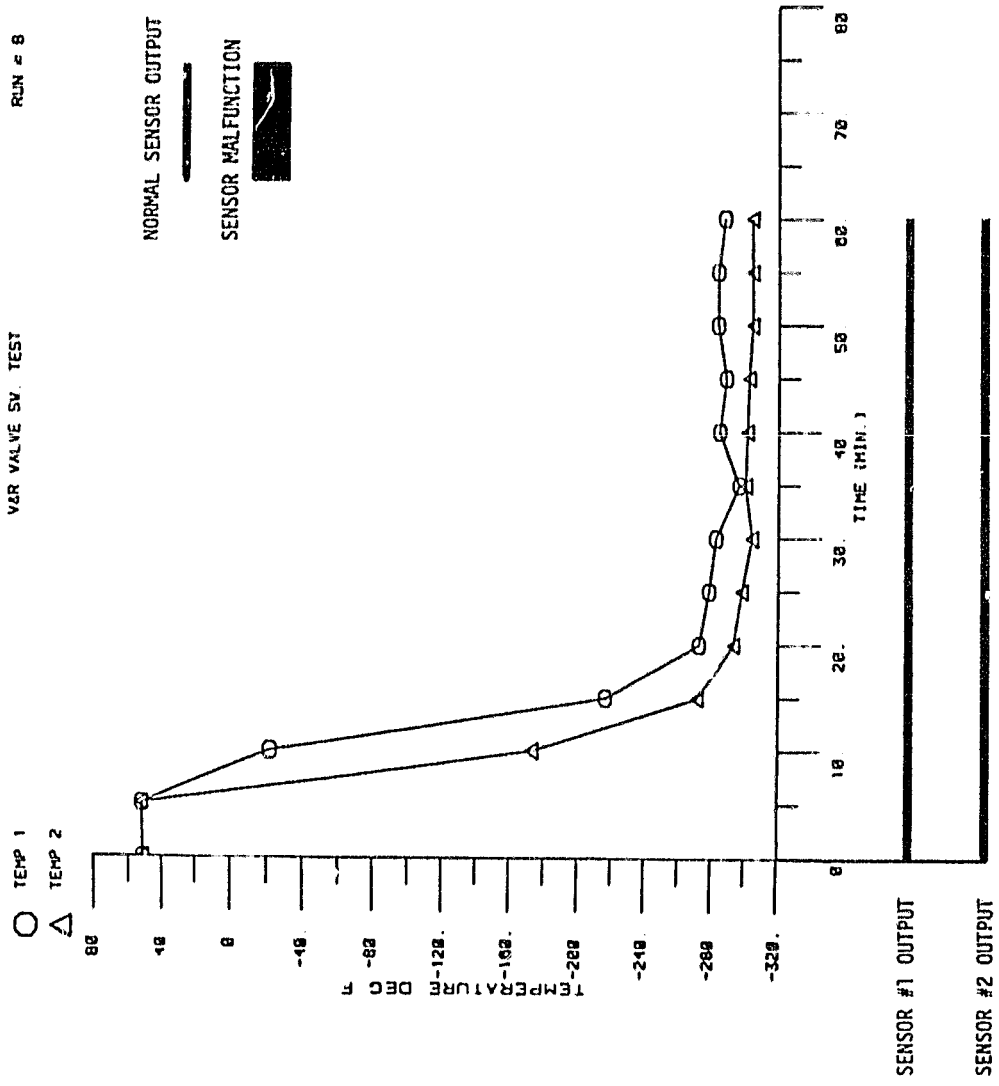


TABLE 9. THERMAL CYCLE NO. 9 GRAPH AND TEMPERATURE DATA

	TIME	T1	T2	T3	T4
	08:11:28	60.2	60.3	60.2	61.2
	08:12:28	60.1	60.3	60.3	61.3
	08:13:28	60.1	60.4	60.4	61.4
	08:14:29	59.9	60.5	60.2	61.4
TIME 0 =	08:15:29	59.9	60.5	60.2	61.4
	08:16:29	59.8	60.5	60.2	61.4
	08:17:29	59.7	60.5	60.2	61.4
	08:18:29	59.6	60.4	60.2	61.4
	08:19:29	59.6	60.6	60.2	61.6
	08:20:29	59.6	61.4	60.8	55.0
	08:21:29	33.4	-39.2	-51.4	-274.4
	08:22.29	-49.6	-218.0	-194.6	-290.9
	08.23:29	-145.0	-282.4	-270.8	-293.2
	08:24:29	-249.9	-292 5	-291.0	-295.3
	08:25:28	-277.1	-297.9	-294.8	-296.1
	08:26:28	-283.3	-300.3	-296.2	-296.5
	08:27:28	-285.8	-307.8	-297.2	-296.9
	08:28:28	-287.0	-315.5	-297.8	-297.1
	08:29:28	-288.8	-314.4	-298.1	-297.3
	08:30:29	-288.2	-313.0	-300.3	-299.0
	08:31:28	-289.7	-304.3	-300.3	-299.7
	08:32:28	-290.6	-303.7	-300.5	-299.8
	08:33:29	-291.9	-301.2	-300.7	-300.0
	08:34:28	-293.0	-298.9	-301.2	-300.4
	08:35:28	-293.1	-298.7	-301.2	-300.5
	08:36:29	-293.2	-299.2	-302.5	-301.5
	08:37:28	-293.8	-299.5	-302.7	-301.6
	08:38:28	-293.2	-299.5	-303.2	-302.0
	08:39:29	-293.7	-300.4	-303.7	-302.6
	08:40:28	-294.1	-300.3	-303.7	-302.6
	08:41:28	-294.9	-300.9	-303.8	-302.7
	08:42:29	-293.0	-300.5	-304.3	-303.2
	08:43:28	-293.6	-301.5	-304.6	-303.7
	08:44:28	-294.2	-301.6	-304.8	-303.7
	08:45:29	-294.1	-301.5	-304.5	-304.9
	08:46:29	-295.8	-302.5	-305.5	-304.9
	08:47:28	-295.4	-302.8	-305.6	-305.0
	08:48:28	-296.7	-302.7	-306.8	-306.0
	08:49:28	-297.6	-304.4	-307.2	-306.4
	08:50:28	-297.6	-305.4	-308.8	-308.3
	08:51:28	-297.3	-305.7	-310.2	-310.1
	08:52:28	-297.5	-307.1	-311.0	-310.9
