INSTRUMENTATION LABORATORY
DEPARTMENT OF ELECTRICAL ENGINEERING
UNITED STATES AIR FORCE ACADEMY, COLORADO

NASA CR-
144515

ANALYSIS OF CHANGES IN LEG VOLUME PARAMETERS, AND ORTHOSTATIC TOLERANCE IN RESPONSE TO LOWER BODY NEGATIVE PRESSURE DURING 59-DAYS EXPOSURE TO ZERO GRAVITY SKYLAB 3

RICHARD D. BARNETT
RICHARD J. GOWEN, LT COL, USAF
DAVID R. CARROLL, MAJOR ,USAF

(NASA-CR-144515) ANALYSIS OF CHANGES IN LEG VOLUME PARAMETERS, AND ORTHOSTATIC TOLERANCE IN RESPONSE TO LOWER BODY NEGATIVE PRESSURE DURING 59 DAYS EXPOSURE TO ZERO GRAVITY SKYLAB 3 (Air Force Academy) 300 p HC $8.75 G3/52
N76-10707
Unclas
39399

JULY, 1975

INSTRUMENTATION LABORATORY
DEPARTMENT OF ELECTRICAL ENGINEERING
UNITED STATES AIR FORCE ACADEMY, COLORADO

ANALYSIS OF CHANGES IN LEG VOLUME PARAMETERS, AND ORTHOSTATIC TOLERANCE IN RESPONSE TO LOWER BODY NEGATIVE PRESSURE DURING 59-DAYS EXPOSURE TO ZERO GRAVITY SKYLAB 3

RICHARD D. BARNETT
RICHARD J. GOWEN, LT COL, USAF
DAVID R. CARROLL, MAJOR ,USAF

JULY, 1975

The prototype development and calibration of the Limb Volume Measuring System (LVMS) for the Skylab Missions was performed in the Instrumentation Laboratory of the Department of Electrical Engineering at the United States Air Force Academy. This report discusses the final processing and analysis of the leg volume data for Skylab Mission 3. This work was supported under NASA Project Number T66344(G).

TABLE OF CONTENTS

LIST OF FIGURES

Page

Page

LIST OF TABLES

Page

INTRODUCTION

The design of the leg volume measuring system employed for the M092 portion of the Skylab Missions required the development of a system sensitive to large and small volume changes at the calf of the leg. These changes in volume were produced in response to the orthostatic stress of a Lower Body Negative Pressure Device (LBNPD) or by venous occlusion.

The prototype capacitive plethysmographs were designed at the U.S. Air Force Academy and were space qualified by the Martin-Marietta Corporation for use on the Skylab Missions. The design and evaluation of this type of measuring system has been described previously (1, 8, 9).

The operational efficiency of the Leg Volume Measuring System (LVMS) was additionally verified during the 56-day simulation of Skylab environment at 1-G (Skylab Medical Experiments Altitude Test) (9). The capacitive plethysmographs were used in conjunction with the M092 Lower Body Negative Pressure test to obtain baseline physiological data. A capacitive plethysmograph must be initially calibrated to establish the correlation between the change in capacitance and the change in volume of the segment being monitored. The devices and techniques used to obtain the calibration data for the seventy-six Skylab leg bands have been described in a previous technical report (2).

In addition to the calibration of the LVMS, specific signal processing was also performed at the Air Force Academy. A previous technical report (3) described the system, techniques and algorithms used for signal processing performed in the Instrumentation Laboratory.

The cardiovascular responses of the Apollo crewmen associated with the postflight evaluations indicate varying decrements of orthostatic tolerance. The postflight changes indicate a slightly diminished ability of the cardiovascular system to function effectively against gravity following exposure to weightlessness. The objective of the Skylab LBNP experiments (M092) was to provide information about the magnitude and time course of the cardiovascular changes associated with prolonged periods of exposure to weightlessness. This report details the equipment, signal processing and analysis of the leg volume data obtained from the M092 experiment of the Skylab 3 Mission.

METHODS AND MATERIALS

The preflight baseline data were acquired prior to flight at varying intervals up to four and one-half months before launch. In-flight tests were performed at approximately 3-day intervals while postflight data were collected at increasing intervals of time over a period of several months. Tables 1 and 2 indicate the chronology and number of the M092 tests conducted on each astronaut of the Skylab 3 Mission.

Experiment Hardware

The M092 experiment hardware consisted of the Lower Body Negative Pressure Device (LBNPD), the Limb Volume Measuring System (LVMS), a Blood Pressure Measuring System (BPMS), a Vector Cardiograph System (VCS) and a Body Temperature Measuring System (BTMS). An Experiment Support System (ESS) provided power and controls for operation and calibration of the hardware. This report will be restricted to a discussion of the leg volume changes except where discussion of other cardiographic parameters help explain or clarify the changes in leg physiology.

a. LBNPD. The lower body negative pressure device used for testing orthostatic tolerance was cylindrical in shape and constructed of anodized aluminum. Adjustable iris-like templates at the open end of the device formed to body contours at the level of the waist. An adjustable padded saddle allowed longitudinal positioning such that the iliac crests were located at the level of the metal iris plates. The final component of the waist seal was a zippered, pliable, contoured sheet of fluorel impregnated beta cloth which was fastened around the waist with velcro fasteners. The LBNPD is shown in Figure 1 in the open position to allow attachment of leg volume sensors. The negative pressure was

TABLE 1. CHRONOLOGY OF M092 LOWER BODY NEGATIVE PRESSURE TESTS DURING PREFLIGHT, IN-FLIGHT AND POSTFLIGHT PERIODS OF SKYLAB 3.

Commander				Scientist Pilot				Pilot			
Run No.	Jul Date	Mis Day	Expr Code	Run No.	Jul Date	Mis Day	Expr Code	Run No.	Jul Date	Mis Day	Expr Code
1	80	F-129	1	1	67	F-142	1	1	79	F-130	1
2	113	F-96	1	2	95	F-114	1	2	92	F-117	1
3	150	F-59	1	3	178	F-31	1	3	178	F-31	1
4	178	F-31	1	4	193	F-16	1	4	193	F-16	1
5	193	F-16	1	5	204	F-5	1	5	204	F-5	1
6	204	F-5	1	6	213	5	2	6	214	6	2
7	214	6	2	7	216	8	2	7	219	11	2
8	219	11	2	8	220	12	2	8	224	16	2
9	224	16	2	9	225	17	2	9	227	19	2
10	228	20	2	10	229	21	2	10	231	23	2
11	232	24	2	12	235	27	2	11	234	26	2
12	235	27	2	13	237	29	2	12	237	29	2
13	239	31	2	14	240	32	2	13	241	33	2
14	242	34	2	15	243	35	2	14	243	35	2
15	244	36	2	16	246	38	2	15	247	39	2
16	248	40	2	17	249	41	2	16	250	42	2
17	251	43	2	18	253	45	2	17	253	45	2
18	254	46	2	19	255	47	2	18	256	48	2
19	257	49	2	20	258	50	2	19	259	51	2
20	260	52	2	21	261	53	2	20	262	54	2
21	263	55	2	22	264	56	2	21	266	58	2
22	266	58	2	23	266	58	2	22	268	R+0	3
23	268	R+0	3	24	268	R+0	3	23	269	R+1	3
24	270	R+2	3	25	269	R+1	3	24	270	R+2	3
25	270	R+2	3	26	270	R+2	3	25	272	R+4	3
26	272	R+4	3	27	272	R+4	3	26	273	R+5	3
27	273	R+5	3	28	273	R+5	3	27	277	R+9	3
28	277	R+9	3	29	277	R+9	3	28	284	R+16	3
29	284	R+16	3	30	284	R+16	3	29	297	R+29	3
30	297	R+29	3	31	297	R+29	3				

TABLE 2. M092 LOWER BODY NEGATIVE PRESSURE TESTS DURING SKYLAB 3.

	Preflight	In-flight	Postflight	Total
Commander	6	16	8	30
Scientist Pilot	5	17	8	30
Pilot	5	16	8	29
	16	49	24	89

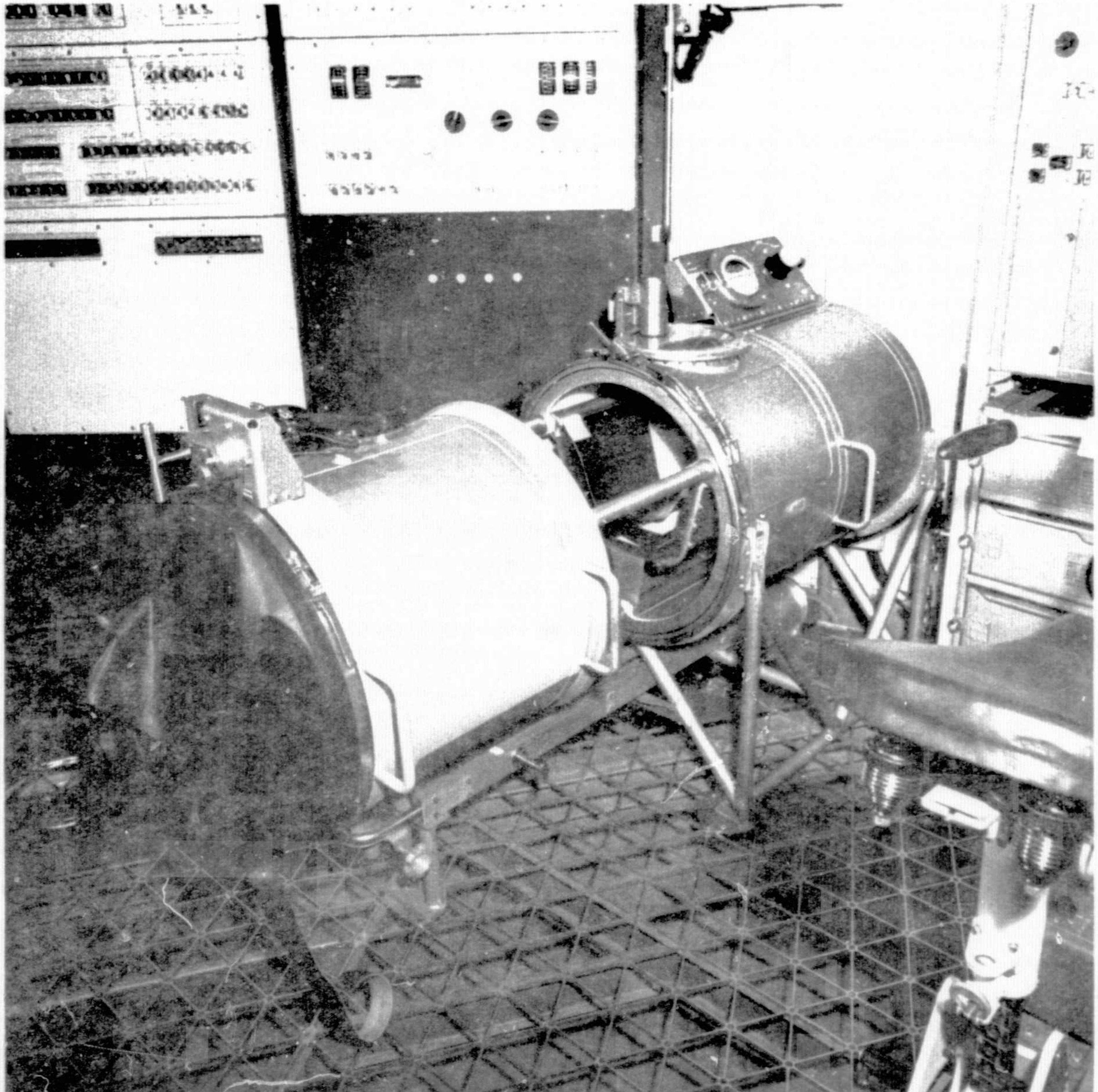


FIGURE 1. THE LOWER BODY NEGATIVE PRESSURE DEVICE (LBNPD).

provided by a vacuum plenum or, during flight, by the vacuum of space, and a manual valve was used to control the decrement of pressure within the device. In case of emergency a quick-release valve was used to vent the chamber to ambient pressure. Temperature sensors were located both internal and external to the LBNPD to provide LBNPD temperature and ambient temperature.

b. Limb Volume Measuring System (LVMS). The limb volume measuring system was designed to measure the volume changes occurring at the calf in response to a lower body negative pressure test or venous occlusion. The magnitude and time course of the leg volume response was used to provide an indication of changes in vascular physiology associated with an altered cardiovascular status. The type of capacitive plethysmograph used on the Skylab Mission is shown in Figure 2. The operation of the plethysmographic sensors has been described in considerable detail in previous technical reports (1, 2, 8, 9). Basically, the sensors function by transducing the change in capacitance between parallel plates (skin and measuring plate) and relating the change in capacitance to a change in volume. The transformation to percent change in volume is accomplished in reference to the initial calibration of the plethysmograph and the calibration plates which are internal to the leg band. Each plethysmograph sensor contains its own electronic module, calibration plates, a spiral torsion spring, foam separation material, measuring band and shield as shown diagrammatically in Figure 3. Each sensor is adjustable through a one-inch range of calf circumference with utilization of the same calibration number over that range. A list of the plethysmographic sensors available for the Skylab mission with their range, calibration value and output voltages are tabulated in Appendix A. The operation of the LVMS required that the astronaut establish the proper sensor gain by adjusting null and gain potentiometers located on the ESS to achieve the current calibration number as indicated by the ESS-LVMS displays.

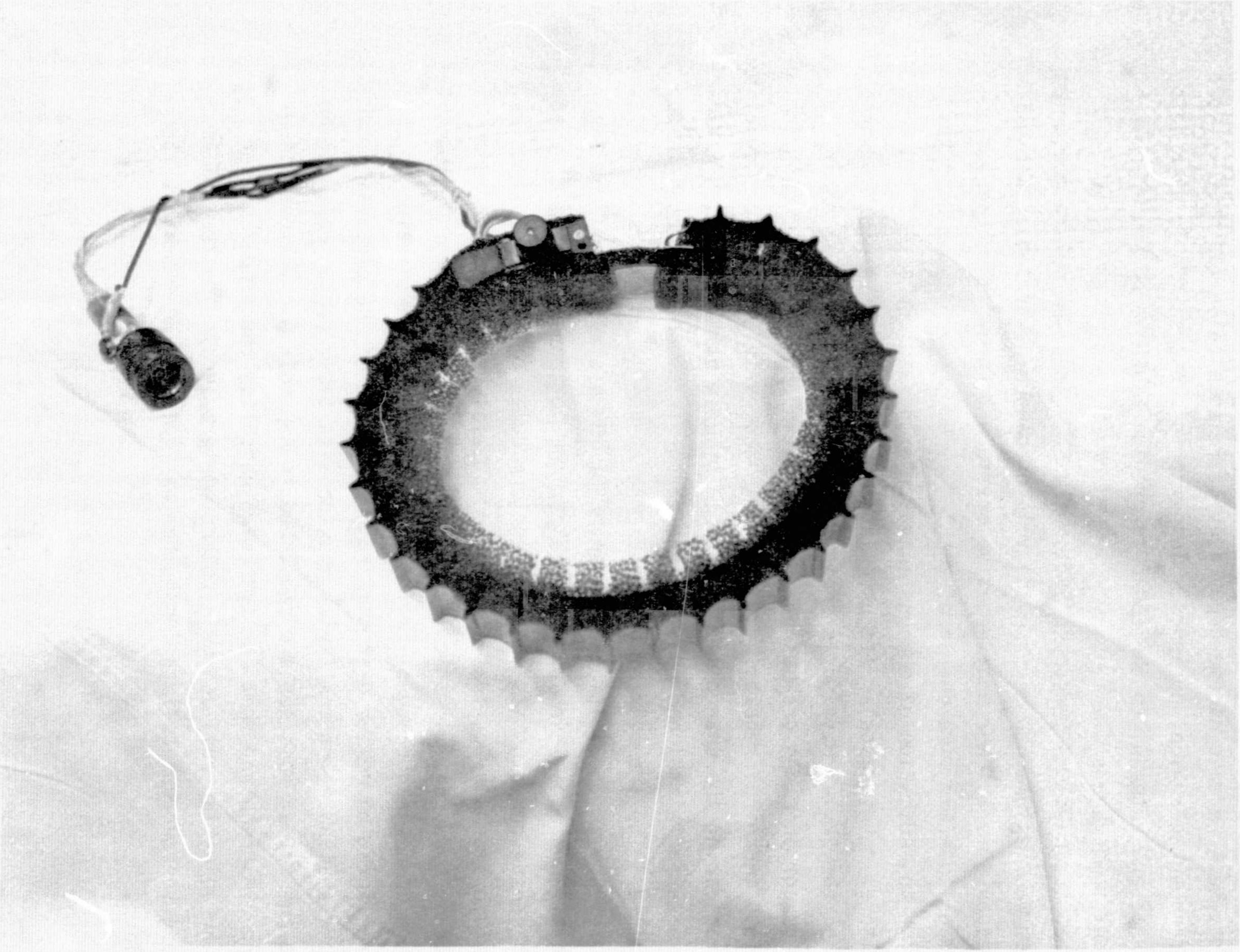


FIGURE 2. CAPACITIVE PLETHYSMOGRAPH USED ON SKYLAB FOR MEASUREMENT OF VOLUME CHANGE AT THE CALF.

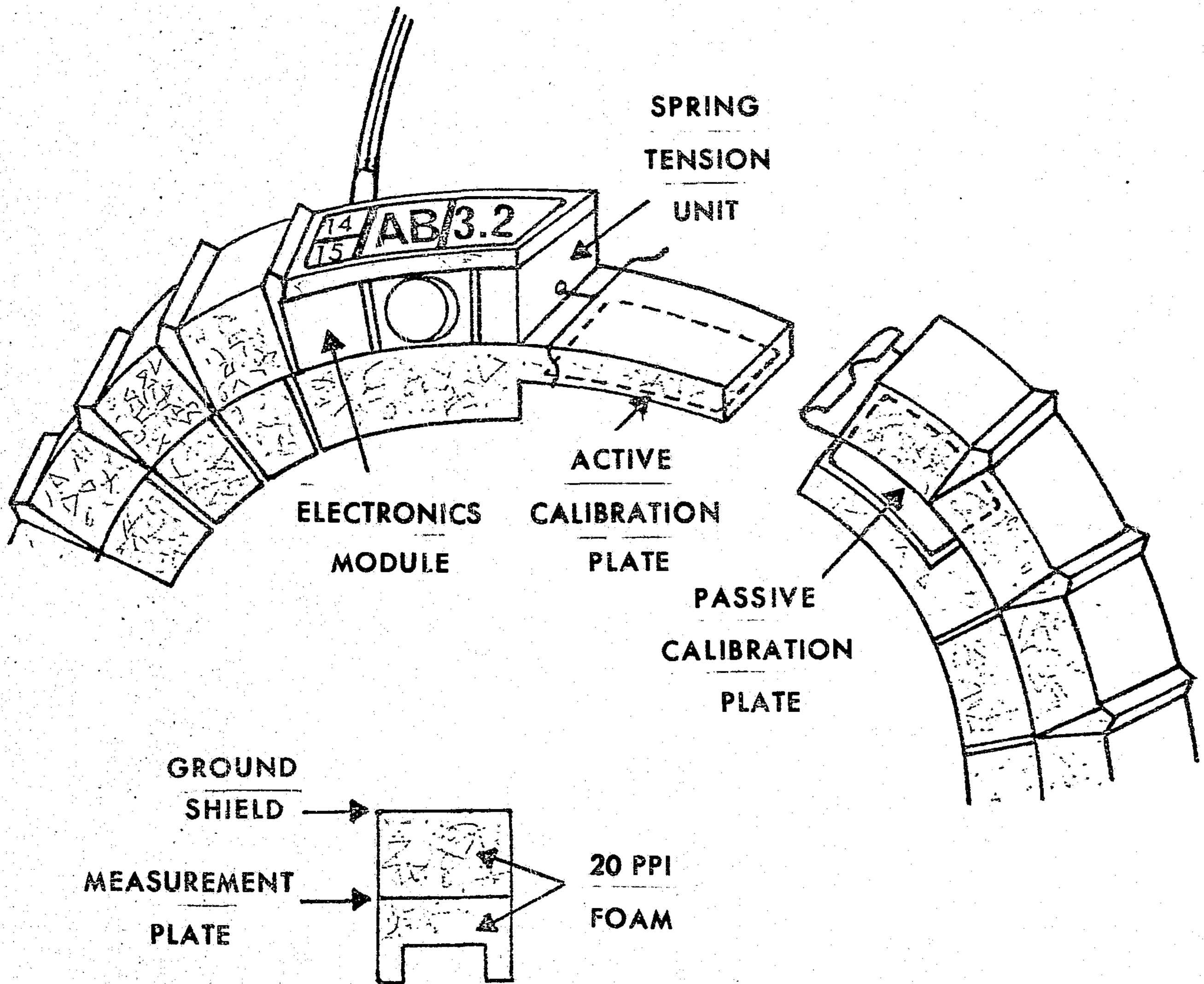


FIGURE 3. DIAGRAMATIC REPRESENTATION OF THE COMPONENTS OF THE CAPACITIVE PLETHYSMOGRAPH

In operation, two plethysmographic sensors are placed on the subject as shown in Figure 4. The sensor on the left leg measures the change in volume at the left calf and is also responsive to changes in temperature and humidity within the LBNPD. The sensor on the right leg is placed over a stainless steel cylinder or reference adapter in contact with the skin. This cylinder or reference adapter insures that the right leg band is responsive only to temperature and humidity changes in the chamber. Thus, by using the difference signal (i.e., left leg band output minus right leg band output), data could be produced which was unaffected by changes in environmental conditions. The typical output from the left and right leg bands as well as the difference or corrected signal is shown in Figure 5.

Experiment Procedures

Provisions were made to allow sufficient time between physical exertion, meals, showers or venipunctures and the LBNP test. Preparations for the test included instrumenting the subject with the modified Frank lead system for the recording of the Vectorcardiogram. With the subject supine in the open LBNPD, both calf circumferences were measured to the nearest one-eighth inch at the location of the maximum girth. After securing the LBNPD seal, knee and ankle restraints were fastened and the plethysmographic sensors of the proper size were installed and their calibration checked. The BPMS cuff was attached to the left arm and VCG electrode impedances were checked. Figure 6 shows a subject fully instrumented for the M092 Lower Body Negative Pressure experiment. Preceding and following each test, calibration values for heart rate, systolic and diastolic blood pressure, left and right leg volumes, and VCG were checked and recorded. The LBNP protocol shown in Figure 7 was identical to that used for the preflight and postflight experiments. The first and last 5 minutes of the 25-minute protocol were control and recovery periods at ambient pressure. The 15-minute stress period consisted of five decrements in negative pressure applied sequentially.

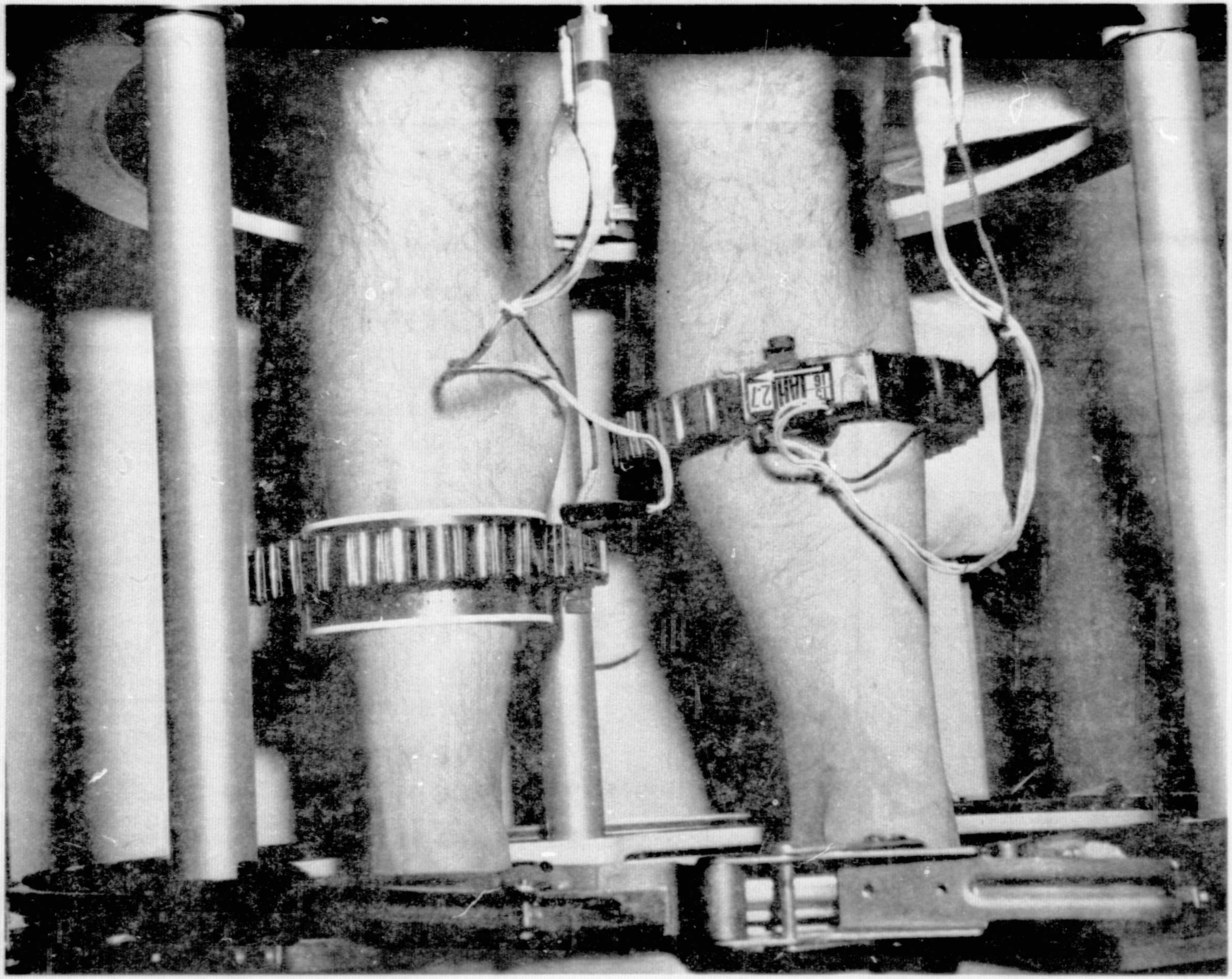


FIGURE 4. POSITION OF THE PLETHYSMOGRAPHS ON THE LEGS FOR VOLUME MEASUREMENTS DURING SKYLAB.

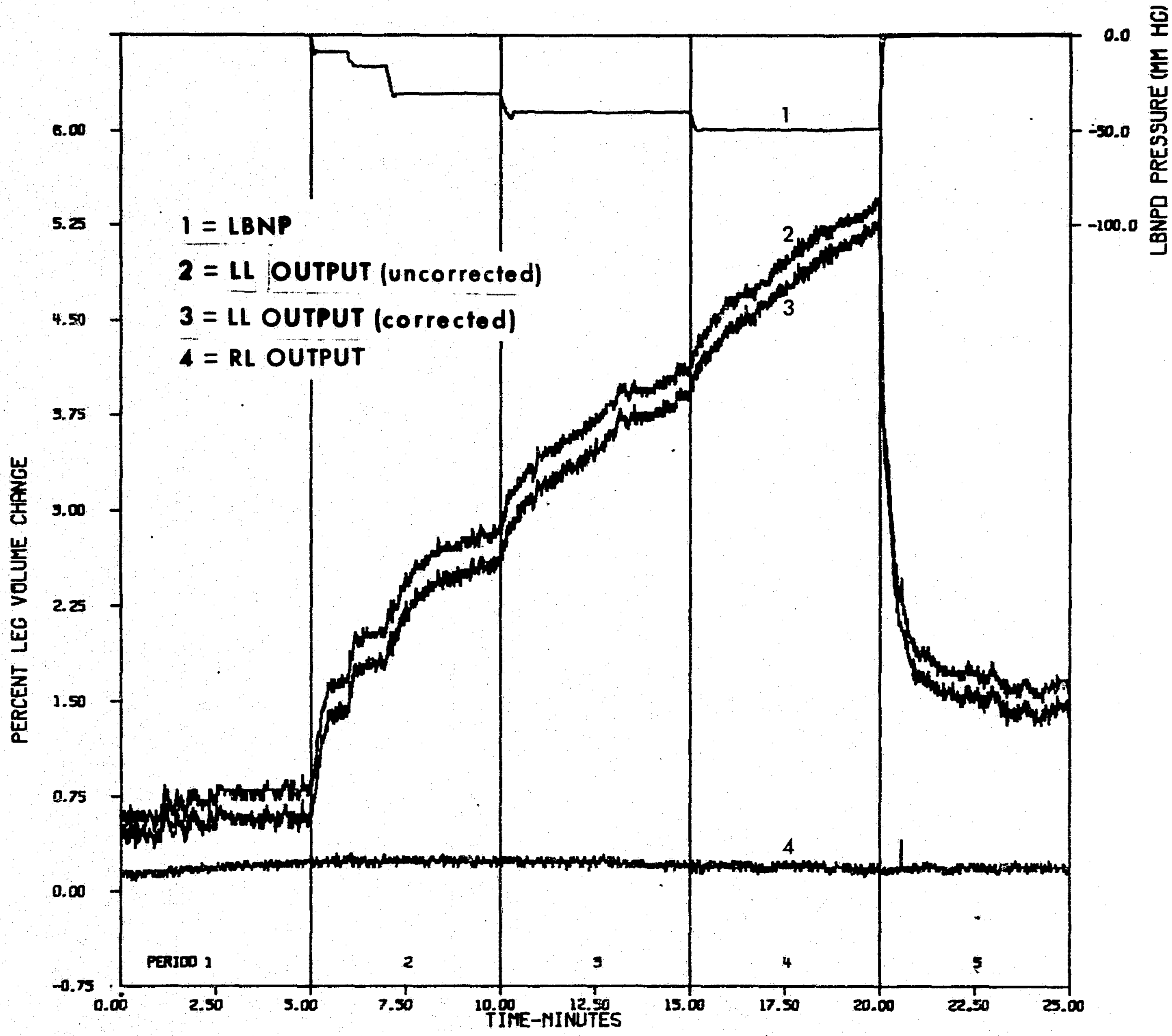


FIGURE 5. OUTPUT PARAMETERS FROM M092 EXPERIMENT.

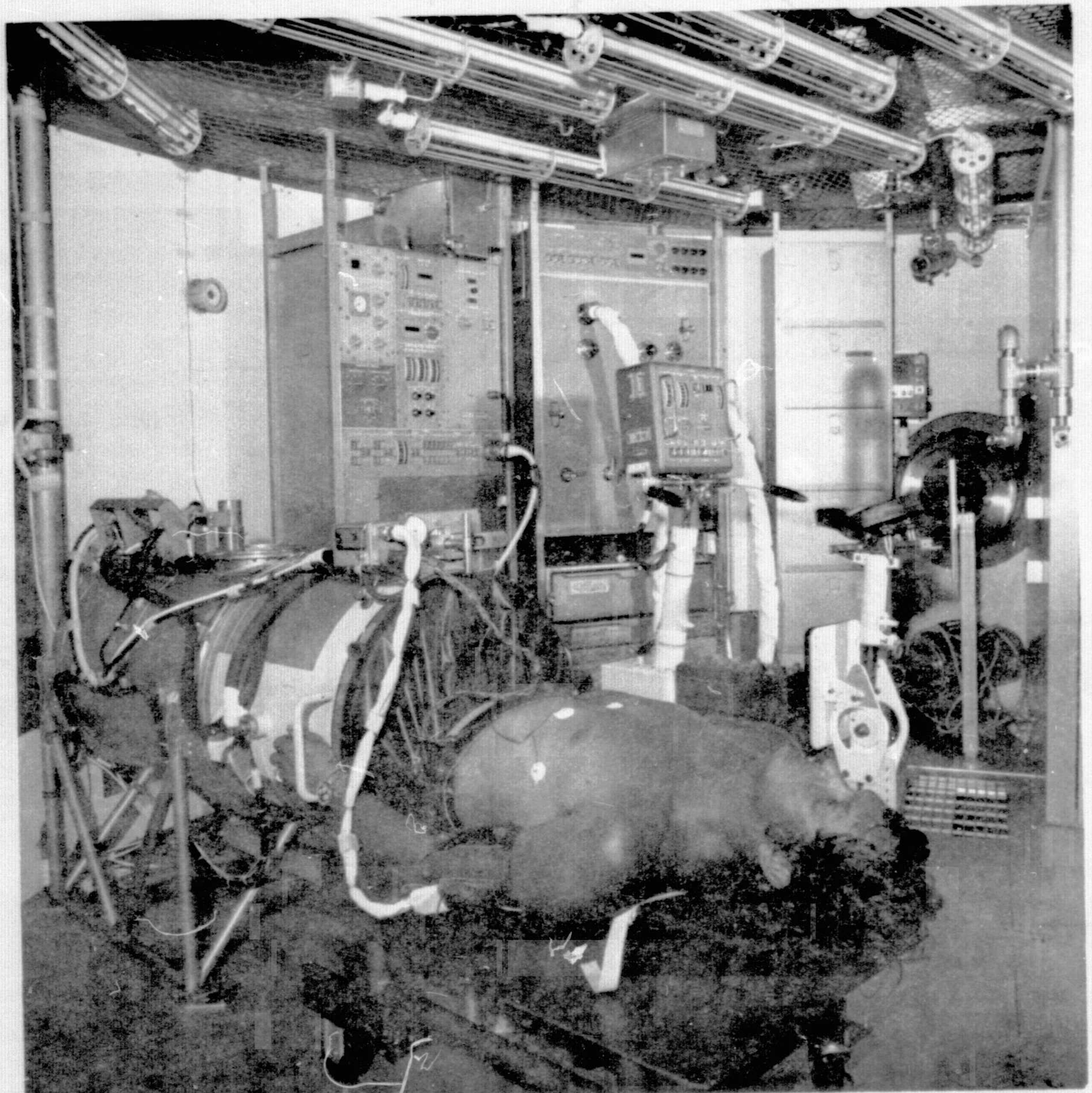


FIGURE 6. SUBJECT FULLY INSTRUMENTED FOR THE M092 EXPERIMENT.

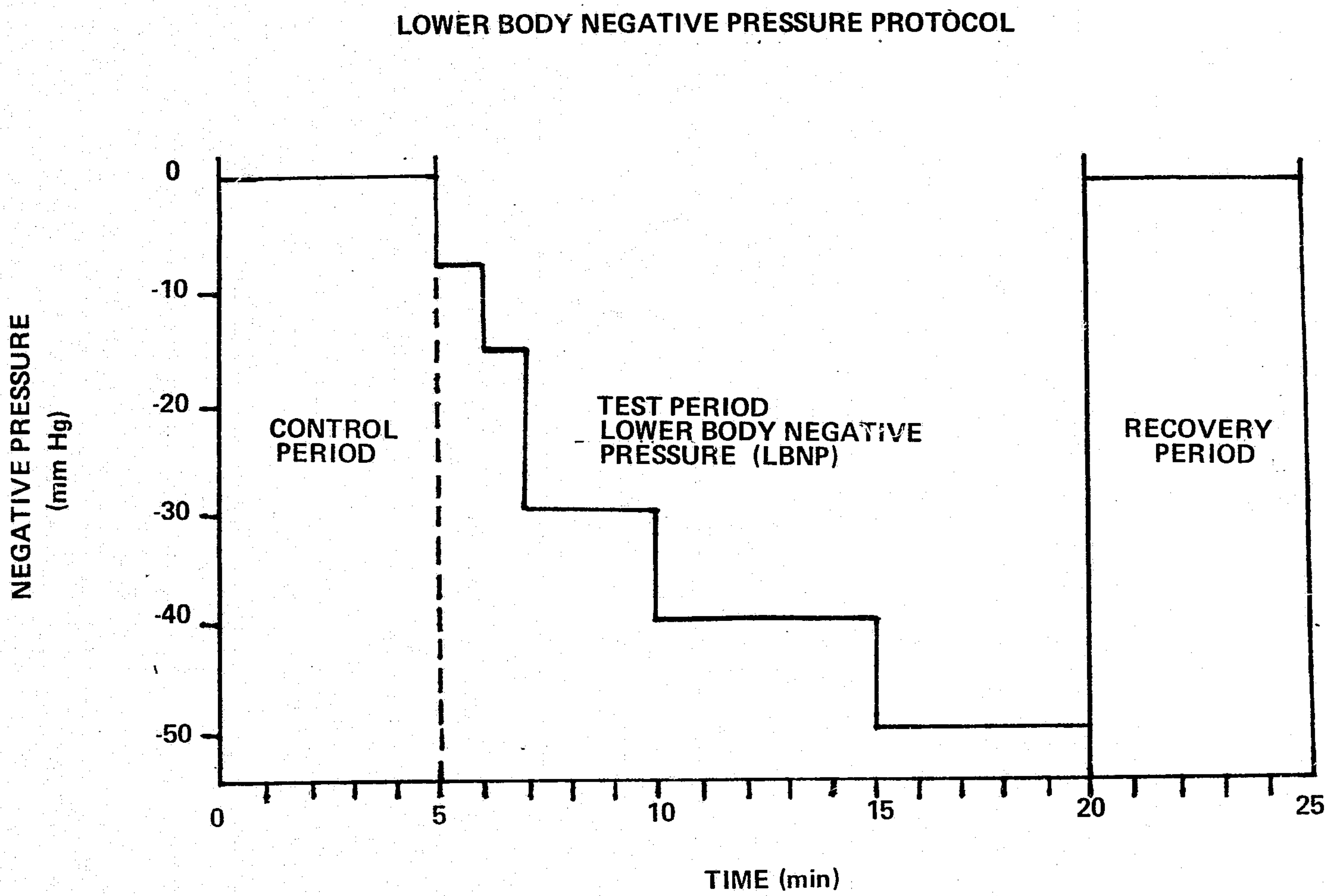


FIGURE 7. LOWER BODY NEGATIVE PRESSURE PROTOCOL USED FOR CARDIOVASCULAR EVALUATIONS.

The protocol required negative pressure to be applied in the following sequence: 1 minute of 8 and 16 mm Hg, 3 minutes of 30 mm Hg and 5 minutes of 40 and 50 mm Hg (Figure 8). The experiment was terminated if the subject experienced significant discomfort or if changes in nail color, facial expression, eye movement, or pupil size indicated a presyncopal episode.

LVMS Signal Processing

The detailed description of the signal processing was previously described in an earlier report (3) so only essential details will be described in this report. The overall simplified scheme of signal processing is illustrated in Figure 8. The outputs from the two leg bands in the configuration previously described are telemetered from the Skylab Workshop with a range of 0 to 5.0 volts. Each leg band's output data is then computer processed through its individual calibration curve. This process is, in effect, a data transform which adjusts the data to account for the characteristics of that particular leg band's calibration curve. The calibration report (2) from the Instrumentation Laboratory explains in detail the techniques used for obtaining calibration curve data. After the leg band data were individually adjusted, the compensation for temperature and humidity was accomplished as indicated by the summing junction of Figure 8. This type of processing was very effective at removing noise, electrical spikes or changes due to LBNPD termperature and humidity provided the artifact was of the same magnitude on both the left and right leg outputs. The calibration curve transforms, the output summation, data printout and initial computer plots of the M092 leg volume data were performed at NASA, Johnson Space Center, Houston, Texas.

The portion of the LVMS processing performed at the Instrumentation Laboratory, USAF Academy, is also indicated on Figure 8. The purpose of this processing was: (1) to remove any large artifacts such as electrical noise, spikes or offsets; (2) to establish the time associated with the

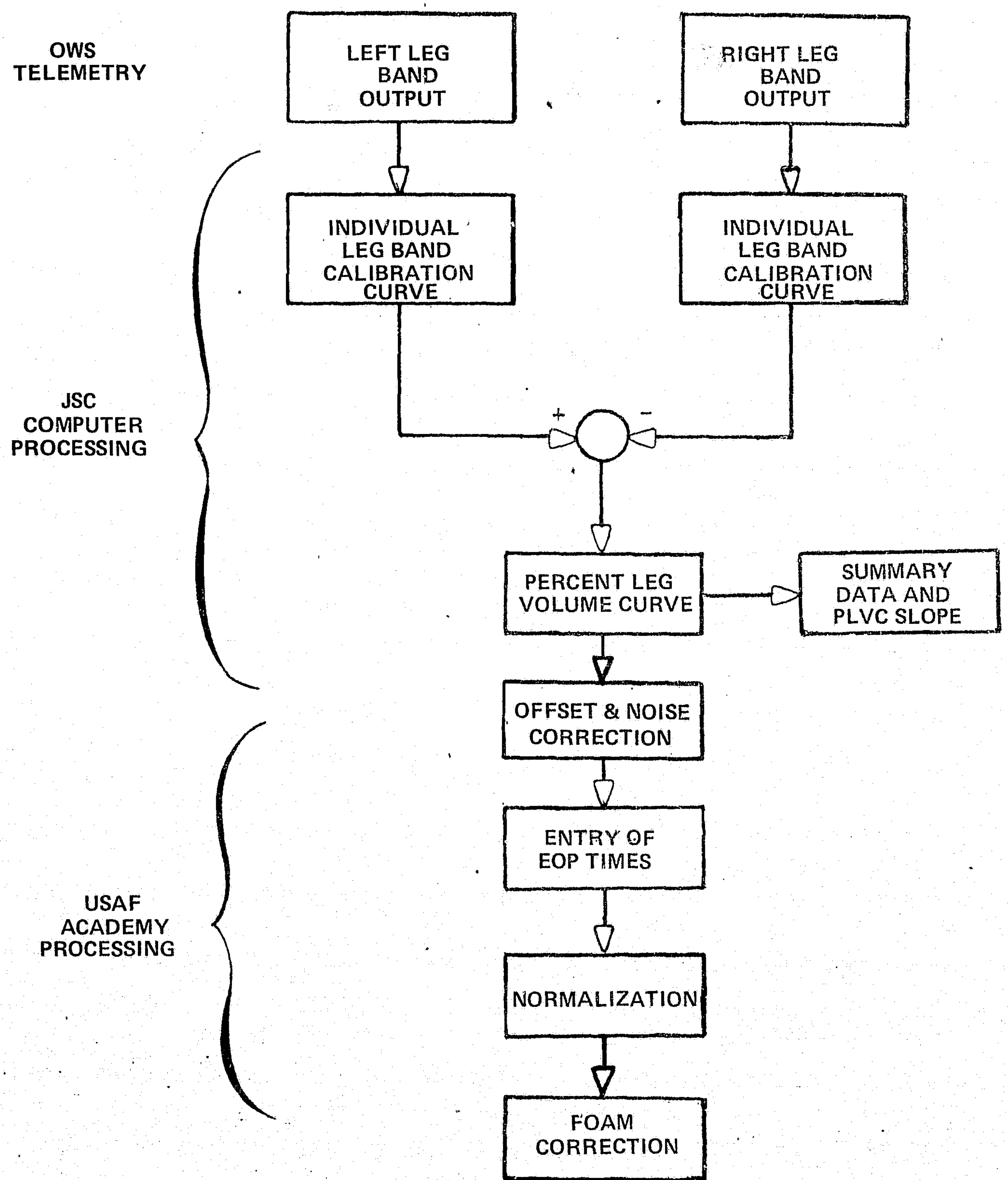


FIGURE 8. SCHEME FOR LEG VOLUME PROCESSING.

last data point in each of the seven periods of the M092 experiment; (3) to normalize the data to a baseline just prior to onset of negative pressure; (4) to perform the foam correction required for each leg band; and (5) to add pertinent identification or experiment information to each M092 experiment.