	08:53:28	-297.6	-307.6	-311.7	-312.1
	08:54:28	-299.2	-308.0	-312.2	-312.5
	08:55:28	-299.3	-308.7	-311.9	-313.3
	08:56:28	-298.2	-308.6	-312.1	-313.4
	08:57:28	-297.6	-308.2	-311.4	-313.3
	08:58:28	-297.2	-308.2	-311.4	-313.3
	08:59:28	-296.9	-308.3	-311.4	-313.3
	09:00:29	-297.7	-308.3	-311.3	-313.3
	08:01:28	-297.1	-308.0	-311.7	-313.2
	08:02:28	-297.9	-308.3	-311.5	-313.2
	09:03:28	-297.8	-308.0	-311.7	-313.3
	09:04:28	-297.3	-308.2	-311.5	-313.4

TIME	T1	T2	T3	T4
09:05:28	-297.5	-308.0	-311.0	-313.3
09:06:28	-298.1	-307.9	-311.1	-313.4
09:07:29	-297.7	-308.0	-311.1	-313.2
09:08:29	-296.9	-308.2	-311.3	-313.4
09:09:28	-298.3	-308.4	-311.4	-313.6
09:10:28	-297.5	-308.2	-310.7	-313.4
09:11:29	-297.8	-308.4	-311.1	-313.3
09:12:28	-297.2	-308.4	-311.3	-313.6
09:13:28	-296.9	-308.3	-311.4	-313.4
09:14:29	-297.1	-308.4	-311.0	-313.3
09:15:29	-296.9	-308.4	-310.9	-313.4
09:16:29	-296.9	-308.4	-311.3	-313.4
09:17:29	-296.5	-308.6	-311.1	-313.3
09:18:29	-297.0	-308.4	-311.0	-313.4
09:19:28	-297.6	-308.8	-311.7	-313.6
09:20:28	-297.8	-308.6	-311.7	-313.4
09:21:28	-297.2	-308.7	-311.4	-313.6
09:22:28	-297.3	-308.6	-311.4	-313.4
09:23:28	-297.0	-308.6	-311.8	-313.6
09:24:28	-297.3	-308.6	-311.8	-313.6
09:25:28	-297.9	-308.8	-311.8	-313.6
09:26:28	-297.9	-308.8	-311.4	-313.3
09:27:28	-297.8	-309.0	-311.9	-313.6
09:28:28	-297.8	-309.1	-311.3	-313.6
09:29:28	-298.1	-309.0	-311.7	-313.6
09:30:28	-297.5	-309.2	-311.1	-313.4
09:31:28	-297.7	-308.8	-311.7	-313.6
09:32:29	-297.6	-308.7	-311.4	-313.8
09:33:29	-297.1	-308.8	-311.3	-313.7
09:34:29	-297.7	-309.2	-311.1	-313.7
09:35:29	-296.7	-309.0	-310.7	-313.7

TABLE 9. (Concluded)

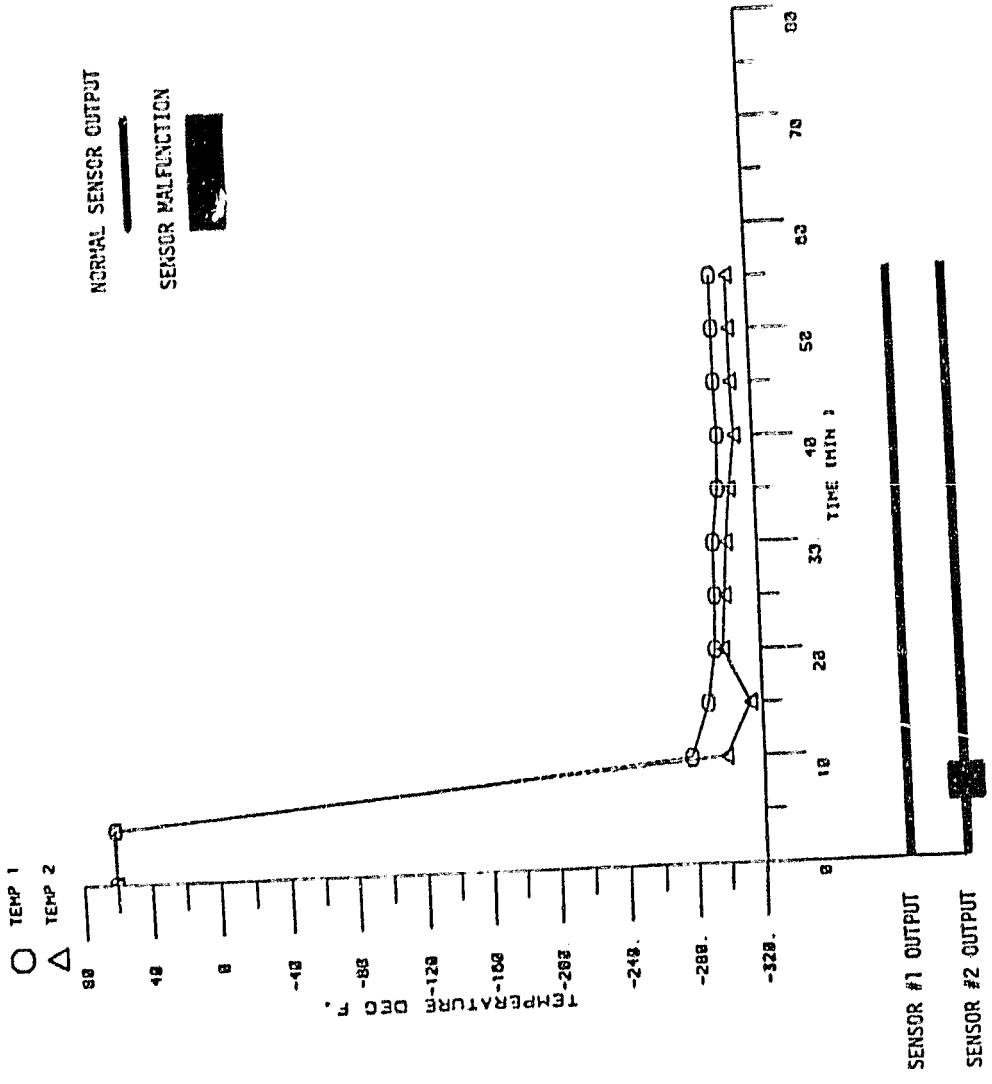


TABLE 10. THERMAL CYCLE NO. 10 GRAPH AND TEMPERATURE DATA

	TIME	T1	T2	T3	T4
	08:06:49	61.1	61.1	61.0	61.1
	08:07:50	61.1	61.2	61.1	61.2
	08:08:50	61.0	61.3	61.1	61.3
	08:09:50	61.0	61.4	61.1	61.4
TIME 0 =	08:10:50	60.9	61.4	61.1	61.4
	08:11:50	60.8	61.4	61.1	61.4
	08:12:50	60.7	61.3	61.0	61.4
	08:13:50	60.7	61.4	61.0	61.4
	08:14:50	60.6	61.4	61.0	61.4
	08:15:50	60.5	61.3	61.0	61.6
	08:16:50	60.2	61.9	61.4	63.9
	08:17:50	59.1	55.2	51.9	-7.3
	08:18:50	51.3	-15.1	-0.5	-285.5
	08:19:50	29.3	-112.2	-76.4	-297.3
	08:20:49	-17.5	-175.6	-129.5	-299.0
	08:21:49	-63.5	-208.5	-163.2	-300.6
	08:22:50	-101.8	-226.3	-189.6	-300.9
	08:23:50	-136.8	-240.5	-214.3	-301.4
	08:24:50	-172.0	-254.8	-241.1	-301.4
	08:25:49	-216.9	-270.1	-274.7	-301.2
	08:26:49	-254.4	-282.9	-293.6	-301.7
	08:27:49	-273.1	-289.4	-297.8	-301.8
	08:28:49	-277.1	-291.7	-298.3	-301.7
	08:29:49	-280.2	-293.6	-299.3	-301.7
	08:30:49	-274.9	-295.9	-302.3	-305.0
	08:31:50	-277.0	-297.2	-301.8	-304.3
	08:32:50	-287.5	-303.7	-297.2	-298.1
	08:33:49	-288.2	-296.0	-299.8	-301.2
	08:34:49	-287.0	-295.0	-300.0	-301.5
	08:35:49	-285.8	-295.9	-299.4	-301.4
	08:35:49	-285.9	-296.1	-299.5	-301.5
	08:37:49	-284.9	-296.0	-299.3	-301.5
	08:38:50	-286.3	-296.1	-299.4	-301.6
	08:39:50	-288.2	-296.2	-300.1	-301.7
	08:40:49	-289.9	-297.3	-300.1	-301.7
	08:41:49	-292.1	-297.0	-301.2	-302.8
	08:42:49	-291.5	-298.1	-301.4	-302.8
	08:43:49	-291.3	-298.2	-301.6	-302.6
	08:44:49	-291.9	-298.1	-301.4	-302.8
	08:45:49	-292.2	-298.3	-301.6	-302.8
	08:46:49	-292.7	-298.1	-301.6	-302.8
	08:47:49	-292.8	-298.2	-301.2	-302.8
	08:48:50	-293.0	-298.4	-301.4	-302.8
	08:49:49	-293.0	-298.4	-301.4	-302.9
	08:50:49	-293.8	-298.6	-301.8	-302.9
	08:51:50	-293.7	-298.6	-301.8	-302.9
	08:52:49	-294.1	-298.9	-301.7	-303.1