In order to perform the special signal processing flowcharted in Figure 9, it was necessary to develop techniques and programs capable of manipulating such a large data base. All computer programs utilized for signal processing are contained in the separate signal processing report (3).

The processing system consists of a Xerox Data Systems Sigma 5 digital computer and 7-track magnetic tape drive as well as the Interactive Graphics Terminal shown in Figure 10. This and other associated equipment used in the processing is shown in the block diagram of Figure 11.

The processing functions performed and charted in Figure 9 are typical operations for a real-time interactive graphics processor. In operation, the NASA data tape with additional identification information was loaded into the Sigma 5 computer and selected single or multiple parameters were displayed on a monitor in 3.3 minute segments of time. Corrective procedures (offset, entry of EOP times, normalization and foam correction) were performed and the data was saved for additional processing. The steps involved with the data processing performed by the Instrumentation Laboratory of the Air Force Academy were performed on all Skylab data. These steps as charted in Figure 9 consisted of a series of operations designed to produce a final consistent data configuration which would lend itself to automatic data processing by subject and mission. All of the raw data as received from JSC-Houston in the 7-track, 800 BPI, packed binary format was plotted as shown in Appendix B. After plotting the raw data, supplemental identification, anthropometric and environmental information was added to each run to expand the identification record from 12 to 42 elements. Tables 3 to 5

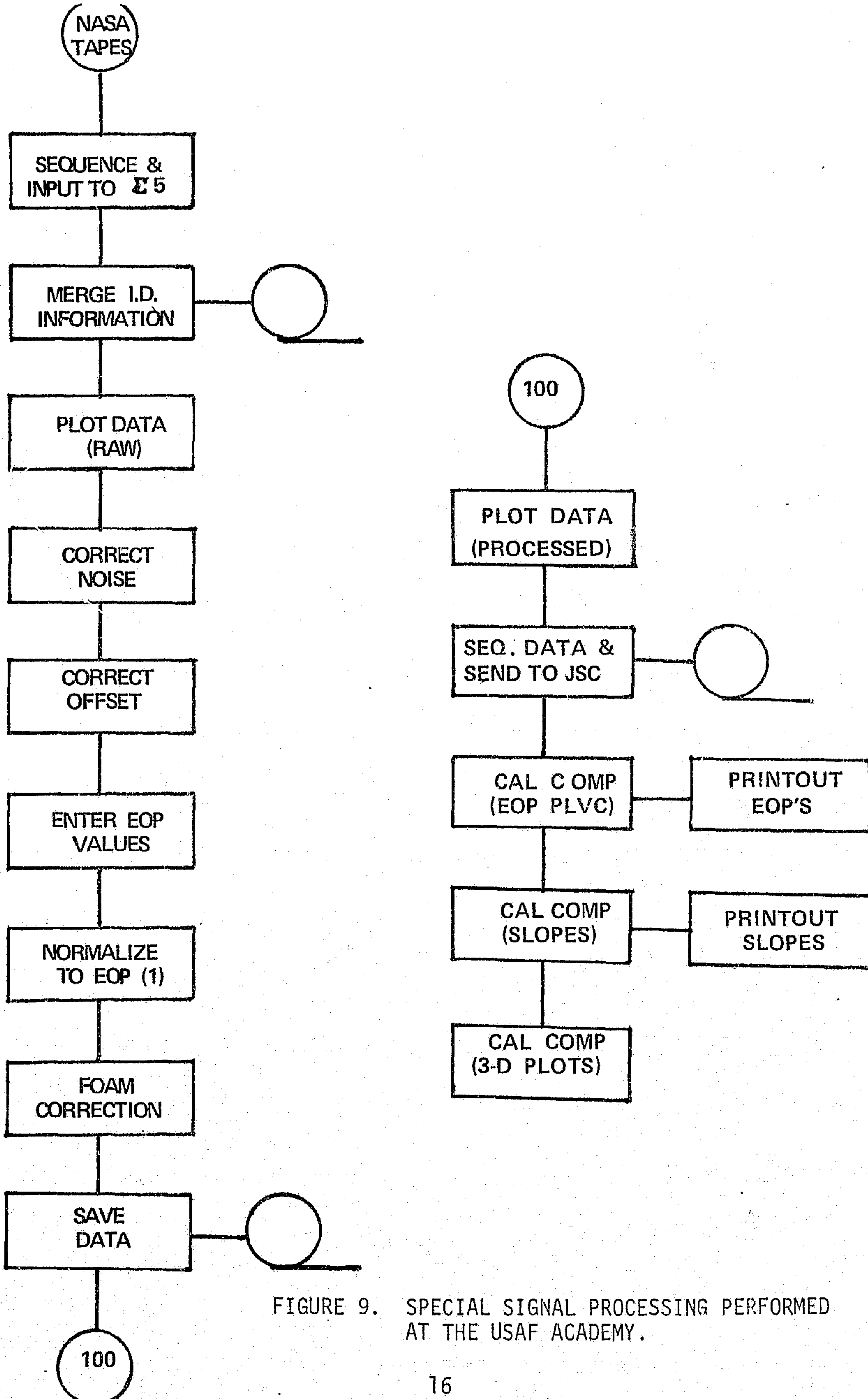


FIGURE 9. SPECIAL SIGNAL PROCESSING PERFORMED AT THE USAF ACADEMY.

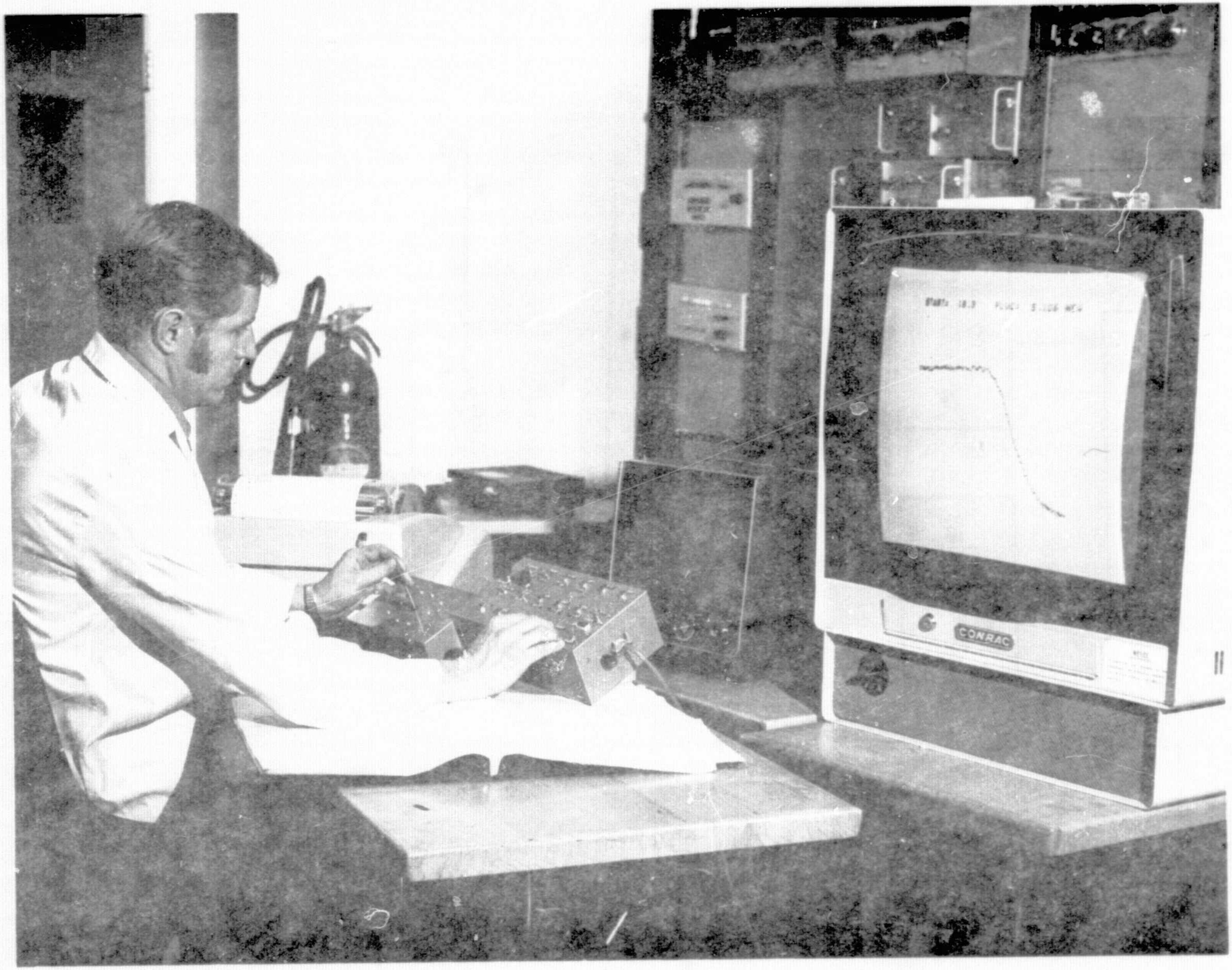


FIGURE 10. INTERACTIVE GRAPHICS TERMINAL USED FOR SPECIAL PROCESSING OF SKYLAB LVMS DATA.

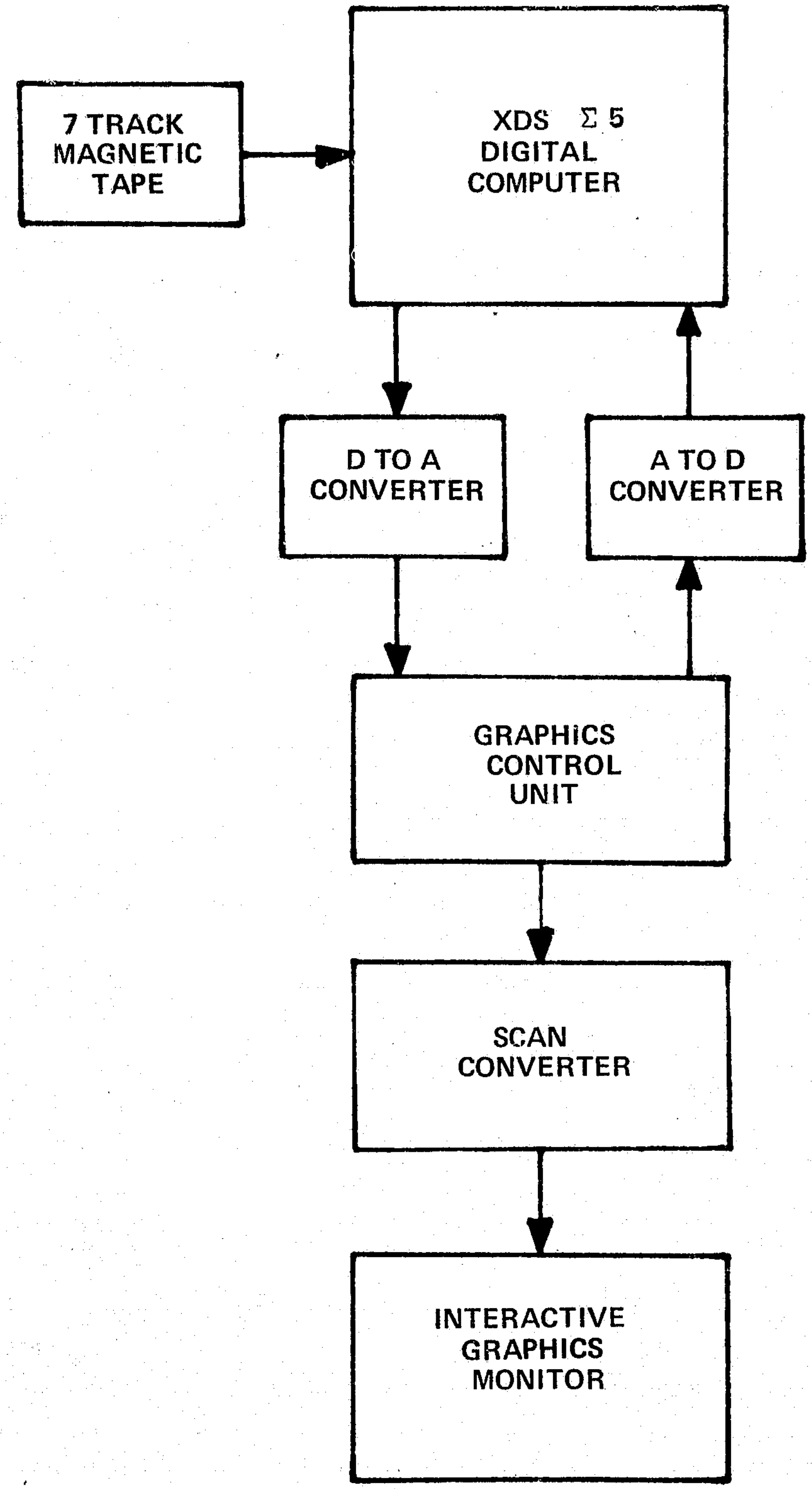


FIGURE 11. BLOCK DIAGRAM FOR SIGNAL PROCESSING.

contain the additional information and serve as summary data tables for each astronaut. Missing runs or asterisks as shown on these tables indicate that the data was not available from Johnson Space Center. The considerable amount of noise, wild points and offsets were removed from the data by the judicious use of the Wild Point Editor, Bias and Update functions of the Interactive Graphics Processor. Examples of raw and processed data plots are illustrated in Figures 12 to 19. In the course of the processing, more accurate end of period (EOP) times were obtained by sampling the time array just as the levels of negative pressure changed. These new times were added to the information elements of supplemental or summary data arrays. The EOP times obtained in this manner and used for all subsequent data processing are contained in Tables 6 to 8. Figure 20 contains the frequency of use data on plethysmographs used for the Skylab 3 Mission.

In order to simplify subsequent processing it was necessary to adjust the data (at least the PLVC data array) to a baseline or reference point. This was accomplished by normalizing the PLVC data array to the mean of the last 10 data samples just prior to the onset of the 8mm Hg negative pressure level.

A foam correction factor was applied to the normalized percent leg volume change to account for the minor difference in leg volume resulting from the back pressure of the foam of the leg band upon the small vessels at the surface of the calf. The foam correction factor was determined from physiological tests comparing data taken with Whitney Guages and Capacitive Plethysmographs. The foam correction factor is a data transform using the best fit second order polynomial equation obtained experimentally for each band size. The equation used for the processing of all Skylab data was $Y = .001 + .90X - .002X^2$. The Y value was the output for the capacitive leg bands and the X represented the Whitney output. This foam correction factor enables the leg band calibration derived from the calibration cylinders to reflect the soft tissue-foam compression interaction on the skin of the calf.

The plots of the M092 leg volume data subjected to the above processing and representing the final data used for statistical comparison and analysis are contained in Appendix D.

ORIGINAL PAGE IS
OF POOR QUALITY

TABLE 3. SUMMARY DATA FOR SKYLAB 3 COMMANDER.

				LEFT LEG LVMS DATA				RIGHT LEG LVMS DATA								AMBIENT		LBNPD			
RUN	JUL.	EXPR.	DATA	BAND	CAL.			BAND	CAL.			L.L.	R.L.	BODY	BODY	TEMPERATURE		TEMPERATURE			
NO.	DATA	CODE	CODE	I.D.	REQ.	PRE.	POST	I.D.	REQ.	PRE.	POST	CIRC	CIRC	MASS	TEMP	START	END	START	P1	P4	P5
1	80	1	1	BL	3.90	3.91	3.86	BP	3.10	3.16	3.18	36.20	36.80	68.9	36.3	19.9	20.0	21.1	21.2	21.4	21.6
2	113	1	3	BP	3.10	3.04	3.08	BL	3.90	3.82	3.95	36.20	36.80	69.4	36.2	20.0	20.0	21.1	20.3	20.8	20.8
3	150	1	38	BY	3.70	3.65	3.54	BT	3.10	3.02	2.99	34.90	35.90	68.5	36.7	21.7	21.7	22.8	22.0	22.4	22.4
4	178	1	1	AP	3.00	****	****	BA	3.10	****	****	34.40	35.70	68.9	36.9	22.5	22.2	23.1	23.3	23.4	23.8
5	193	1	1	CY	3.40	3.42	3.58	AP	3.00	2.79	3.12	34.30	35.60	68.0	36.3	23.9	23.9	25.6	25.6	25.6	25.8
6	204	1	8	CY	3.40	3.44	3.65	AP	3.00	3.16	3.11	35.10	36.10	68.5	36.3	23.9	24.4	24.4	24.4	25.0	25.0
7	214	2	34	CH	3.20	3.03	3.00	CV	3.10	2.98	3.03	33.70	34.60	65.9	37.1	25.6	25.6	27.8	28.2	28.2	28.3
8	219	2	3	CH	3.20	3.10	3.14	BU	3.50	3.45	3.19	33.00	34.00	66.0	36.4	25.8	25.9	27.2	27.4	27.7	27.8
9	224	2	2	CI	4.50	4.28	4.27	AQ	3.20	3.19	3.03	33.40	34.30	66.1	36.6	23.3	23.8	25.6	25.3	25.4	25.6
10	228	2	48	CI	4.50	4.44	4.30	AQ	3.20	3.12	2.98	33.00	34.10	66.2	****	23.6	23.6	25.0	25.1	25.6	25.6
11	232	2	37	CI	4.50	****	4.11	AQ	3.20	****	3.07	32.70	34.00	65.9	36.7	****	****	26.1	26.4	26.6	26.7
12	235	2	7	CI	4.50	4.30	3.71	AQ	3.20	3.10	3.07	33.00	34.00	66.1	****	24.4	24.8	26.1	26.2	26.5	26.6
13	239	2	3	CI	4.50	4.36	****	AQ	3.20	3.22	3.03	32.40	33.70	66.4	37.0	24.8	25.0	26.1	26.3	25.4	26.7
14	242	2	1	CI	4.50	4.43	4.24	AQ	3.20	3.10	3.07	32.40	33.70	66.6	37.0	23.8	23.8	25.0	25.0	25.6	25.6
15	244	2	1	CI	4.50	3.03	2.98	AQ	3.20	4.39	****	32.70	33.70	66.4	****	24.0	23.9	25.6	25.6	25.6	26.1
16	248	2	3	CI	4.50	4.44	4.30	AQ	3.20	3.12	3.03	32.40	33.70	66.4	****	22.6	22.8	23.3	23.9	23.9	24.4
17	251	2	3	CI	4.50	4.38	4.00	AQ	3.20	3.17	3.00	32.40	33.70	66.5	****	23.7	23.7	24.4	24.4	25.0	25.0
18	254	2	34	CI	4.50	4.47	****	AQ	3.20	3.10	2.98	32.40	33.30	66.0	****	23.2	23.3	23.9	24.4	24.4	24.4
19	257	2	3	CI	4.50	4.47	4.26	AQ	3.20	3.24	3.17	32.40	33.30	65.8	37.0	23.3	23.4	23.9	23.9	24.4	24.4
20	260	2	3	CI	4.50	4.59	****	AQ	3.20	3.14	3.12	32.40	33.30	65.9	****	23.3	23.3	23.9	24.4	24.4	24.4
21	263	2	3	CI	4.50	4.43	4.32	AQ	3.20	3.07	3.05	32.40	33.30	66.2	36.8	22.7	22.6	23.3	23.9	23.9	23.9
22	266	2	3	CI	4.50	4.32	4.30	AQ	3.20	3.10	3.05	32.10	33.30	65.3	37.1	23.3	23.2	24.4	24.4	25.0	25.0
23	268	3	3	CE	3.60	3.61	3.69	AP	3.00	2.97	3.08	32.10	32.80	64.6	36.4	20.9	21.8	22.5	22.6	22.8	23.1
24	269	3	3	CG	3.90	3.54	3.50	AP	3.00	2.93	3.04	32.30	33.30	64.2	37.1	22.3	22.3	24.1	24.1	23.8	23.9
25	270	3	23	CE	3.60	3.47	3.54	AP	3.00	3.23	3.01	32.10	33.40	64.5	36.1	22.2	23.0	23.6	23.7	23.7	23.9
26	272	3	3	CE	3.60	3.58	3.60	AP	3.00	2.86	3.13	32.80	34.60	66.8	36.9	23.2	23.1	24.1	24.2	24.5	24.8
27	273	3	3	CE	3.60	3.65	3.79	AP	3.00	3.02	3.13	32.90	34.90	66.5	36.7	23.9	23.6	24.7	24.2	24.9	23.9
28	277	3	3	CE	3.60	3.49	3.71	AP	3.00	3.02	3.19	32.80	34.50	66.8	36.7	21.1	21.4	20.0	****	****	22.5
29	284	3	23	CG	3.90	3.87	4.00	AP	3.00	3.09	3.01	33.70	35.20	67.6	36.4	22.9	22.1	23.2	23.6	24.1	23.9
30	297	3	23	CY	3.40	3.54	3.60	AP	3.00	3.00	3.01	34.30	36.10	69.4	36.4	21.7	20.9	22.5	22.5	22.5	22.4

* Indicates data was not available.