	08:53:49	-294.1	-299.0	-301.6	-302.8
	08:54:50	-293.9	-298.4	-301.6	-302.6
	08:55:49	-294.3	-298.9	-301.7	-303.2
	08:56:49	-294.8	-299.7	-302.0	-303.4
	08:57:50	-295.1	-300.0	-302.6	-304.0
	08:58:50	-295.4	-300.6	-303.3	-304.9
	08:59:49	-295.6	-301.4	-303.9	-305.2
	09:00:49	-295.5	-301.5	-303.5	-305.0
	09:01:49	-295.6	-301.6	-303.7	-305.1
	09:02:49	-295.9	-301.6	-304.3	-305.9
	09:03:49	-296.4	-302.5	-304.4	-306.9
	09:04:49	-296.9	-304.5	-306.5	-308.8
	09:05:49	-298.1	-305.6	-308.4	-312.1
	09:06:50	-300.3	-308.2	-310.9	-314.8
	09:07:50	-301.2	-309.5	-312.1	-315.2
	09:08:49	-301.1	-309.4	-311.4	-315.1
	09:09:49	-301.2	-309.0	-310.7	-315.2
	09:10:49	-300.7	-308.8	-310.2	-315.2
	09:11:49	-300.0	-308.6	-310.1	-315.2
	09:12:49	-298.6	-308.2	-308.8	-315.2
	09:13:49	-295.4	-306.0	-305.9	-309.9
	09:14:49	-291.6	-303.1	-304.0	-308.2
	09:15:50	-296.4	-306.0	-310.7	-314.9
	09:16:50	-300.7	-309.4	-312.2	-315.1
	09:17:49	-300.6	-308.8	-310.6	-314.9
	09:18:49	-300.7	-308.8	-310.5	-315.1
	09:19:49	-300.3	-308.7	-310.6	-315.1
	09:20:49	-299.7	-308.4	-310.7	-315.1
	09:21:49	-298.2	-308.0	-309.1	-314.9
	09:22:50	-293.9	-306.0	-306.4	-313.8
	09:23:50	-289.8	-304.8	-303.5	-314.0
	09:24:49	-284.6	-303.3	-299.8	-313.7
	09:25:49	-286.3	-300.3	-302.3	-307.2
	09:26:49	-294.2	-303.9	-307.9	-312.2
	09:27:49	-296.1	-306.0	-309.8	-313.0
	09:28:49	-296.7	-306.5	-309.9	-312.9
	09:29:50	-296.7	-306.8	-310.2	-312.9
	09:30:49	-296.9	-306.9	-309.4	-312.9
	09:31:49	-297.5	-306.9	-310.1	-313.2
	09:32:49	-297.3	-306.9	-310.1	-313.3
	09:33:49	-297.1	-306.8	-310.1	-313.2
	09:34:49	-296.9	-306.8	-309.9	-313.0
	09:35:50	-296.6	-307.1	-310.6	-313.0
	09:36:50	-296.5	-307.1	-310.2	-312.9
	09:37:49	-297.5	-307.1	-310.2	-313.0
	09:38:49	-297.6	-307.4	-310.5	-313.2

TABLE 10. (Concluded)