Data code is a condition code for signal processing (See Appendix C).

EXPR CODE

1 = Preflight
2 = In-flight
3 = Postflight

TABLE 4. SUMMARY DATA FOR SKYLAB 3 SCIENTIST PILOT.

				LEFT LEG LVMS DATA				RIGHT LEG LVMS DATA								AMBIENT TEMPERATURE		LBNPD TEMPERATURE			
RUN NO.	JUL. DATA	EXPR. CODE	DATA CODE	BAND I.D.	CAL. REQ.	PRE.	POST	BAND I.D.	CAL. REQ.	PRE.	POST	L.L. CIRC	R.L. CIRC	BODY MASS	BODY TEMP	START	END	START	P1	P4	P5
1	67	1	3	AY	3.90	3.98	3.83	AZ	3.90	4.17	4.13	35.20	34.90	61.7	36.7	20.2	20.3	20.9	21.6	21.6	21.8
2	95	1	3	AY	3.90	3.98	3.83	AZ	3.90	4.10	4.14	34.90	35.60	62.1	36.5	20.9	20.8	21.2	21.6	21.8	22.2
3	178	1	1	AP	3.00	****	****	BA	3.10	****	****	34.50	34.30	61.7	36.8	23.3	22.8	23.9	****	****	24.4
4	193	1	3	AP	3.00	3.02	3.61	CY	3.60	3.61	****	34.00	34.20	61.5	36.5	23.9	22.8	25.6	25.8	24.7	24.7
5	204	1	8	AP	3.00	2.93	3.11	CY	3.60	3.84	3.08	34.50	34.60	61.9	36.9	25.0	24.4	26.8	25.8	25.6	25.7
6	213	2	47	AX	3.70	3.59	3.57	CJ	3.50	3.40	3.38	33.30	33.00	59.4	36.8	27.3	27.3	28.9	28.8	28.8	28.9
7	216	2	1	AX	3.70	3.66	3.95	BU	3.50	3.36	3.36	33.00	33.00	59.4	36.9	25.8	26.1	26.7	25.4	26.9	27.2
8	220	2	3	AX	3.70	3.71	3.59	BU	3.50	3.57	3.33	32.70	32.40	59.1	36.6	25.0	25.2	26.1	26.3	26.6	26.7
9	225	2	1	US	3.80	****	3.64	AQ	3.20	****	3.07	32.40	32.40	59.1	36.7	23.2	23.2	25.0	24.7	24.9	25.0
10	229	2	78	US	3.80	3.69	3.71	AQ	3.20	3.12	3.07	32.40	32.10	58.9	****	22.9	23.1	24.4	24.6	24.9	25.0
12	235	2	1	US	3.80	3.69	3.64	AQ	3.20	3.05	3.07	31.80	31.80	58.6	36.8	23.8	24.3	****	25.3	25.8	26.0
13	237	2	1	US	3.80	3.83	3.81	AQ	3.20	3.10	3.17	31.80	31.60	58.7	36.8	24.9	24.9	26.7	26.7	26.8	27.1
14	240	2	1	US	3.80	3.71	3.62	AQ	3.20	2.96	2.86	32.00	32.00	58.8	36.9	24.1	24.2	25.0	25.6	25.6	25.6
15	243	2	38	US	3.80	3.71	3.10	AQ	3.20	3.74	3.05	32.10	31.80	58.6	36.8	24.8	25.1	26.1	26.1	26.7	26.7
16	246	2	37	US	3.80	3.66	3.66	AQ	3.20	3.00	2.96	32.00	31.80	58.8	****	23.2	23.2	24.4	24.4	24.4	25.0
17	249	2	1	US	3.80	3.50	3.48	AQ	3.20	3.00	3.03	31.40	31.10	58.3	****	22.3	22.4	23.3	23.3	23.9	23.9
18	253	2	1	US	3.80	3.69	3.66	AQ	3.20	3.36	3.03	31.80	31.60	58.1	****	23.4	23.4	23.9	24.4	24.4	24.4
19	255	2	1	US	3.80	3.71	3.95	AQ	3.20	3.10	2.98	31.80	31.40	58.6	****	23.2	23.2	23.9	23.9	24.4	24.4
20	258	2	1	US	3.80	3.64	3.64	AQ	3.20	3.03	2.98	31.80	31.40	58.3	****	22.8	23.0	23.3	23.3	23.9	23.9
21	261	2	1	US	3.80	3.78	3.71	AQ	3.20	3.00	3.00	31.40	31.10	58.2	36.7	23.1	23.2	24.4	24.4	24.4	24.4
22	264	2	1	US	3.80	****	3.71	AQ	3.20	****	3.07	31.40	31.10	59.0	37.0	23.1	23.2	23.9	23.9	24.4	24.4
23	266	2	37	US	3.80	3.71	3.66	AQ	3.20	3.07	3.07	31.10	30.80	58.0	36.9	22.9	22.9	23.9	23.9	24.4	24.4
24	268	3	3	UE	3.60	3.42	3.38	AP	3.00	2.81	3.03	31.10	30.60	58.2	36.9	20.7	19.9	22.5	22.6	22.7	22.8
25	269	3	3	UE	3.60	3.47	3.70	AP	3.00	2.97	3.08	31.90	31.30	58.3	36.5	20.8	22.4	23.1	23.1	23.2	23.4
26	270	3	3	UE	3.60	3.56	3.67	AP	3.00	3.16	3.18	31.80	31.40	58.9	36.9	22.7	23.0	22.6	23.0	23.7	24.1
27	272	3	3	UE	3.60	3.37	3.62	AP	3.00	2.95	3.08	32.10	31.90	60.0	36.5	22.8	22.7	19.3	19.9	23.7	23.8
28	273	3	3	UE	3.60	3.35	3.60	AP	3.00	2.97	3.03	32.10	31.90	60.2	36.6	22.2	24.2	23.3	****	****	24.7
29	277	3	1	UE	3.60	3.56	3.71	AP	3.00	2.95	3.05	32.90	32.30	60.3	36.7	23.9	21.4	23.9	24.2	23.9	23.7
30	284	3	1	UG	3.90	3.87	4.04	AP	3.00	3.04	3.13	33.00	32.90	61.1	37.0	24.4	24.1	25.0	25.1	24.9	25.3
31	297	3	1	AP	3.00	3.21	3.04	CY	3.60	3.73	3.62	33.80	33.40	61.8	36.8	20.3	20.0	21.7	21.6	21.6	21.7

* Indicates data was not available.

Data code is a condition code for signal processing (See Appendix C).

EXPR CODE
1 = Preflight
2 = In-flight
3 = Postflight

TABLE 5. SUMMARY DATA FOR SKYLAB 3 PILOT.

RUN NO.	JUL. DATA	EXPR CODE	DATA CODE	LEFT LEG LVMS DATA BAND I.D.	CAL. REQ.	PRE.	POST	RIGHT LEG LVMS DATA BAND I.D.	CAL. REQ.	PRE.	POST	L.L. CIRC	R.L. CIRC	BODY MASS	BODY TEMP	AMBIENT TEMPERATURE START	END	LBNPD TEMPERATURE START	P1	P4	P5
1	79	1	7	AG	3.70	3.70	3.76	BF	3.20	3.18	3.29	39.40	40.30	89.8	36.4	21.1	21.3	21.9	22.2	22.7	22.8
2	92	1	8	BF	3.20	3.28	3.15	AG	3.70	3.75	3.76	40.00	41.00	88.5	36.1	20.7	20.8	21.6	21.8	22.1	22.4
3	178	1	1	BD	3.40	****	****	BE	3.00	****	****	39.10	39.50	87.9	36.6	23.1	22.8	24.4	24.4	24.4	24.4
4	193	1	99	BE	3.00	2.86	3.03	CC	3.00	3.24	3.31	38.30	39.40	87.1	36.3	23.9	23.6	25.0	25.0	25.0	24.9
5	204	1	1	BE	3.00	2.79	2.92	CC	3.00	2.97	3.15	39.00	39.90	87.7	36.5	23.9	23.9	25.6	25.6	25.6	25.6
6	214	2	8	AD	3.40	3.59	3.57	CV	3.10	3.04	3.00	37.50	38.40	85.7	****	26.6	26.8	27.8	27.9	28.2	28.3
7	219	2	7	AD	3.40	3.31	3.36	CV	3.10	2.98	2.93	37.20	37.80	85.8	36.5	25.1	25.1	26.7	25.4	26.8	26.9
8	224	2	7	BK	3.60	3.62	3.55	BU	3.50	3.31	3.36	36.80	37.50	85.9	36.7	****	****	25.0	25.0	25.2	25.6
9	227	2	7	BK	3.60	3.52	3.45	BU	3.50	3.43	3.38	36.80	37.80	86.0	36.6	22.9	23.3	23.9	24.4	24.9	25.0
10	231	2	1	BK	3.60	3.48	3.43	BU	3.50	3.31	3.31	36.80	37.50	85.8	36.8	23.2	23.4	24.4	25.0	25.3	25.6
11	234	2	1	BK	3.60	3.55	3.62	BU	3.50	3.48	3.43	36.50	37.50	85.7	39.4	23.6	23.8	25.0	25.6	25.8	25.9
12	237	2	78	BK	3.60	3.57	3.45	BU	3.50	3.38	3.31	36.50	37.50	85.6	****	24.0	24.0	25.6	26.0	26.1	26.2
13	241	2	1	BK	3.60	3.45	3.50	BU	3.50	3.50	3.22	36.40	37.20	85.7	36.8	23.8	24.0	25.0	25.0	25.6	25.6
14	243	2	3	BK	3.60	3.57	3.43	BU	3.50	3.38	3.31	36.20	37.20	85.7	****	23.3	23.3	24.4	24.4	24.4	25.0
15	247	2	1	BK	3.60	3.62	3.50	BU	3.50	3.48	3.48	35.90	36.80	85.6	36.8	23.2	23.2	24.4	24.4	24.4	25.0
16	250	2	1	BK	3.60	3.57	3.36	BU	3.50	3.40	3.33	36.00	37.00	85.9	****	23.2	23.2	23.9	23.9	24.4	24.4
17	253	2	8	BK	3.60	****	3.50	BU	3.50	****	3.31	35.90	36.80	85.7	36.8	22.6	22.7	23.3	23.3	23.9	23.9
18	256	2	3	BK	3.60	3.50	3.43	BU	3.50	3.36	3.31	35.90	36.50	85.7	36.6	22.6	22.8	23.3	23.9	24.4	24.4
19	259	2	1	BK	3.60	3.48	3.40	BU	3.50	3.31	3.31	35.90	36.80	85.3	37.2	23.7	23.9	24.4	25.0	25.6	25.6
20	262	2	8	BK	3.60	3.69	3.38	BU	3.50	3.45	3.40	35.90	36.50	85.7	35.9	22.6	22.3	23.9	23.9	23.9	24.4
21	266	2	8	BK	3.60	3.40	4.04	BU	3.50	3.43	3.33	35.60	36.50	85.1	36.9	22.2	22.3	23.3	23.3	23.9	23.9
22	268	3	8	BB	3.30	3.16	3.27	BC	3.60	3.68	3.60	36.10	37.10	84.1	36.4	18.9	20.7	22.3	22.1	21.7	21.9
23	269	3	1	BC	3.60	3.30	3.64	BB	3.30	3.16	3.32	35.50	36.70	84.1	36.7	22.2	22.3	23.4	23.6	23.8	24.1
24	270	3	1	BB	3.30	3.04	3.34	BC	3.60	3.65	3.62	36.00	37.10	84.6	36.7	22.4	22.0	23.5	23.6	23.7	23.9
25	272	3	1	BB	3.30	2.90	3.34	BC	3.60	3.68	3.67	38.40	38.50	87.1	36.9	23.6	24.5	25.2	25.5	25.6	25.7
26	273	3	8	BC	3.60	3.49	3.62	BB	3.30	3.28	3.36	38.40	38.20	87.0	36.8	22.8	22.5	25.0	****	****	****
27	277	3	8	BB	3.30	2.97	3.31	BC	3.60	3.63	3.64	38.10	38.80	86.7	36.4	22.2	21.7	24.4	24.2	23.7	23.7
28	284	3	8	BD	3.40	3.21	3.55	BB	3.30	3.49	3.48	38.30	39.60	88.7	36.4	23.4	21.6	25.7	25.5	24.2	24.1
29	297	3	8	BD	3.40	3.40	2.75	BE	3.00	2.97	3.05	38.60	39.20	88.0	36.7	23.9	23.9	24.7	24.6	24.8	25.1

* Indicates data was not available.

Data code is a condition code for signal processing (See Appendix C).

EXPR CODE
1 = Preflight
2 = In-flight
3 = Postflight

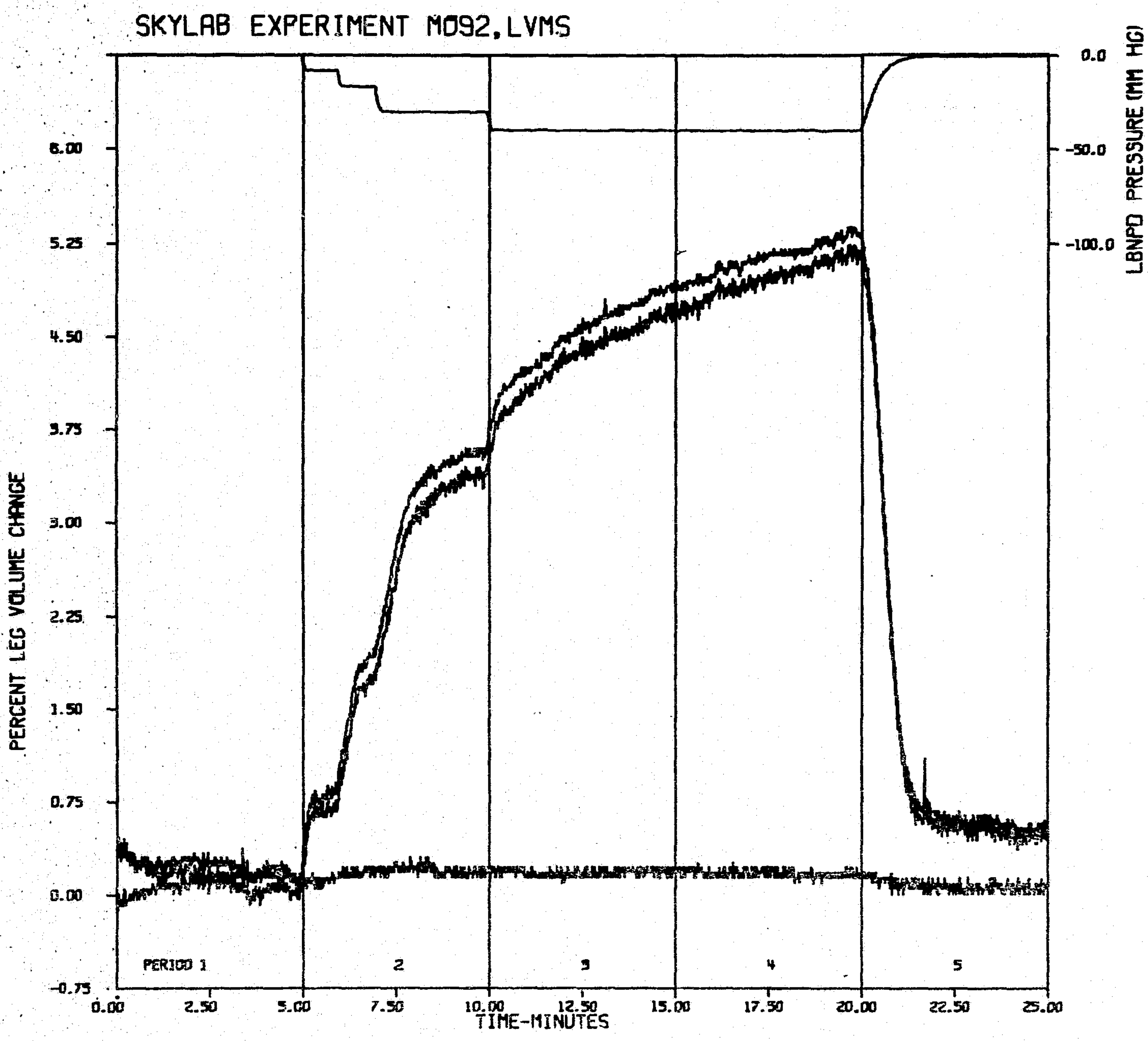


FIGURE 12. PLOT OF UNPROCESSED DATA.

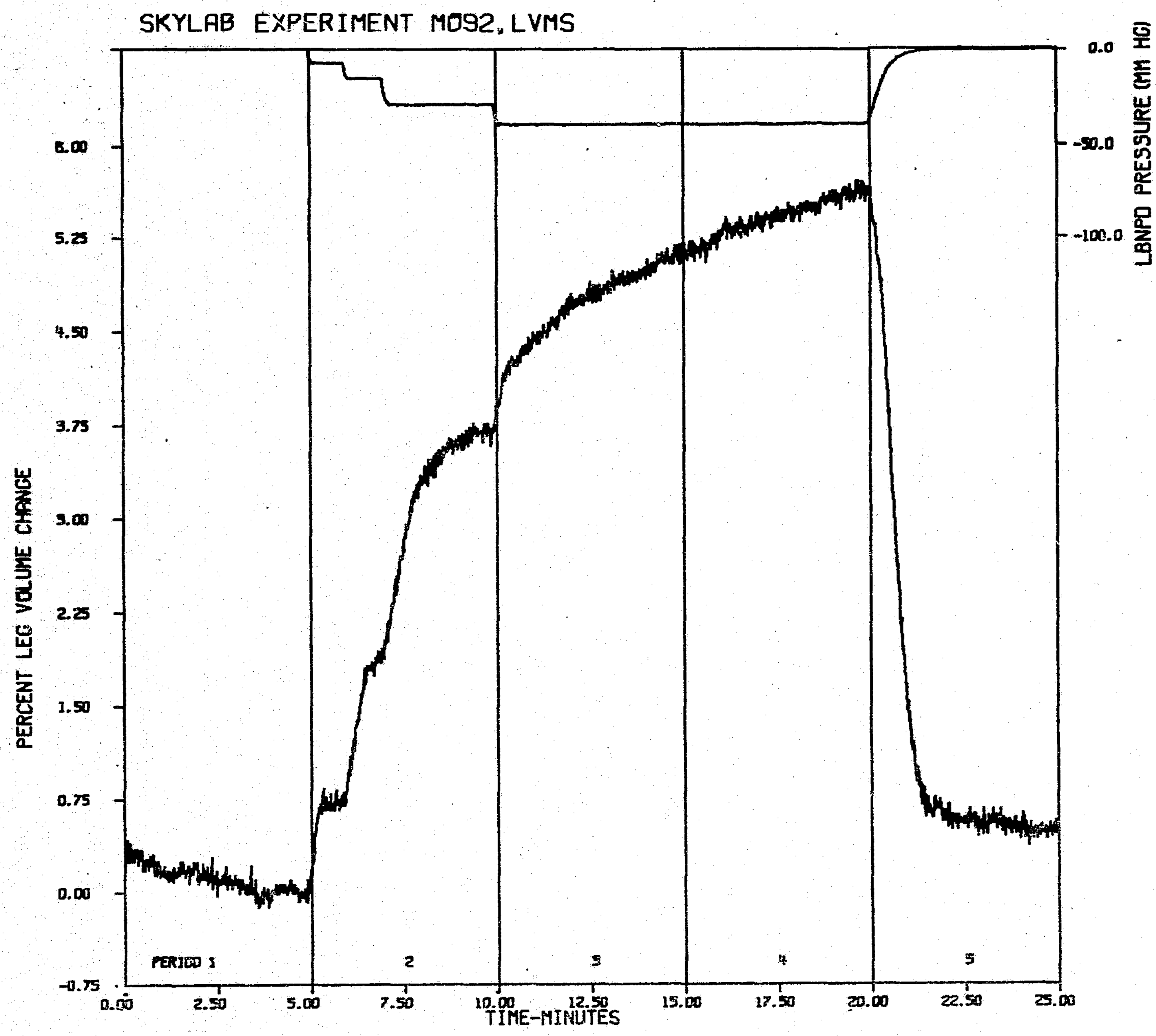


FIGURE 13. PLOT OF PROCESSED DATA.