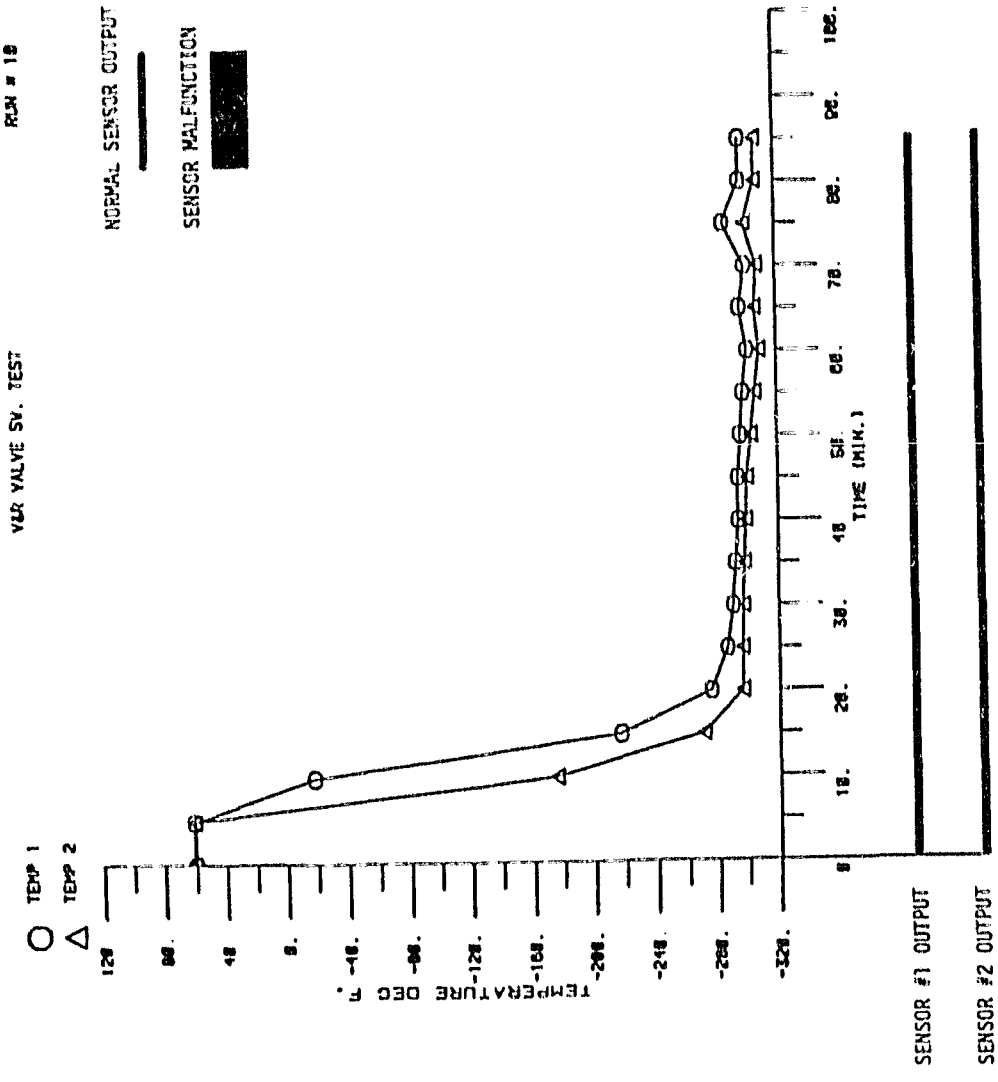


TABLE 11. LIQUID HYDROGEN THERMAL CYCLE NO. 1 GRAPH AND TEMPERATURE DATA

	TIME	T1	T2	T3	T4
	06:52:16	69.4	69.6	66.2	69.7
	06:53:16	69.4	69.5	69.6	69.7
	06:54:16	69.4	69.6	69.7	69.7
TIME 0 =	06:55:16	69.5	69.7	69.7	69.7
	06:56:16	69.5	69.7	69.7	69.7
	06:57:16	69.6	69.8	69.8	69.6
	06:58:16	69.6	69.8	69.8	69.7
	06:59:16	69.6	69.8	69.9	69.7
	07:00:16	69.7	69.9	69.9	69.7
	07:01:16	69.8	70.0	69.9	69.7
	07:02:16	69.8	69.9	69.9	69.7
	07:03:16	69.8	69.9	69.9	69.7
	07:04:16	69.8	70.0	69.9	69.7
	07:05:16	69.8	70.0	70.0	69.7
	07:06:16	69.8	69.9	69.8	68.2
	07:07:16	69.5	65.4	65.0	34.0
	07:08:16	66.9	39.7	66.5	-60.6
	07:09:16	57.6	-16.9	66.5	-191.6
	07:10:16	40.5	-76.9	-40.4	-188.6
	07:11:16	20.9	-105.6	-65.6	-238.8
	07:12:16	0.1	-132.7	-89.6	-248.1
	07:13:16	-20.7	-153.6	-110.5	-268.0
	07:14:16	-41.4	-174.3	-132.1	-294.2
	07:15:16	-62.1	-196.4	-155.1	-320.9
	07:16:16	-82.8	-218.5	-177.5	-342.4
	07:17:16	-103.3	-239.1	-198.7	-365.4
	07:18:16	-123.5	-260.6	-221.3	-383.1
	07:19:16	-143.0	-282.3	-244.1	-290.1
	07:20:16	-163.3	-298.3	-262.9	-289.6
	07:21:16	-181.1	-296.5	-267.2	-365 3
	07:22:16	-195.1	-293.6	-271.4	-360.2
	07:23:16	-207.1	-296.1	-279.3	-405.4
	07:24:16	-219.0	-310.7	-292.6	-369.3
	07:25:16	-227.2	-306.5	-293.0	-354.2
	07:26:16	-238.4	-330.5	-320.3	-390.6
	07:27:16	-250.0	-341.0	-334.8	-407.0
	07:28:16	-261.4	-347.6	-345.0	-407.0
	07:29:16	-271.4	-351.3	-351.3	-407.0
	07:30:16	-279.2	-355.6	-357.5	-405.6
	07:31:16	-286.1	-354.5	-356.8	-392.4
	07:32:16	-284.7	-341.4	-341.1	-370.1
	07:33:16	-282.4	-335.6	-332.8	-365.9
	07:34:16	-280.9	-332.0	-328.5	-365.3
	07:35:16	-279.5	-329.9	-326.1	-364.0

TABLE 11. (Concluded)