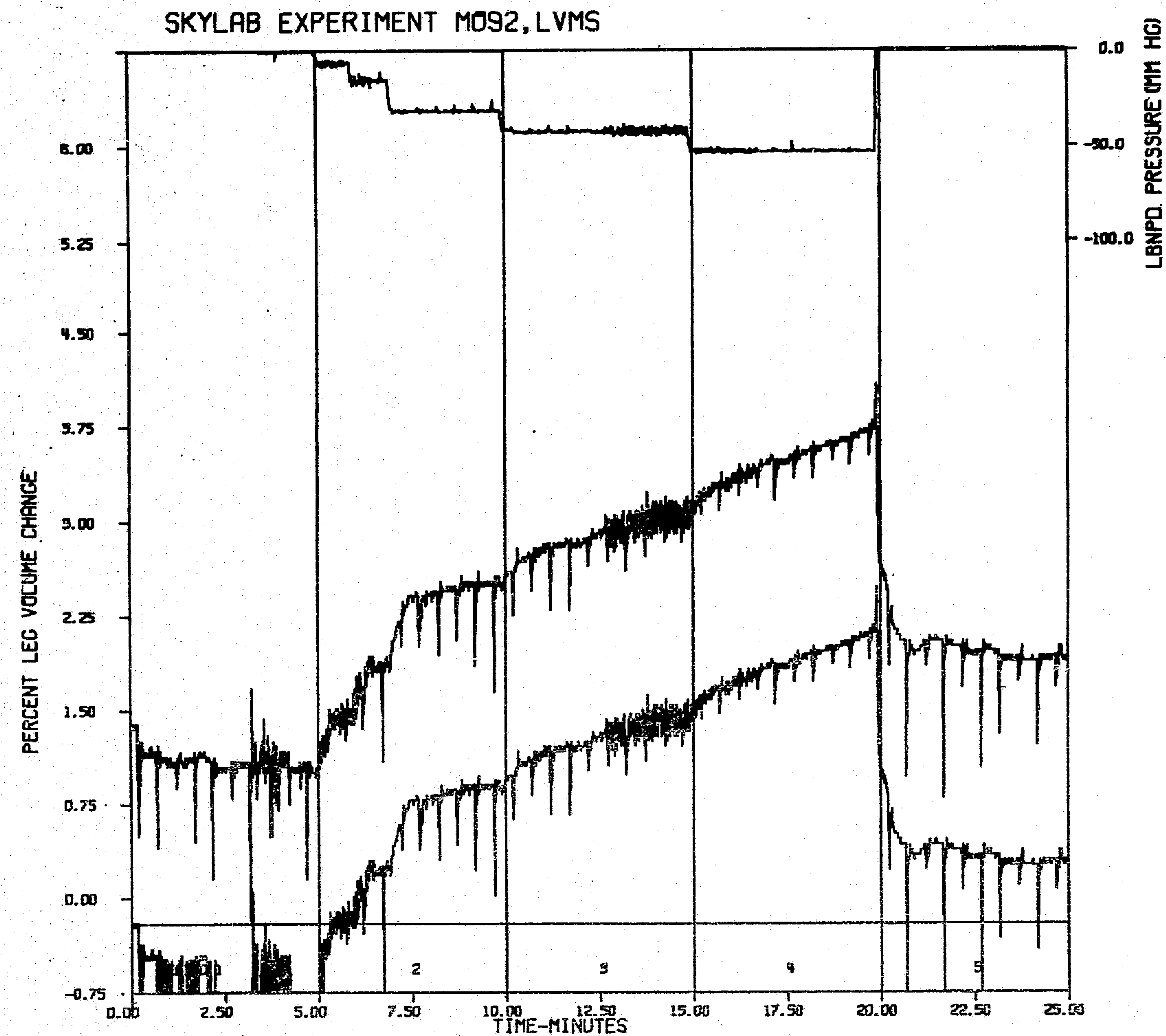


FIGURE 14. PLOT OF DATA WITH NOISE AND ELECTRICAL SPIKES.

25

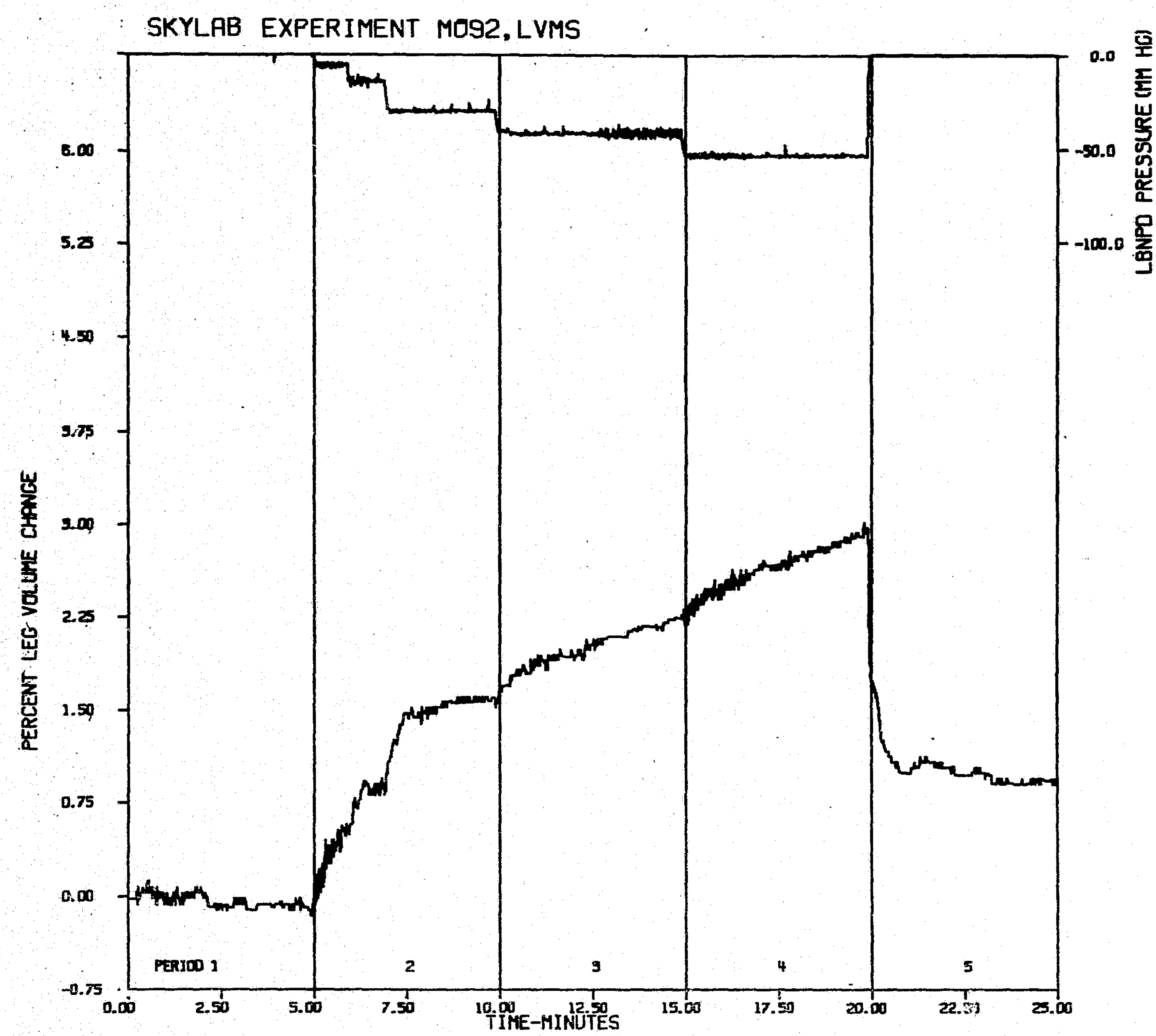


FIGURE 15. FINAL PROCESSED DATA.

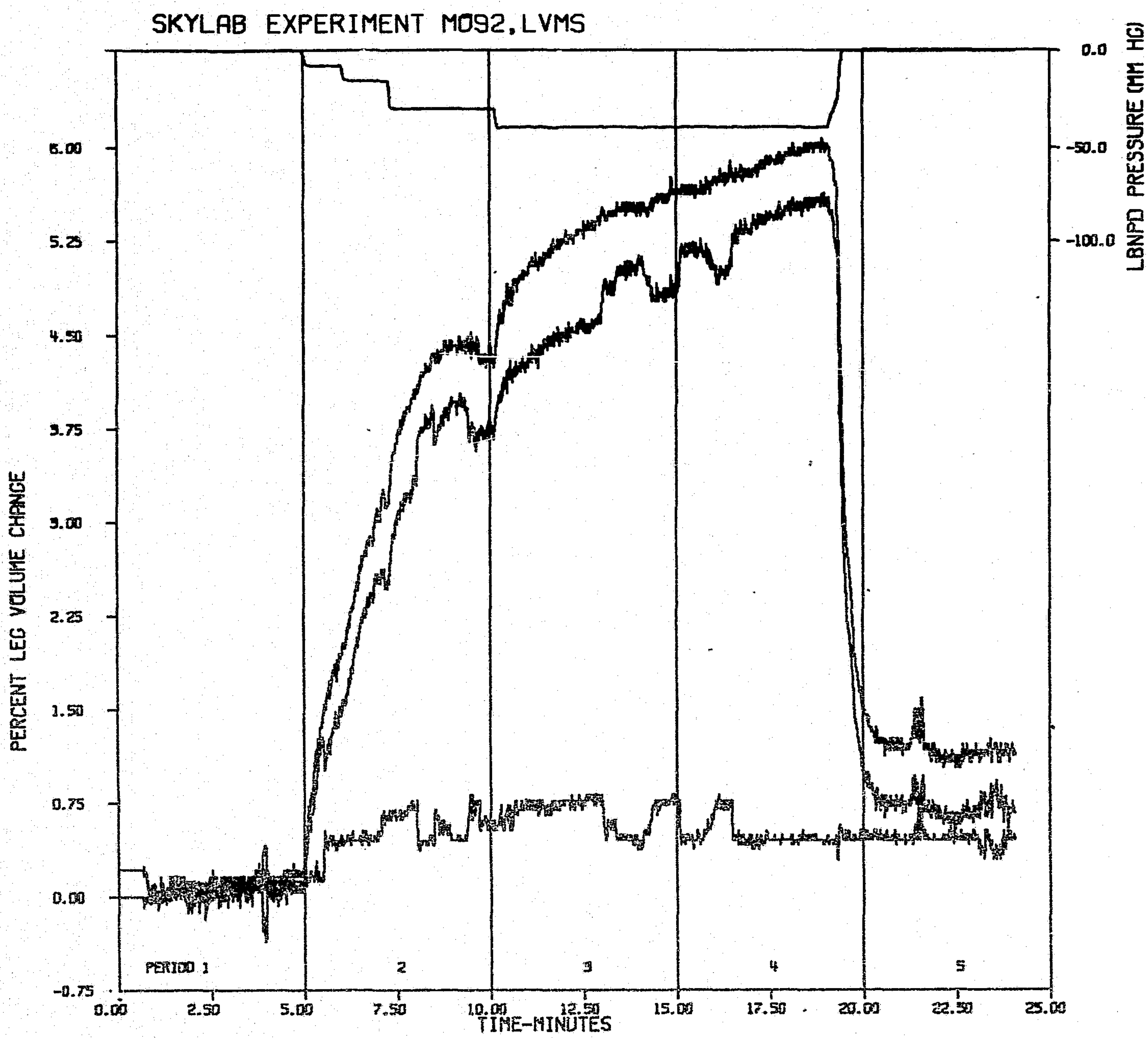


FIGURE 16. PLOT OF DATA WITH OFFSETS ON RIGHT LEG OUTPUT.

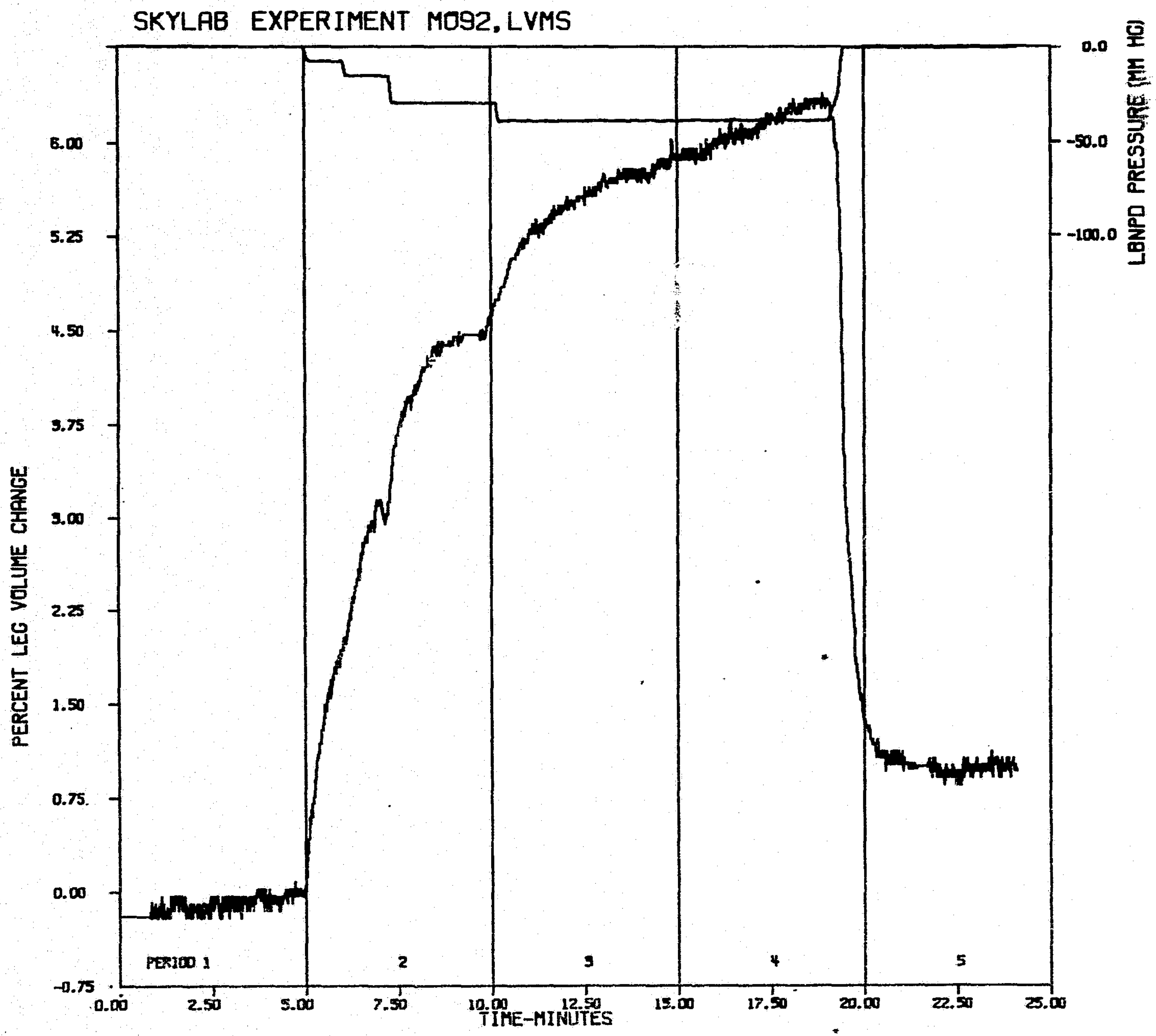


FIGURE 17. PLOT OF CORRECTED LEFT LEG DATA.

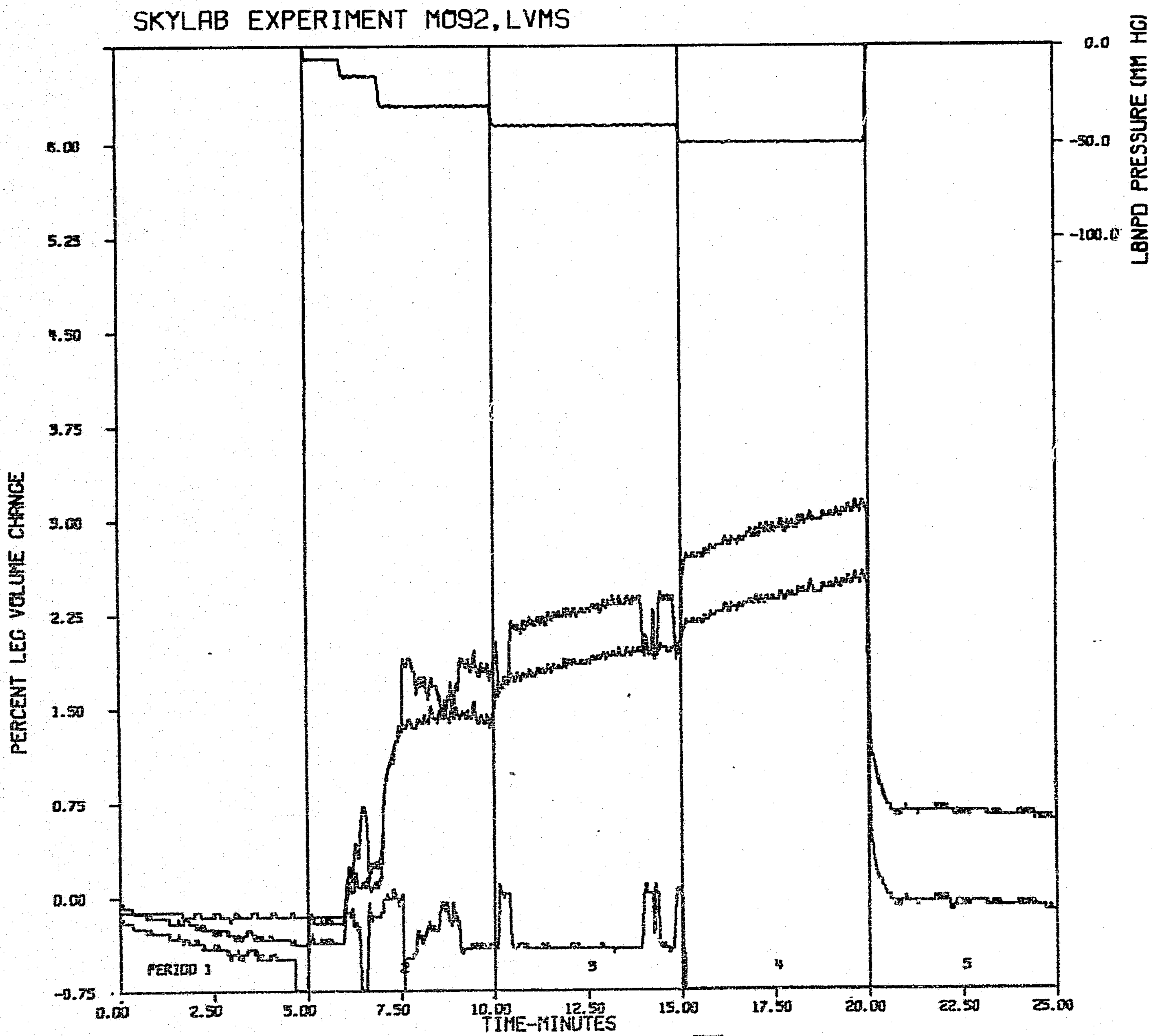


FIGURE 18. PLOT OF DATA WITH NOISE ON BOTH LEFT AND RIGHT LEG OUTPUTS.

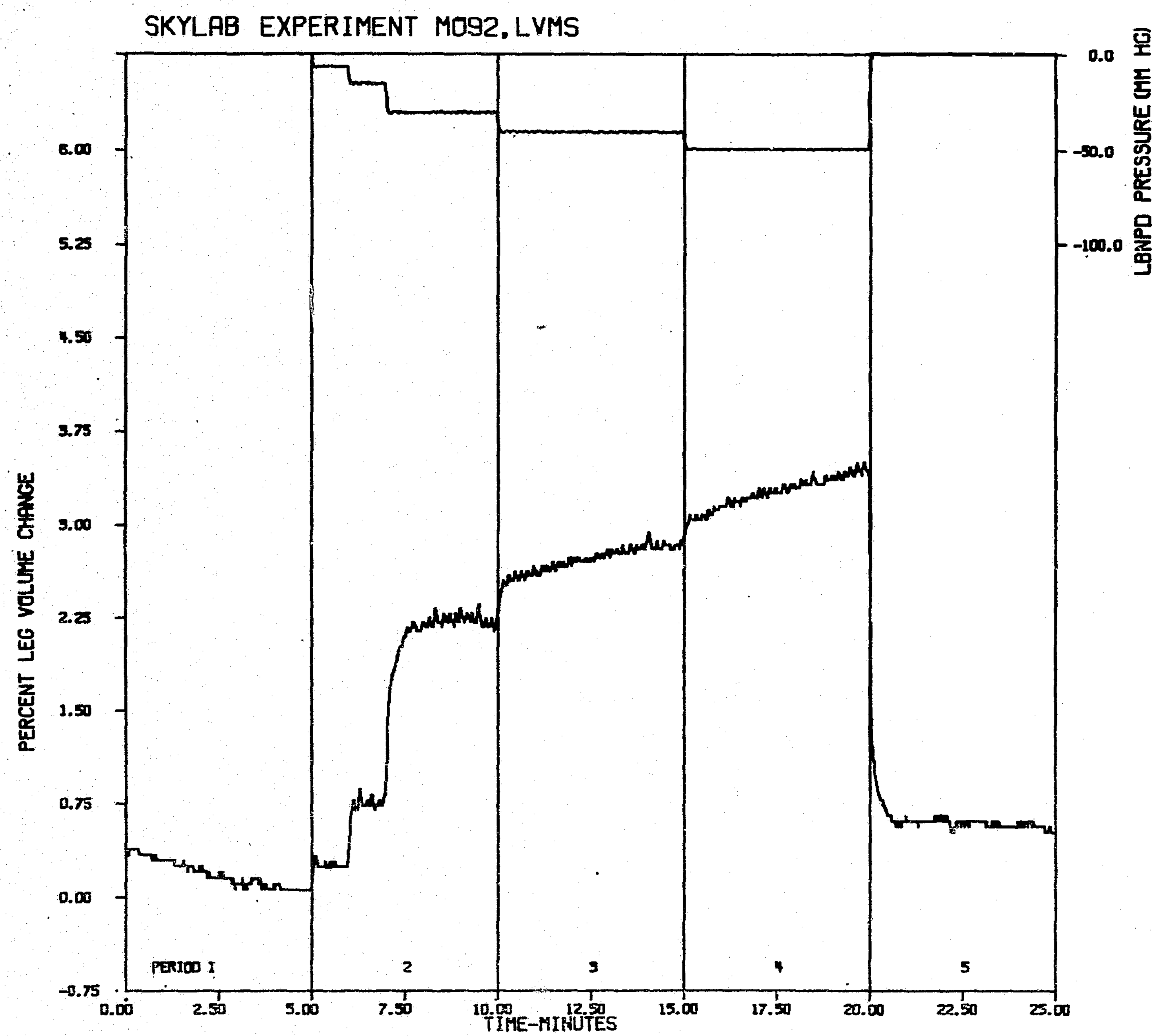


FIGURE 19. FINAL PROCESSED PLVC DATA.

TABLE 6. ELAPSED TIME (SECONDS) TO END OF PERIOD (EOP) FOR SKYLAB 3 COMMANDER.

RUN NO.	JUL. DATE	CONTROL	-8	-16	-30	-40	-50	RECOVERY
1	80	298.39893	363.19897	421.59888	599.19897	903.19800	1203.99683	1499.19580
2	113	299.19995	358.39893	416.79883	594.39893	895.19800	1197.59692	1498.39600
3	150	299.19897	358.39893	416.79883	601.59888	904.79785	1201.59692	1499.19580
4	178	299.19995	358.39990	419.19995	599.19995	899.19995	1199.19995	1499.19995
5	193	300.00000	360.00000	420.00000	600.00000	900.00000	1200.00000	1499.19995
6	204	300.00000	360.00000	420.79980	600.00000	896.00000	1200.00000	1499.19995
7	214	298.39990	357.60083	440.80078	597.60083	688.79980	0.50000*	998.40088
8	219	298.39990	361.60083	417.60083	596.00098	899.15088	1195.15088	1498.30078
9	224	298.40088	356.80078	416.00000	599.19995	895.19995	1196.00000	1268.00000
10	228	298.39893	385.59985	434.39893	600.00000	896.79980	1088.79980	1499.19897
11	232	285.62500	356.02490	403.22485	586.42480	885.62500	1184.82495	1482.42480
12	235	298.40088	353.60083	448.80078	592.75000	891.15088	1191.15088	1491.15088
13	239	298.37378	363.94995	418.34985	595.94897	895.12500	1198.32397	1498.32397
14	242	298.40088	357.60083	416.79980	596.79980	896.79980	1200.79980	1499.20093
15	244	298.39990	356.79883	416.79883	600.79980	899.19995	1197.59888	1499.19995
16	248	291.87500	374.37500	433.57495	615.97388	915.97388	1216.77393	1499.17480
17	251	298.40088	363.20093	415.19995	592.80078	891.20093	1196.79980	1492.80078
18	254	297.59888	357.59888	420.00000	596.00000	895.19995	1068.79980	1499.19995
19	257	298.39990	357.60083	419.19995	599.19995	898.39990	1198.39990	1499.19995
20	260	298.39990	356.00000	416.79980	597.59985	896.00000	1197.59985	1499.19995
21	263	297.59985	364.00000	417.59985	597.59985	900.00000	1199.19995	1499.19995
22	266	298.39990	355.19897	435.19897	594.39893	892.79980	1196.79980	1497.59985
23	268	299.19995	360.00000	420.00000	600.00000	900.00000	1199.19995	1499.19995
24	269	299.19995	360.00000	419.19995	599.19995	896.79980	1199.19995	1499.19995
25	270	299.19995	360.00000	419.19995	599.19995	899.19995	1199.19995	1499.19995
26	272	299.19995	359.19995	419.19995	599.19995	899.19995	1199.19995	1498.39990
27	273	299.19995	360.00000	419.19995	599.19995	900.00000	1199.19995	1499.19995
28	277	299.19995	359.19995	419.19995	599.19995	899.19995	1199.19995	1499.19995
29	284	299.19995	359.19995	422.39990	599.19995	899.19995	1198.39990	1498.39990
30	297	300.79980	356.79980	417.59985	596.79980	896.00000	1196.00000	1496.00000

* A value of .5 indicates that no data was collected for the indicated phase of the experiment.

TABLE 7. ELAPSEC TIME (SECONDS) TO END OF PERIOD (EOP) FOR SKYLAB 3 SCIENTIST PILOT.

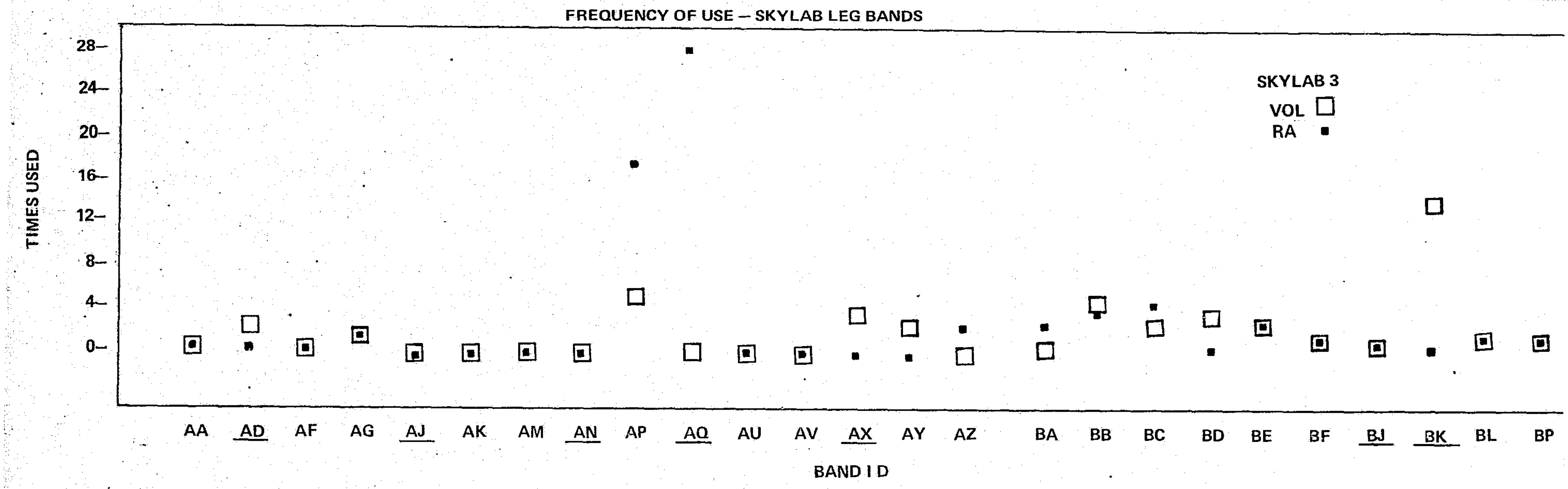
RUN NO.	JUL. DATE	CONTROL	-8	-16	-30	-40	-50	RECOVERY
1	67	299.19897	364.79883	422.39893	603.19800	899.19678	1202.39697	1499.19580
2	95	298.39893	359.19897	417.59888	599.99780	896.79688	1202.39600	1499.19482
3	178	299.19995	360.00000	420.00000	600.00000	900.00000	1197.59985	1499.19995
4	193	299.19995	360.00000	420.00000	604.79980	899.19995	1199.19995	1412.00000
5	204	299.19995	359.19995	419.19995	599.19995	899.19995	1199.19995	1499.19995
6	213	298.39893	356.00000	416.79883	584.00000	641.59985	0.50000*	949.59888
7	216	299.19995	363.19897	419.19995	596.77393	895.92480	1199.09888	1499.07495
8	220	299.19995	357.59888	418.39990	594.39990	895.99878	1194.39990	1495.99878
9	225	298.39893	357.57495	416.77490	596.74878	896.72485	1198.29980	1495.89893
10	229	298.39893	358.39893	420.75000	599.14990	895.92480	1199.09888	1499.09888
12	235	298.40088	358.40088	416.00098	596.00098	896.00098	1199.20093	1499.20093
13	237	298.39893	371.19897	416.79980	596.00000	895.19995	1197.59888	1498.39893
14	240	300.00000	339.19897	389.59985	569.59985	873.59985	1173.59985	1474.39990
15	243	298.40088	362.40088	419.19995	594.40088	896.00098	1197.60083	1498.40088
16	246	298.40088	364.00000	416.00098	601.60083	896.80078	1197.60083	1496.00098
17	249	298.40088	359.20093	478.40088	598.40088	898.34985	1197.54980	1499.09985
18	253	299.19995	360.77490	418.37378	602.37500	895.22485	1198.39990	1496.77490
19	255	298.39893	373.59985	420.00000	597.59888	895.92480	1199.12378	1499.12378
20	258	298.39990	357.60083	421.60083	602.40088	898.39990	1200.80078	1499.19995
21	261	298.39990	359.19995	418.39990	598.39990	900.00000	1200.00000	1499.19995
22	264	298.39990	355.99878	415.99878	592.00000	895.19897	1197.59985	1498.39990
23	266	298.39893	356.00000	417.59888	596.79883	898.39893	1197.59888	1490.39893
24	268	299.19995	362.39990	422.39990	602.39990	896.79980	1202.39990	1499.19995
25	269	299.19995	360.00000	420.00000	600.00000	900.00000	1198.39990	1499.19995
26	270	299.19995	360.00000	423.19995	600.00000	900.00000	1199.19995	1499.19995
27	272	299.19995	360.00000	420.00000	599.19995	900.00000	1199.19995	1499.19995
28	273	299.19995	359.19995	419.19995	599.19995	900.00000	1198.39990	1498.39990
29	277	299.19995	360.00000	420.79980	600.00000	900.00000	1199.19995	1499.19995
30	284	299.19995	359.19995	419.19995	599.19995	899.19995	1197.59985	1496.79980
31	297	299.19995	360.00000	420.00000	600.00000	900.00000	1200.00000	1499.19995

* A value of .5 indicates that no data was collected for the indicated phase of the experiment.

TABLE 8. ELAPSED TIME (SECONDS) TO END OF PERIOD (EOP) FOR SKYLAB 3 PILOT.

RUN NO.	JUL. DATE	CONTROL	-8	-16	-30	-40	-50	RECOVERY
1	79	300.00000	360.79980	428.79980	601.59888	905.59790	1204.79688	1499.19580
2	92	299.99878	357.59888	420.79883	599.19800	895.19800	1200.79688	1489.59595
3	178	299.19995	354.39990	414.39990	594.39990	895.19995	1194.39990	1494.39990
4	193	299.19995	360.00000	419.19995	600.00000	780.00000	0.50000*	0.50000*
5	204	299.19995	359.19995	419.19995	599.19995	900.00000	1203.19995	1499.19995
6	214	298.39893	353.59888	413.59888	598.39893	896.79980	1193.52393	1495.12500
7	219	298.40088	352.79980	412.00098	586.40088	891.92578	1189.50098	1481.50098
8	224	298.39893	392.79883	437.59888	584.00000	885.59888	1184.79883	1485.59888
9	227	297.57593	386.35083	421.55078	598.32593	897.52588	1197.52588	1497.47580
10	231	298.39990	352.00000	415.99878	592.79980	894.39990	1192.79980	1494.39990
11	234	298.37378	358.37378	419.17383	598.32397	899.09985	1196.69995	1491.89990
12	237	297.57397	343.17480	399.17383	579.17383	875.97485	1183.02393	1483.87500
13	241	298.39990	360.00000	436.79980	597.60083	896.80078	1196.80078	1497.60083
14	243	297.59985	384.79883	424.00000	601.59888	897.59985	1203.19995	1492.00000
15	247	298.39990	353.54980	414.34883	595.92480	891.12378	1195.09985	1495.89990
16	250	297.59888	358.39990	416.79883	597.59888	898.32495	1199.12500	1499.12500
17	253	297.59888	356.79980	417.59888	597.59888	897.59888	1199.19897	1499.19897
18	256	298.40088	370.40088	419.19995	597.60083	900.79980	1201.60083	1499.19995
19	259	298.39990	360.79980	419.19995	598.39990	900.00000	1199.19995	1499.19995
20	262	298.39893	351.19995	416.00000	591.99878	894.39990	1196.00000	1496.79883
21	266	297.60083	348.00000	412.79980	597.52588	895.12500	1193.52490	1493.52490
22	268	299.19995	359.19995	419.19995	599.19995	900.00000	1198.39990	1498.39990
23	269	299.19995	359.19995	420.00000	599.19995	900.00000	1199.19995	1499.19995
24	270	299.19995	359.19995	419.19995	599.19995	899.19995	1198.39990	1439.20000
25	272	300.00000	360.00000	420.00000	601.59985	900.00000	1200.00000	1499.19995
26	273	300.00000	359.19995	420.00000	599.19995	900.00000	1199.19995	1499.19995
27	277	299.19995	360.00000	420.00000	601.59985	900.00000	1199.19995	1499.19995
28	284	298.39990	359.19995	419.19995	599.19995	899.19995	1199.19995	1498.39990
29	297	299.19995	360.00000	420.00000	600.00000	900.00000	1199.19995	1499.19995

* A value of .5 indicates that no data was collected for the indicated phase of the experiment.



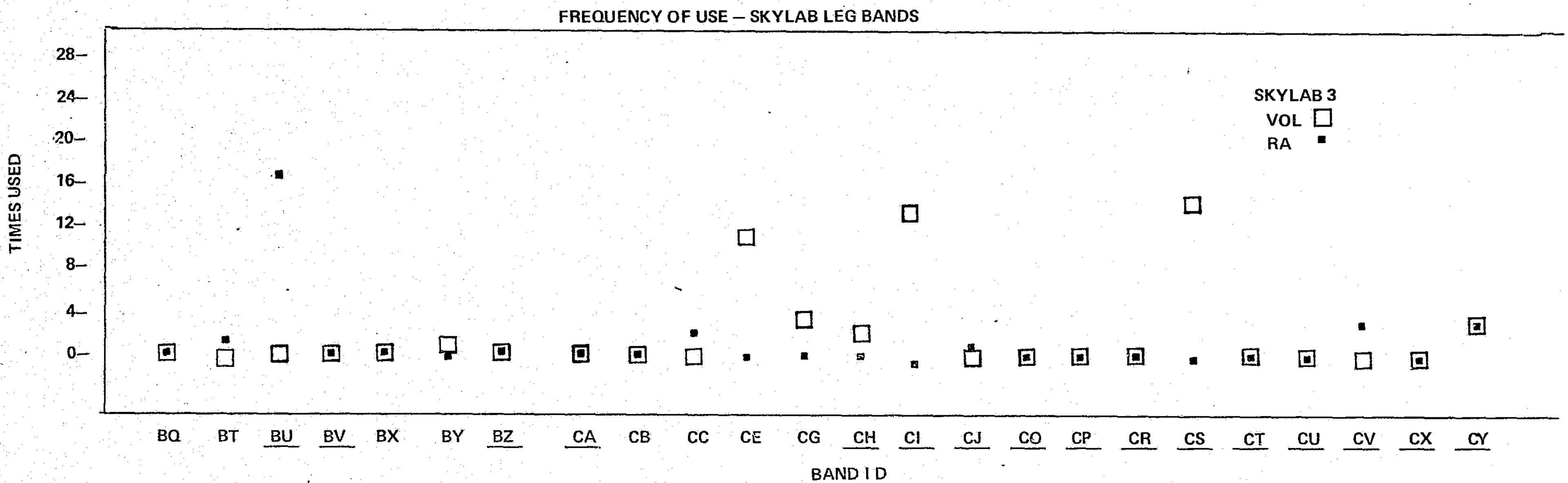


FIGURE 20. FREQUENCY OF USE FOR PLETHYSMOGRAPH FOR SKYLAB 3 MISSION.
Vol. (□) indicates use on left leg; R.A. (■) indicates use on right leg reference adapter. Underlined band ID indicates band in Skylab Workshop.

RESULTS

Calf Volume

The magnitude of the volume change at the calf in response to LBNP is tabulated in Tables 9 through 11. These tables indicate the end of period (EOP) percent leg volume change (PLVC) at each level of negative pressure for each experiment of the mission. These individual PLVC data are plotted by run number in Figures 21 to 23. The EOP percentage change in calf volume was computed by averaging the last ten data samples in each portion of the negative pressure protocol (con, -8, -16, -30, -40, -50 and REC). All data were previously normalized so that control period EOP values were zero and all other EOP values are expressed relative to the control period EOP. The discontinuous portion of the EOP PLVC graphs indicate test days when either the subject did not totally complete that portion of the protocol or the data could not be processed correctly.

The graphic presentation of the EOP PLVC data as plotted by run number indicates the nature of the volume variation occurring on the limited number of preflight experiments. The preflight variation which was similar for all three crewmembers presumably represents primarily the biological variation between runs and reflects the conditions of body weight, water balance, preflight stress but must also reflect some small variation due to the leg volume measuring system and the techniques utilized. The preflight EOP PLVC data also indicates the large quantitative differences between the crewmembers' volume responses to LBNP. The commander responded with an average 2.8% volume change at the -50 mm Hg level while the scientist pilot averaged 4.7% and the pilot averaged an intermediate 3.7% volume change.

In contrast to the Skylab 2 mission, the greater (-50 mm Hg) levels of the negative pressure profile were used on all crewmembers for the M092 in-flight experiments. The EOP PLVC data demonstrate an increase at the time of the first LBNP test in zero gravity. The response to in-flight LBNP experiments as shown in Figures 21 to 23 resulted in sizable increases in leg volume response (relative to preflight) for the

TABLE 9. END OF PERIOD (EOP) VALUES OF PERCENTAGE CHANGE IN CALF VOLUME BY LEVEL OF NEGATIVE PRESSURE FOR THE COMMANDER.

RUN	DAY	CODE	DATA	CON	-8	-16	-30	-40	-50	REC
1	80	1	PLVC	0.00	0.34	0.91	1.80	2.37	2.96	0.33
2	113	1	PLVC	0.00	0.00	0.27	1.03	1.51	2.10	0.05
3	150	1	PLVC	0.00	0.00	0.53	1.40	2.49	3.40	1.16
4	178	1	PLVC	0.00	0.05	0.44	1.35	2.11	2.95	0.54
5	193	1	PLVC	0.00	-0.02	0.50	1.29	1.96	2.77	0.18
6	204	1	PLVC	0.00	0.20	0.71	1.33	1.99	2.68	-0.73
7	214	2	PLVC	0.00	0.19	0.63	0.81	0.88#	****	-0.62
8	219	2	PLVC	0.00	0.82	1.18	1.85	2.36	3.99 #	1.01#
9	224	2	PLVC	0.00	0.24	0.69	1.44	2.05	2.94	0.60#
10	228	2	PLVC	0.00	0.52	1.00	1.93	2.84	3.36 #	0.01
11	232	2	PLVC	0.00	0.76	1.27	2.75	3.37	4.36	0.42
12	235	2	PLVC	0.00	0.75	1.31	2.15	2.93	3.97	0.41
13	239	2	PLVC	0.00	0.59	1.15	1.95	2.87	3.97	0.59
14	242	2	PLVC	0.00	0.73	1.43	2.43	3.38	4.42	-0.18
15	244	2	PLVC	0.00	0.54	1.07	1.98	2.84	3.62	0.18
16	248	2	PLVC	0.00	0.42	0.89	1.83	2.67	3.52	-0.54
17	251	2	PLVC	0.00	0.92	1.39	2.43	3.16	3.94	0.16
18	254	2	PLVC	0.00	0.62	2.00	3.04	3.84	4.14 #	0.46
19	257	2	PLVC	0.00	-0.16#	0.28#	1.49#	2.24#	3.14 #	0.06 #
20	260	2	PLVC	0.00	0.62	1.08	2.39	3.04	3.96	0.19
21	263	2	PLVC	0.00	0.72	1.25	2.12	3.07	3.78	-0.49
22	266	2	PLVC	0.00	0.73	1.22	1.94	2.68	3.67	0.72
23	268	3	PLVC	0.00	0.42	1.00	2.06	2.93	3.82	0.33
24	269	3	PLVC	0.00	0.08	0.45	0.93	1.50	2.17	-0.53
25	270	3	PLVC	0.00	0.01	0.43	1.80	2.69	3.67	-0.35
26	272	3	PLVC	0.00	0.38	1.37	2.53	4.27	5.70	1.76
27	273	3	PLVC	0.00	0.34	1.12	1.94	2.47	3.03	-0.32
28	277	3	PLVC	0.00	-0.06	0.73	1.57	2.76	3.90	-0.16
29	284	3	PLVC	0.00	-0.04	0.90	2.41	3.24	4.06	0.04
30	297	3	PLVC	0.00	0.02	0.77	2.08	3.18	4.13	0.85

* Indicates data was not available or could not be calculated.