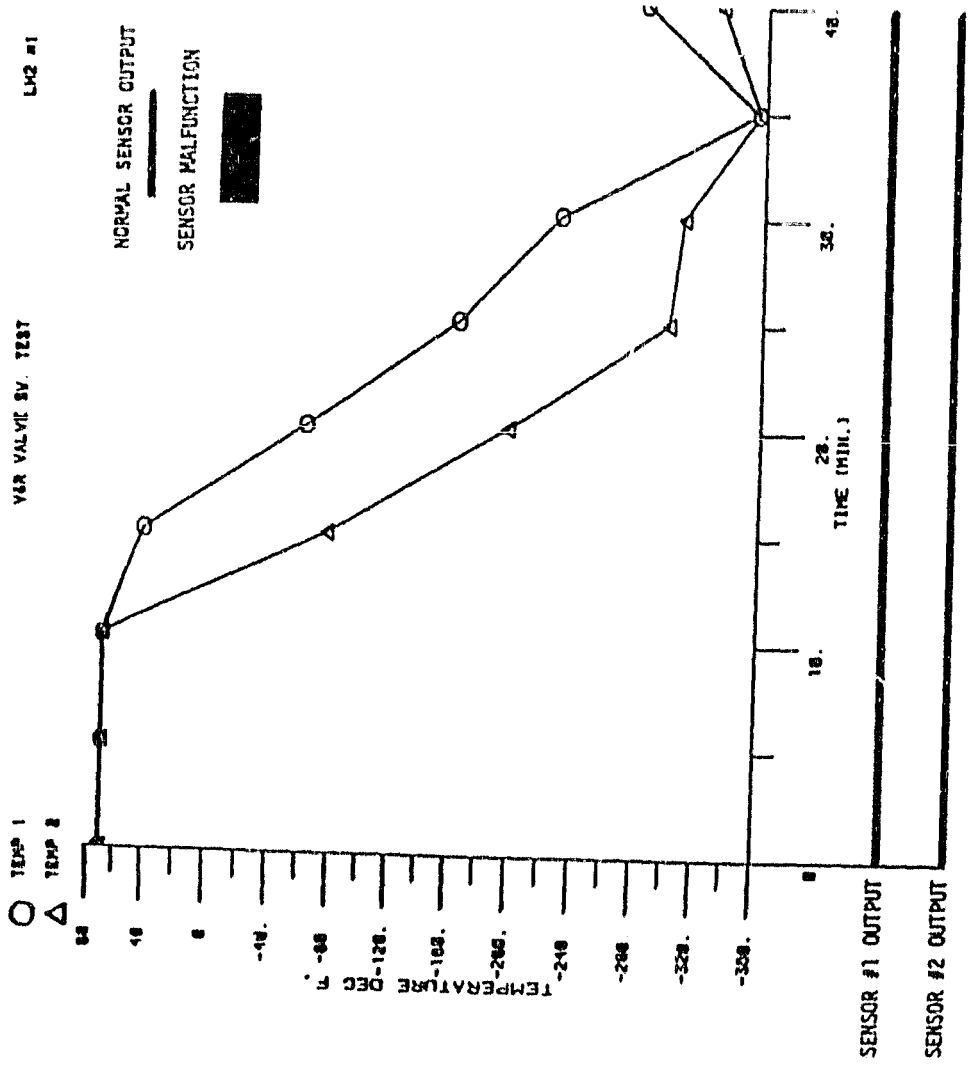


TABLE 12. LIQUID HYDROGEN THERMAL CYCLE NO. 2 GRAPH AND TEMPERATURE DATA

	TIME	T1	T2	T3	T4
	12:21:06	70.0	72.0	71.3	72.6
	12:22:06	69.8	71.9	71.2	72.6
	12:23:06	70.2	71.9	71.3	72.6
	12:24:06	70.5	72.0	71.5	72.5
TIME 0 =	12:25:06	70.7	72.0	71.6	72.5
	12:26:06	71.0	72.1	71.7	72.5
	12:27:06	71.3	72.2	72.0	72.5
	12:28:06	71.6	72.3	72.1	72.6
	12:29:06	71.7	72.5	72.2	72.6
	12:30:06	71.9	72.5	72.3	72.6
	12:31:06	72.1	72.5	72.3	72.6
	12:32:06	72.3	72.7	72.5	72.7
	12:33:06	72.4	72.7	72.5	72.7
	12:34:06	72.4	71.6	71.0	27.9
	12:35:06	68.8	23.9	28.7	-178.3
	12:36:06	53.5	-66.6	-35.9	-388.1
	12:37:06	27.6	-147.1	-94.0	-406.8
	12:38:06	-4.9	-209.1	-146.2	-407.1
	12:39:06	-41.2	-259.1	-191.1	-407.5
	12:40:06	-77.1	-277.7	-223.3	-407.3
	12:41:06	-111.4	-292.8	-249.0	-408.1
	12:42:06	-143.0	-306.5	-272.3	-408.1
	12:43:06	-170.8	-317.6	-291.6	-406.9
	12:44:06	-195.5	-327.2	-308.7	-408.5
	12:45:06	-218.2	-337.2	-324.2	-409.5
	12:46:06	-237.7	-345.1	-336.8	-409.5
	12:47:06	-254.0	-351.2	-345.9	-408.7
	12:48:06	-266.9	-354.9	-352.0	-409.5
	12:49:06	-276.9	-357.1	-356.3	-409.5
	12:50:06	-284.4	-360.2	-358.4	-409.5
	12:51:06	-289.6	-362.1	-360.2	-409.2
	12:52:06	-292.6	-362.8	-361.8	-408.7
	12:53:06	-294.4	-363.2	-362.1	-409.2
	12:54:06	-295.6	-363.2	-363.8	-409.5
	12:55:06	-297.7	-364.0	-366.1	-409.5
	12:56:06	-300.3	-365.1	-368.2	-409.5
	12:57:06	-302.5	-365.6	-370.4	-410.0
	12:58:06	-304.8	-367.1	-372.1	-410.0
	12:59:06	-306.9	-368.8	-373.9	-410.0
	13:00:06	-308.7	-369.6	-373.9	-410.0
	13:01:06	-309.1	-369.6	-373.1	-410.0
	13:02:06	-309.5	-369.6	-374.6	-410.7
	13:03:06	-310.2	-369.6	-375.2	-410.2
	13:04:06	-311.1	-370.1	-376.1	-410.0
	13:05:06	-312.1	-370.7	-378.1	-410.2
	13:06:06	-313.0	-371.1	-378.7	-410.2
	13:07:06	-314.1	-371.9	-381.4	-410.2
	13:08:06	-316.1	-372.7	-383.2	-410.0
	13:09:06	-317.8	-373.0	-382.0	-410.0
	13:10:06	-317.9	-373.8	-378.9	-410.0
	13:11:06	-317.9	-373.3	-376.4	-410.0
	13:12:06	-318.3	-374.2	-377.0	-410.0
	13:13:06	-318.7	-374.8	-377.4	-410.2
	13:14:06	-319.2	-375.4	-376.9	-410.0
	13:15:06	-320.0	-376.1	-378.2	-410.0
	13:16:06	-322.2	-377.3	-379.1	-410.2
	13:17:06	-323.7	-378.1	-381.6	-410.7
	13:18:06	-325.3	-379.1	-384.0	-410.8
	13:19:06	-323.0	-375.6	-374.6	-410.7
	13:20:06	-317.5	-373.1	-372.4	-410.0

TABLE 12. (Concluded)