# Indicates data was not used for statistical analysis.

ORIGINAL PAGE IS OF POOR QUALITY

TABLE 10. END OF PERIOD (EOP) VALUES OF PERCENTAGE CHANGE IN CALF VOLUME BY LEVEL OF NEGATIVE PRESSURE FOR THE SCIENTIST PILOT.

RUN	DAY	CODE	DATA	CON	-8	-16	-30	-40	-50	REC
1	67	1	PLVC	0.00	0.02	1.13	2.52	3.84	4.43	0.43
2	95	1	PLVC	0.00	0.06	0.58	2.44	3.37	4.24	0.09
3	178	1	PLVC	0.00	0.12	1.23	2.58	3.88	5.32	0.42
4	193	1	PLVC	0.00	0.04	1.06	2.54	3.58	4.72	-0.23
5	204	1	PLVC	0.00	0.11	1.16	3.19	4.02	4.96	0.33
6	213	2	PLVC	0.00	1.02	2.38	3.41	4.02#	****	0.21
7	216	2	PLVC	0.00	0.70	1.31	3.33	4.27	5.45	1.20
8	220	2	PLVC	0.00	1.09	1.83	3.86	5.03	6.65	-0.77#
9	225	2	PLVC	0.00	0.93	2.07	3.87	5.58	7.04	0.71
10	229	2	PLVC	0.00	1.07	2.31	3.67	4.85	6.25	1.49
12	235	2	PLVC	0.00	0.38	0.99	2.23	3.49	4.80	0.19
13	237	2	PLVC	0.00	0.76	1.53	2.82	4.19	5.38	0.24
14	240	2	PLVC	0.00	0.58	1.48	2.44	3.46	4.60	-0.14
15	243	2	PLVC	0.00	1.48#	2.58#	4.74#	6.32#	7.67#	1.42#
16	246	2	PLVC	0.00	0.60	0.96#	2.56	3.52	4.63	1.35
17	249	2	PLVC	0.00	0.69	1.87	3.01	4.35	5.25	0.48
18	253	2	PLVC	0.00	0.43	0.96	2.18	3.32	4.59	0.61
19	255	2	PLVC	0.00	0.89	1.53	2.81	3.54	4.53	0.56
20	258	2	PLVC	0.00	0.34	0.70	1.83	2.78	3.96	0.40
21	261	2	PLVC	0.00	0.91	1.42	2.71	3.85	5.14	0.71
22	264	2	PLVC	0.00	0.45	1.11	2.06	2.76	3.89	-0.34
23	266	2	PLVC	0.00	0.94	1.78	3.41	4.32	4.85	0.14
24	268	3	PLVC	0.00	-0.22	0.63	2.30	3.63	4.82	0.94
25	269	3	PLVC	0.00	-0.06	1.11	2.81	4.14	5.35	0.10
26	270	3	PLVC	0.00	0.16	1.03	2.86	4.46	5.76	0.36
27	272	3	PLVC	0.00	0.02	1.33	3.36	5.22	7.58	1.38
28	273	3	PLVC	0.00	0.03	0.95	2.46	3.94	5.14	1.24
29	277	3	PLVC	0.00	-0.06	0.68	2.64	3.71	5.02	0.24
30	284	3	PLVC	0.00	-0.16	1.10	2.63	3.87	4.86	0.24
31	297	3	PLVC	0.00	0.05	0.75	2.90	4.38	5.33	-0.15

* Indicates data was not available or could not be calculated.

# Indicates data was not used for statistical analysis.

TABLE 11. END OF PERIOD (EOP) VALUES OF PERCENTAGE CHANGE IN CALF VOLUME BY LEVEL OF NEGATIVE PRESSURE FOR THE PILOT.

RUN	DAY	CODE	DATA	CMH	-8	-16	-30	-40	-50	REC
1	79	1	PLVC	0.00	-0.03	-0.06	0.90	2.25	3.94	1.19
2	92	1	PLVC	0.00	-0.10	0.16	1.12	2.45	3.33	0.70
3	178	1	PLVC	0.00	0.04	0.49	1.66	2.70	3.55	0.81
4	193	1	PLVC	0.00	-0.05	0.39	1.59	2.20 #	****	****
5	204	1	PLVC	0.00	0.07	0.65	2.00	3.06	3.99	0.75
6	214	2	PLVC	0.00	0.44	1.14	1.95	2.95	3.75	0.07
7	219	2	PLVC	0.00	0.53	1.03	2.35	3.48	4.73	-0.11
8	224	2	PLVC	0.00	0.69	1.04	1.73	2.62	3.22	0.28
9	227	2	PLVC	0.00	0.69	1.33	2.71	3.65	4.88	0.19
10	231	2	PLVC	0.00	1.38	1.83	2.78	3.97	5.50	0.93
11	234	2	PLVC	0.00	1.15	1.85	2.94	3.93	5.21	0.80
12	237	2	PLVC	0.00	0.92	1.74	3.03	4.19	5.36	-0.68
13	241	2	PLVC	0.00	1.00	1.90	3.08	4.32	5.99	0.68
14	243	2	PLVC	0.00	0.41#	0.55 #	1.88#	3.17 #	4.80#	-0.49#
15	247	2	PLVC	0.00	1.03	1.97	3.01	4.06	5.20	1.37
16	250	2	PLVC	0.00	0.99	1.48	2.76	3.70	5.23	0.82
17	253	2	PLVC	0.00	0.92	1.67	2.74	4.09	5.28	0.83
18	256	2	PLVC	0.00	0.98	1.61	2.67	3.82	5.36	0.88
19	259	2	PLVC	0.00	1.15	1.94	2.98	4.36	5.98	1.02
20	262	2	PLVC	0.00	0.95	1.71	2.74	3.84	5.31	0.89
21	266	2	PLVC	0.00	0.89	1.54	2.55	3.80	5.11	0.80
22	268	3	PLVC	0.00	0.13	0.77	2.04	2.93	3.71	0.68
23	269	3	PLVC	0.00	0.30	0.98	2.37	3.55	4.87	1.83
24	270	3	PLVC	0.00	0.19	0.82	2.24	3.30	4.23	0.82
25	272	3	PLVC	0.00	0.23	0.90	2.29	3.67	4.96	0.35
26	273	3	PLVC	0.00	0.25	0.78	1.94	3.18	4.53	1.83
27	277	3	PLVC	0.00	-0.05	0.67	2.04	2.95	3.81	0.47
28	284	3	PLVC	0.00	-0.08	0.72	2.36	3.70	4.72	0.20
29	297	3	PLVC	0.00	-0.05	0.39	1.46	2.23	3.23	0.52

* Indicates data was not available or could not be calculated.

# Indicates data was not used for statistical analysis.

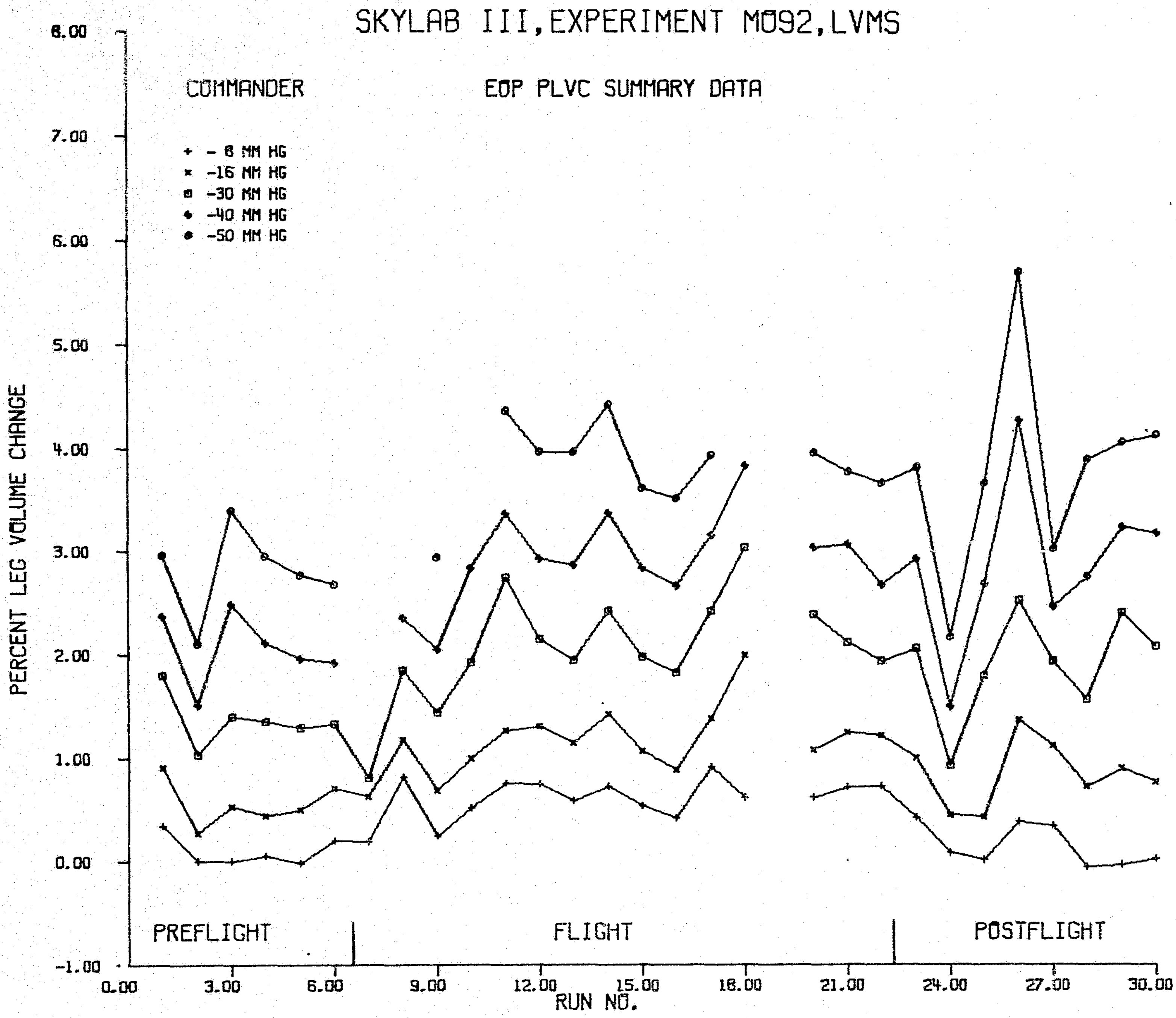


FIGURE 21. GRAPH OF END OF PERIOD (EOP) CALF VOLUME CHANGES AT EACH LEVEL OF NEGATIVE PRESSURE FOR EACH INDIVIDUAL EXPERIMENT.

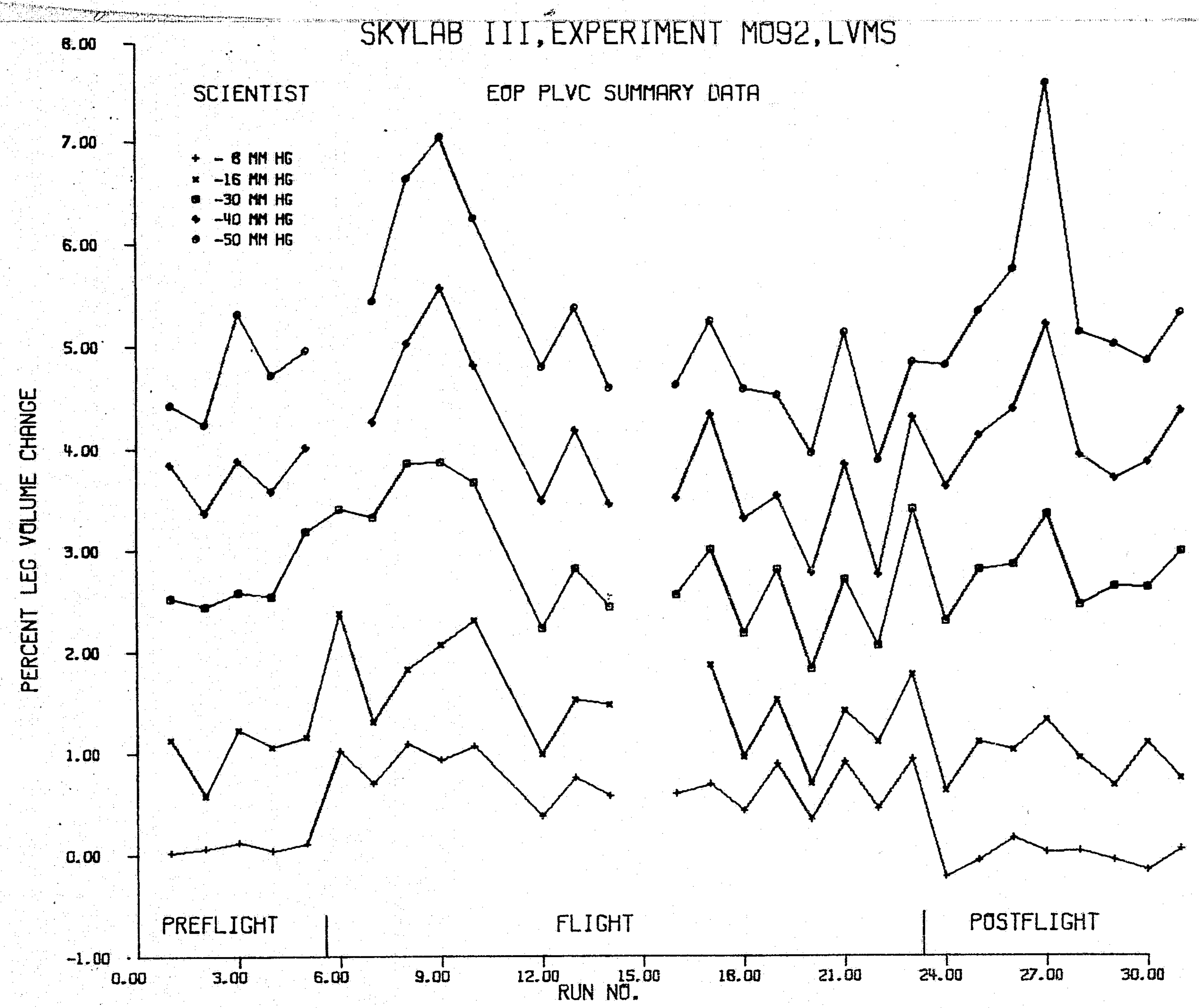


FIGURE 22. GRAPH OF END OF PERIOD (EOP) CALF VOLUME CHANGES AT EACH LEVEL OF NEGATIVE PRESSURE FOR EACH INDIVIDUAL EXPERIMENT.

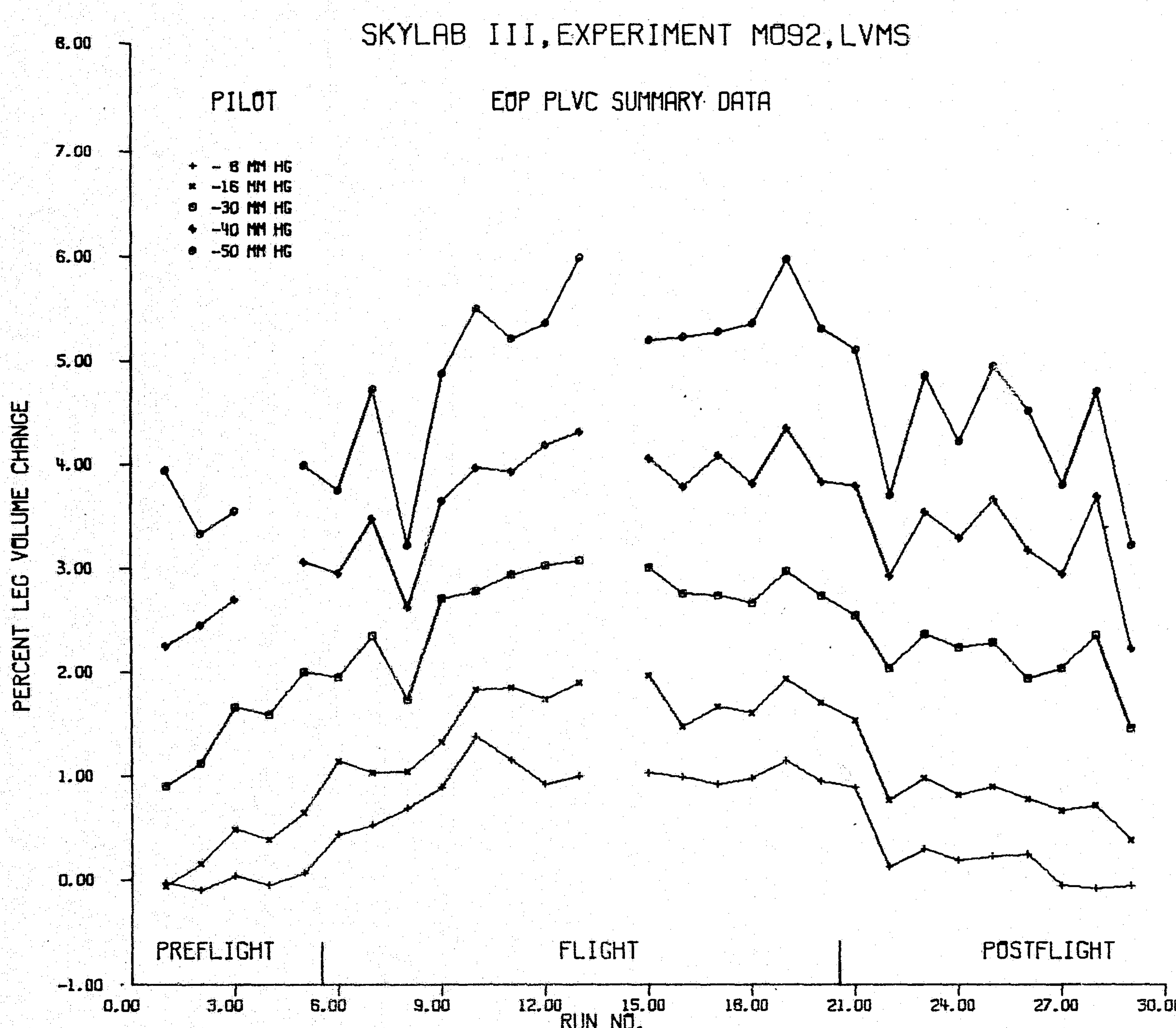


FIGURE 23. GRAPH OF END OF PERIOD (EOP) CALF VOLUME CHANGES AT EACH LEVEL OF NEGATIVE PRESSURE FOR EACH INDIVIDUAL EXPERIMENT.

commander and pilot but considerably less dramatic changes for scientist pilot. In all crewmembers, the initial in-flight M092 experiments resulted in large increases of leg volume in response to the -8 and -16 mm Hg level of negative pressure. While the increased in-flight values were widely fluctuating among the three crewmembers during the initial in-flight tests, there did appear to be a stabilization around a higher leg volume response during subsequent in-flight LBNP tests. The large daily variations mask any long term trends if present.

Linear regression of the in-flight -50 mm Hg data indicates a variable trend for the three crewmembers. The commander's data showed no trend and no correlation with time in zero gravity. The scientist pilot data indicated a low and insignificant correlation (-.74) with a slope of -0.042 PLVC per day while the pilot's data also indicated a low and insignificant correlation (.61) and a positive slope of 0.027 PLVC per day. The postflight data demonstrate an immediate return to near preflight values particularly for EOP values at the early levels of negative pressure (-8 and -16 mm Hg). Both the commander and scientist pilot seemed to undergo a "rebound" effect with much variation in leg volume response The average postflight data at the -30, -40 and -50 mm Hg levels tended to exceed preflight values and was approximately equal to the volume changes obtained in-flight.

Table 12 contains the average EOP calf volume changes induced by the various levels of negative pressure for the preflight, in-flight and postflight test periods. The histograms of Figures 24 to 26 indicate the average percentage change in calf volume for all levels of negative pressure for all mission phases. Comparison of these data indicate that the average in-flight EOP PLVC (excluding the recovery period) was always greater than the average preflight change and in most cases was significantly higher than the preflight at all levels of negative pressure for the commander and pilot. Only the volume response at the -8 and -16 mm Hg levels of negative pressure were significantly higher for the scientist pilot. Recovery values tended to be highly variable for all mission phases.

TABLE 12. SUMMARY OF EOP PLVC INDUCED BY LEVELS OF LOWER BODY NEGATIVE PRESSURE.

SUBJECT	EXPR PHASE	Average Percentage Change in Leg Volume, ± S. D. and No. of Runs at Indicated Levels of Pressure					
		-8	-16	-30	-40	-50	REC
CDR	Preflight	.10 ± .14 6	.56 .22 6	1.37 .25 6	2.06 .35 6	2.81 .43 6	.26 .62 6
CDR	In-flight	.61* ± .20 15	1.17* .33 15	2.07* .53 15	2.94* .44 14	3.83* .41 11	.10 .44 13
CDR	Postflight	.14# ± .20 8	.85# .32 8	1.92* .50 8	2.88* .78 8	3.81* 1.00 8	.20 .77 8
SPT	Preflight	.07 ± .04 5	1.03 .26 5	2.65 .30 5	3.74 .26 5	4.73 .43 5	.21 .28 5
SPT	In-flight	.74* ± .25 16	1.55* .50 15	2.89 .65 16	3.95 .80 15	5.13 .91 15	.52 .52 15
SPT	Postflight	- .03# ± .12 8	.95# .24 8	2.76 .33 8	4.16 .51 8	5.48 .90 8	.54 .57 8
PLT	Preflight	- .01 ± .07 5	.33 .28 5	1.45 .44 5	2.62 .35 4	3.70 .32 4	.86 .22 4
PLT	In-flight	.93* ± .24 15	1.59* .32 15	2.67* .39 15	3.79* .48 15	5.07* .73 15	.58 .53 15
PLT	Postflight	.12# ± .15 8	.75* .18# 8	2.09* .30# 8	3.19# .49 8	4.26# .62 8	.84 .64 8

* Indicates significant difference (P<.05) from preflight.