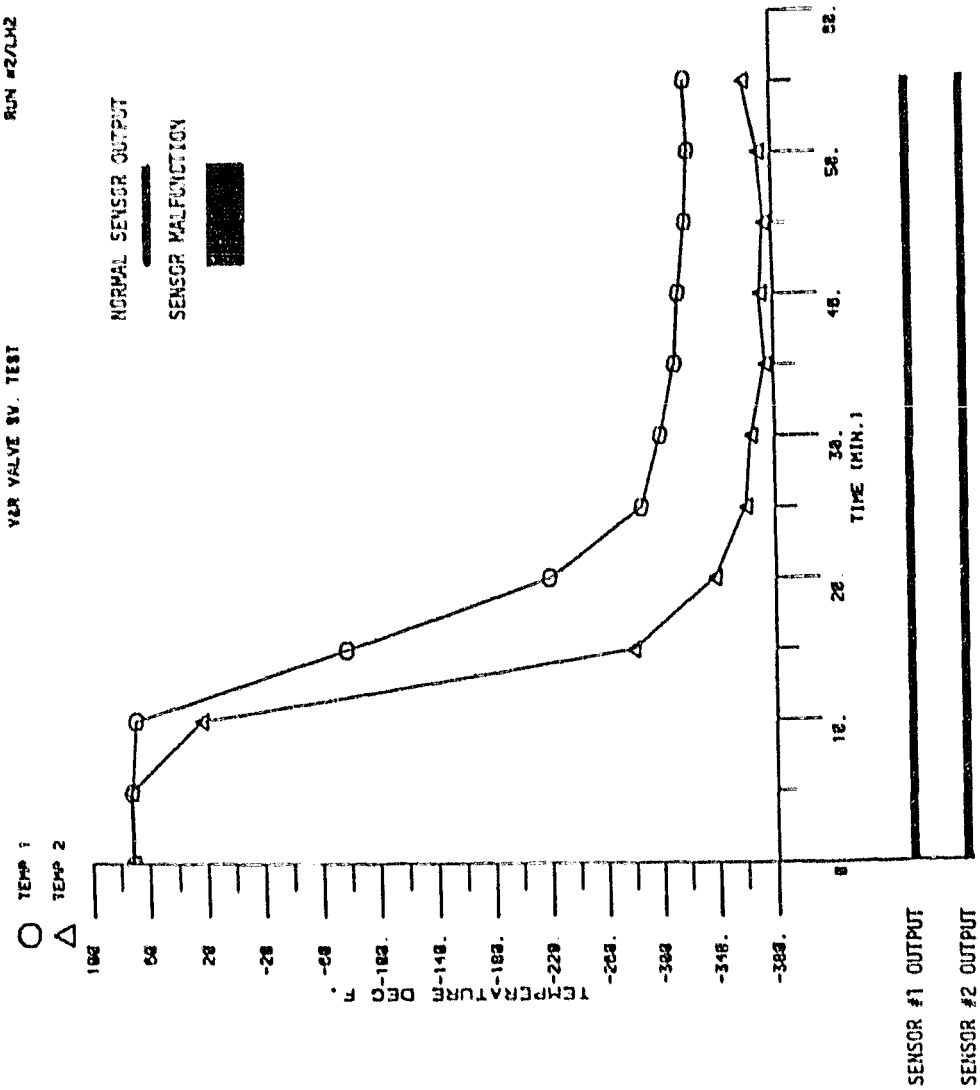
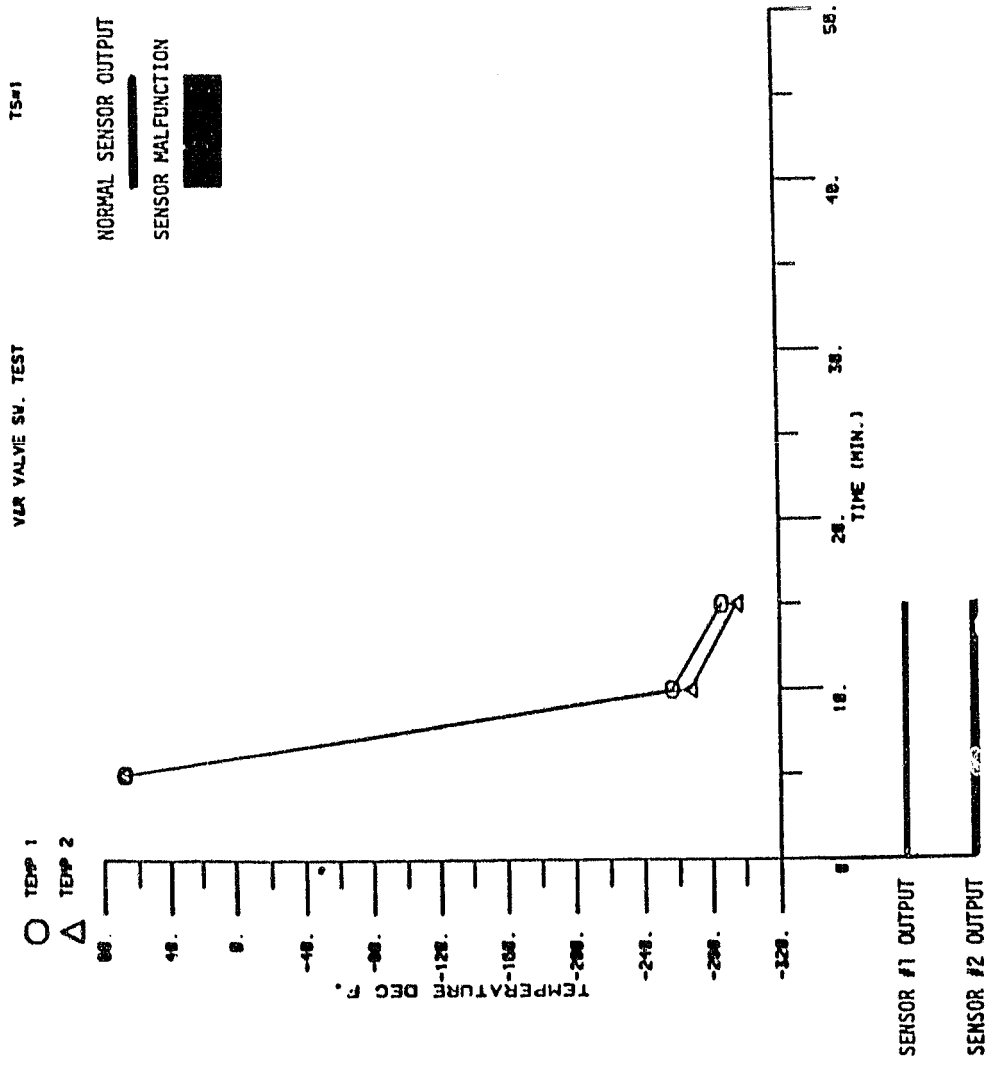


TABLE 13. THERMAL SHOCK TEST GRAPH AND TEMPERATURE DATA

	TIME	T1	T2	T3	T4
TIME 0 =	10:05:10	68.2	68.6	67.7	68.5
	10:06:09	-17.1	11.8	-73.2	58.4
	10:07:08	-89.7	-96.5	-172.3	32.6
	10:08:10	-187.1	-169.3	-266.1	7.7
	10:09:10	-229.1	-218.7	-278.1	-15.1
	10:10:09	-255.8	-267.2	-284.6	-40.1
	10:11:11	-286.2	-282.2	-288.4	-71.9
	10:12:10	-278.8	-287.9	-293.1	-95.4
	10:13:09	-276.3	-291.4	-300.3	-113.4
	10:14:09	-279.4	-302.9	-299.7	-127.7
	10:15:11	-286.4	-295.3	-301.3	-141.6
	10:16:10	-294.8	-296.1	-300.9	-154.3
	10:17:10	-302.3	-298.5	-301.4	-166.6
	10:18:09	-298.7	-298.2	-302.0	-177.6
	10:19:05	-242.3	-284.0	-295.9	-185.9

TABLE 13. (Concluded)



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APPROVAL

VARIABLE RELUCTANCE PROXIMITY SENSORS FOR CRYOGENIC VALVE POSITION INDICATION

By R. A. Cloyd

The information in this report has been reviewed for technical content. Review of any information concerning Department of Defense or nuclear energy activities or programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

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