# Indicates significant difference (P<.05) from in-flight.

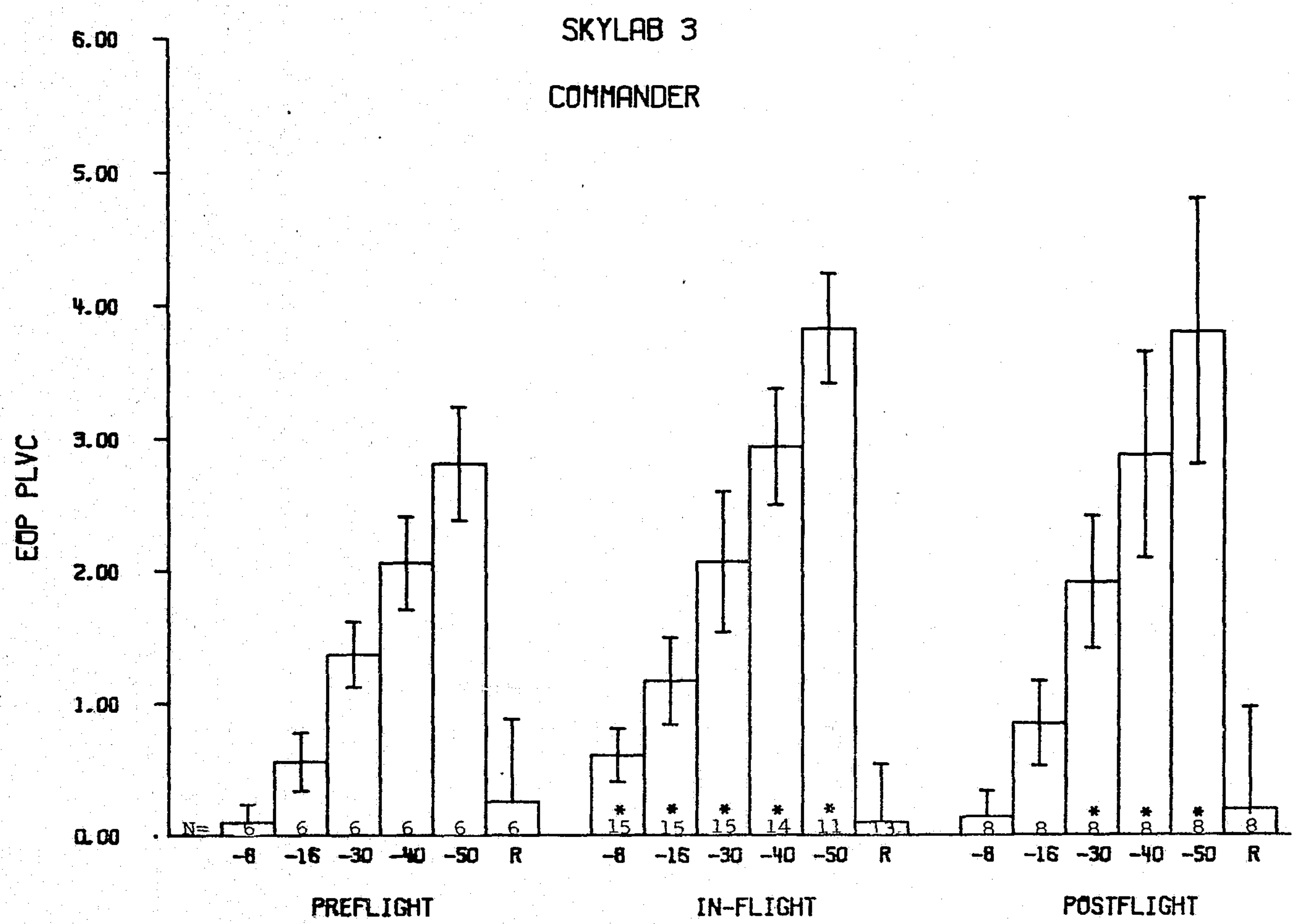


FIGURE 24. HISTOGRAMS SHOWING AVERAGE ($\pm$ 1S.D.) PERCENTAGE CHANGE IN CALF VOLUME FOR ALL LEVELS OF NEGATIVE PRESSURE.

* Indicates significant differences (P<0.05) from preflight.

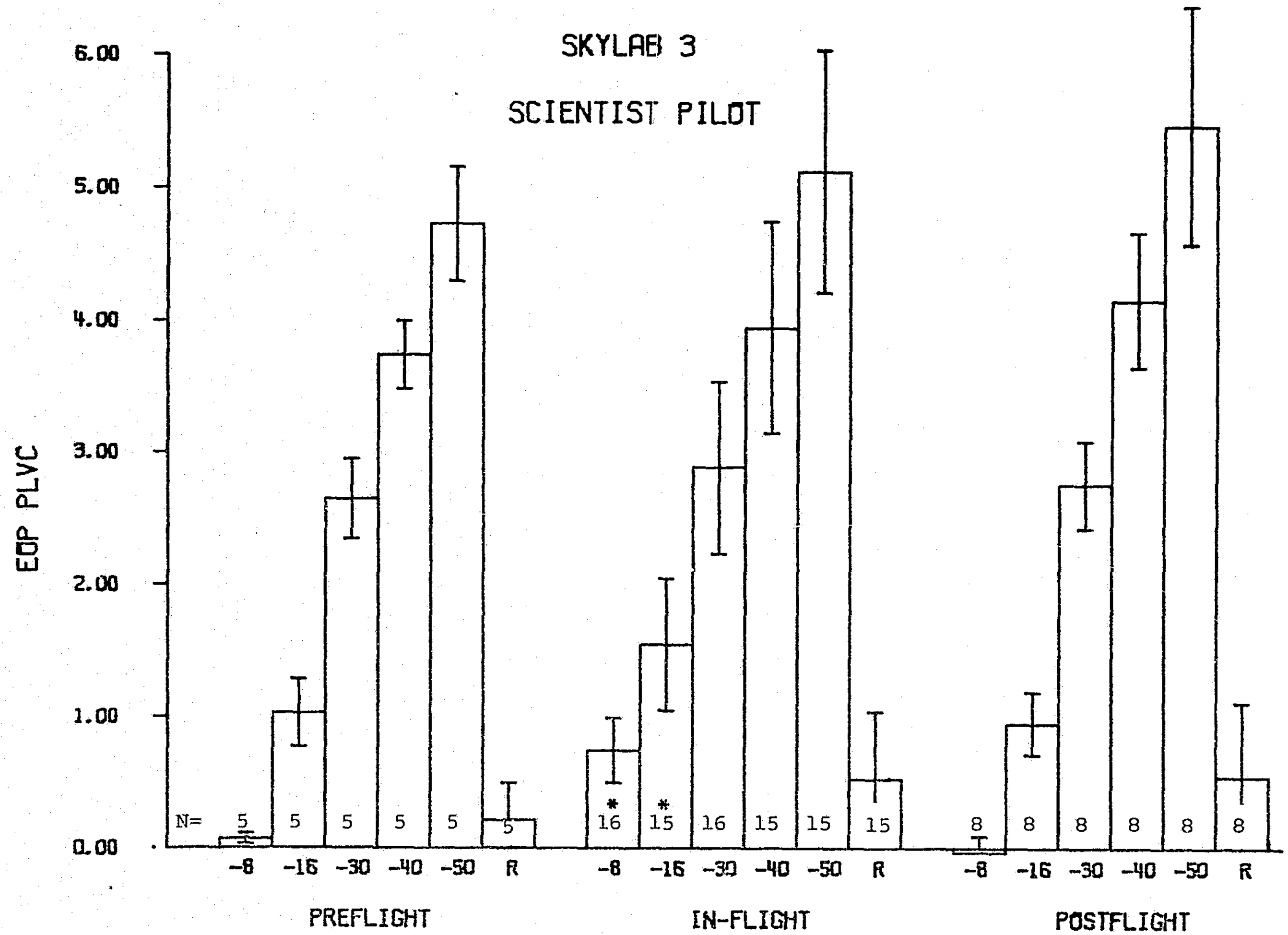


FIGURE 25. HISTOGRAMS SHOWING AVERAGE ($\pm$1S.D.) PERCENTAGE CHANGE IN CALF VOLUME FOR ALL LEVELS OF NEGATIVE PRESSURE.

* Indicates significant differences (P<0.05) from preflight.

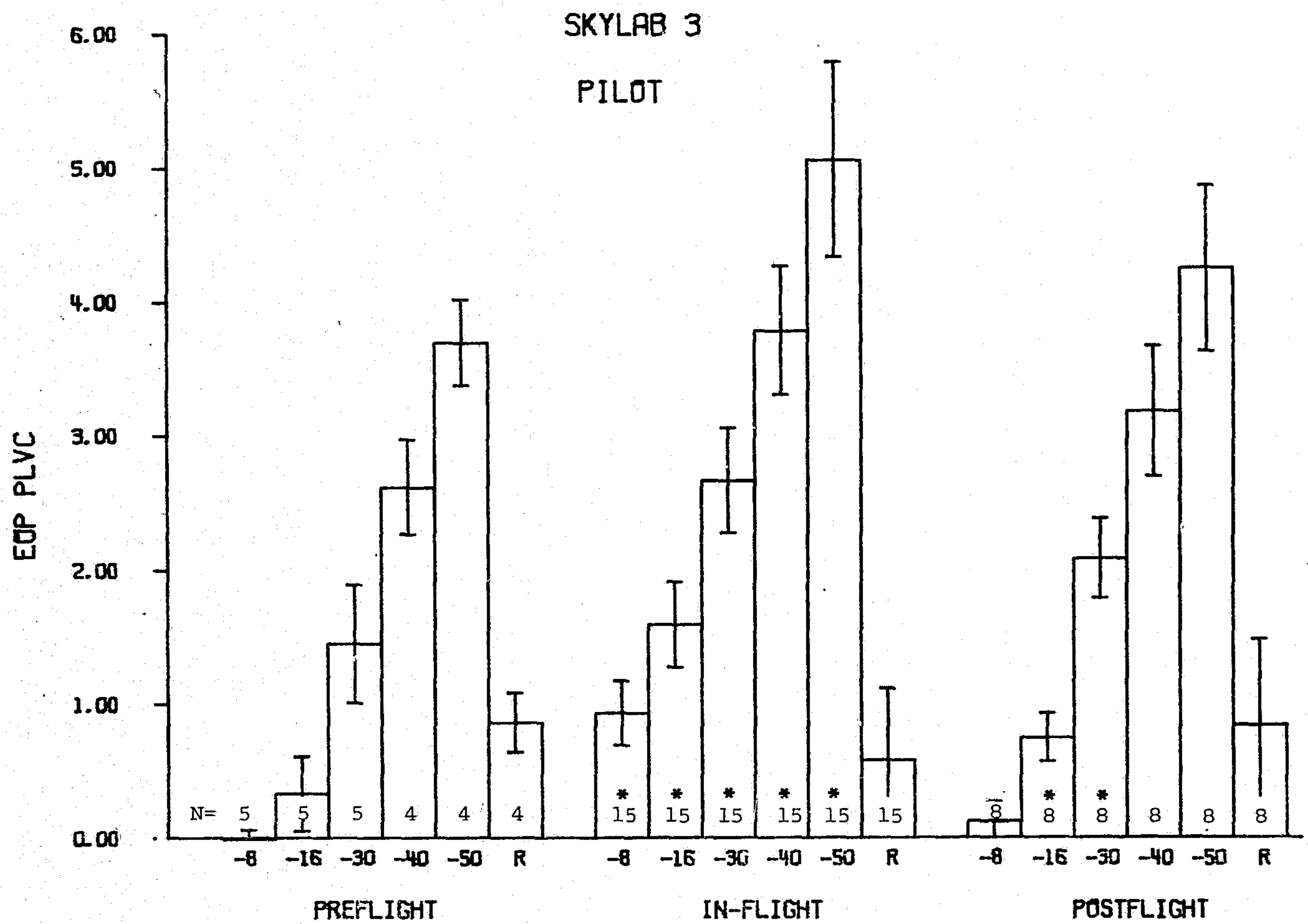


FIGURE 26. HISTOGRAMS SHOWING AVERAGE (± 1S.D.) PERCENTAGE CHANGE IN CALF VOLUME FOR ALL LEVELS OF NEGATIVE PRESSURE.

* Indicates significant differences (P<0.05) from preflight.

Postflight averages of EOP PLVC tended to be greater than preflight averages and less than in-flight averages. In general, the variation in the in-flight and postflight data was noticeably greater than in the preflight data. This illustrates the slightly unstable adaptation response going into zero gravity and again after reentry. Even though postflight averages were usually higher than the preflight values, the in-flight averages were still significantly higher at the -8 and -16 mm Hg levels for the commander and scientist pilot and at all levels for the pilot.

The realization of the relative increase in LBNP induced calf volume is emphasized more dramatically by the compilation of the ratio of in-flight volume changes compared to preflight values as shown in Table 13. These data illustrate where the in-flight volume changes are occurring relative to the levels of the LBNP protocol used. There was a thirty-six fold average increase in volume change at the -8 mm Hg level of negative pressure which decreased to 1.3 fold at the -40 and -50 mm Hg levels. The tremendous increase in the ratio at the -8 mm Hg level was primarily the result of the large change observed in the pilot's response although the average of the commander's and scientist pilot's data was still an impressive 8 fold increase. The individual and average data is graphically displayed in Figure 27. The fact that such huge percentage increases in calf volume were observed at -8 mm Hg negative pressure supports the theory that the leg veins in weightlessness prior to application of negative pressure were considerably more empty than they were prior to the preflight 1G LBNP tests. While the in-flight data demonstrate a 36 fold volume increase at the -8 mm Hg level, this actually represents a volume shift of 0.7% increase in calf volume over the preflight values. The fact that the preflight -8 mm Hg LBNP response was very small makes the 0.7% increase appear overwhelming. The average magnitude increase over the preflight values for each level of negative pressure is tabulated in Table 14. Since computation of a ratio or percentage difference comparison of the in-flight to preflight leg volume response is misleading due to the fact that the -8 mm Hg PLVC preflight data is close to zero, the

TABLE 13. RATIO OF IN-FLIGHT AND POSTFLIGHT VOLUME CHANGE IN COMPARISON TO PREFLIGHT VALUE.

SUBJECT	EXPR PHASE	Ratio of Average Calf Volume Change In-flight and Postflight Compared to Average Preflight Changes at Indicated Levels of Pressure					
		-8	-16	-30	-40	-50	REC
CDR	In-flight	6.1	2.1	1.5	1.4	1.4	0.4
CDR	Postflight	1.4	1.5	1.4	1.4	1.4	0.8
SPT	In-flight	10.6	1.5	1.1	1.1	1.1	2.5
SPT	Postflight	-1.4	0.9	1.0	1.1	1.2	2.6
PLT	In-flight	93.0	4.8	1.8	1.4	1.4	0.6
PLT	Postflight	13.0	2.3	1.4	1.2	1.2	1.0
GROUP	In-flight	36.5	2.8	1.5	1.3	1.3	1.2
MEAN	Postflight	4.3	1.6	1.3	1.2	1.3	1.5

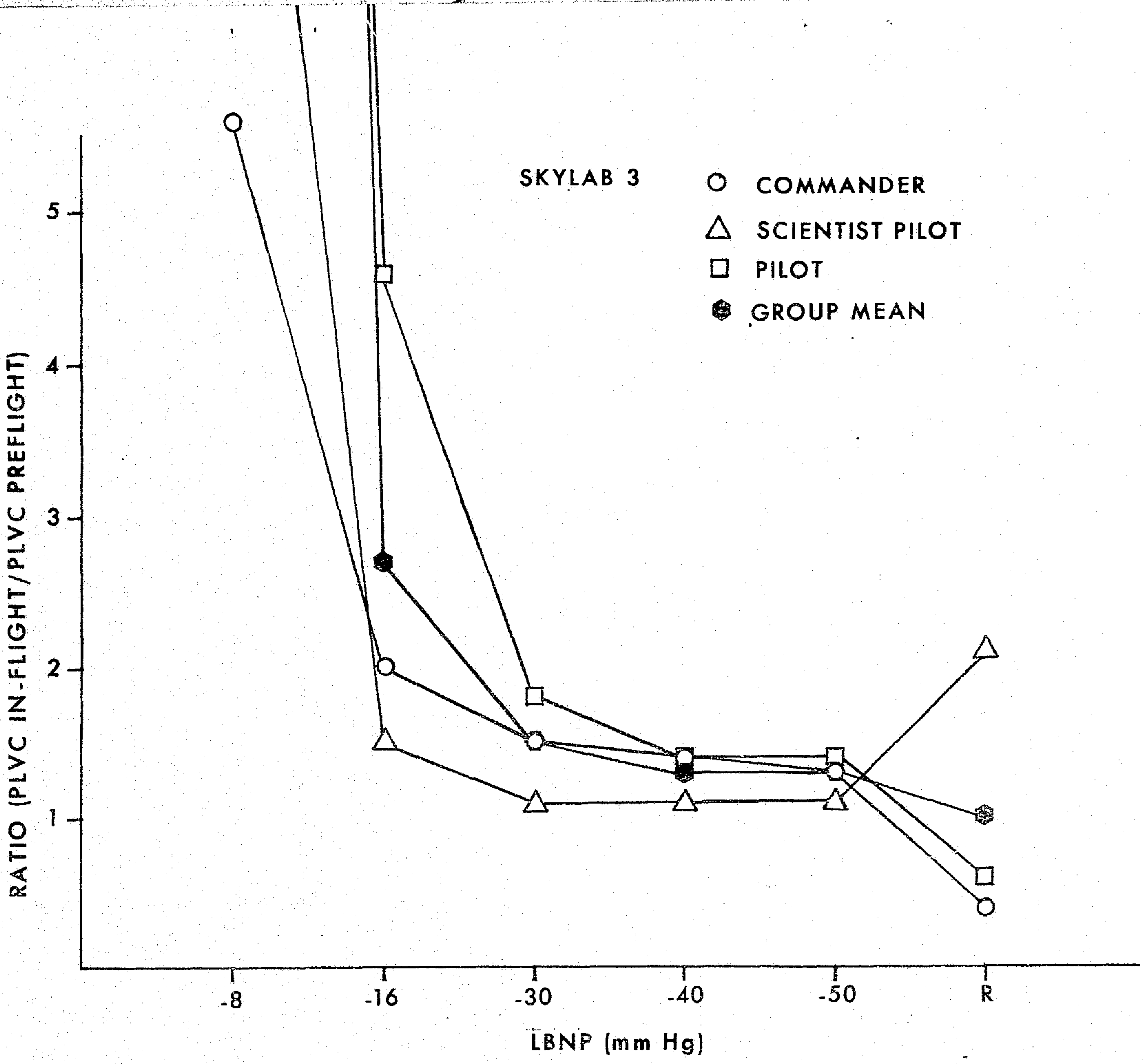


FIGURE 27. RATIO OF AVERAGE CALF VOLUME CHANGE (IN-FLIGHT/ PREFLIGHT) AT EACH LEVEL OF NEGATIVE PRESSURE.

TABLE 14. COMPARISON OF MAGNITUDE DIFFERENCE BETWEEN AVERAGE PREFLIGHT AND IN-FLIGHT VOLUME CHANGES INDUCED BY LBNP.

SUBJECT	Difference in Average Calf Volume Change In-flight Compared to Preflight Volume at Indicated Levels of Pressure					
	-8	-16	-30	-40	-50	REC
CDR	.51 (49.5)*	.61 (10.8)	.70 (10.8)	.88 (18.3)	1.02 (10.8)	-.16
SPT	.67 (167.5)	.52 (-37.5)	.24 (-70.0)	.21 (-7.5)	.40 (47.5)	.31
PLT	.94 (68.6)	1.26 (23.4)	1.22 (-2.9)	1.17 (-3.6)	1.37 (14.6)	-.28
GROUP MEAN	.71 (76.4)	.80 (9.7)	.72 (-8.6)	.75 (3.2)	.93 (19.4)	-.04

magnitude difference tabulated in Table 14 allows an accurate comparison of volumes at the initial levels of negative pressure. These data and the graphic display of Figure 28 illustrate that approximately 75% of the increased volume change observed in Skylab 3 astronauts occurred during the -8 mm Hg level of negative pressure. The average change for the other levels of negative pressure was slightly increased for the -16, -40 and -50 mm Hg levels and slightly decreased for the -30 mm Hg level.

The EOP PLVC data can be summarized in a slightly different manner to emphasize the fact that most of the in-flight increase in EOP PLVC was due to the volume response at the -8 mm Hg pressure level. The data tabulated in Table 15 represents the average EOP PLVC delta or difference between succeeding phases or levels of the negative pressure profile for all mission phases. This data illustrates that the delta for each

* Numbers within parentheses indicate percentage of magnitude difference occurring at each level of negative pressure.

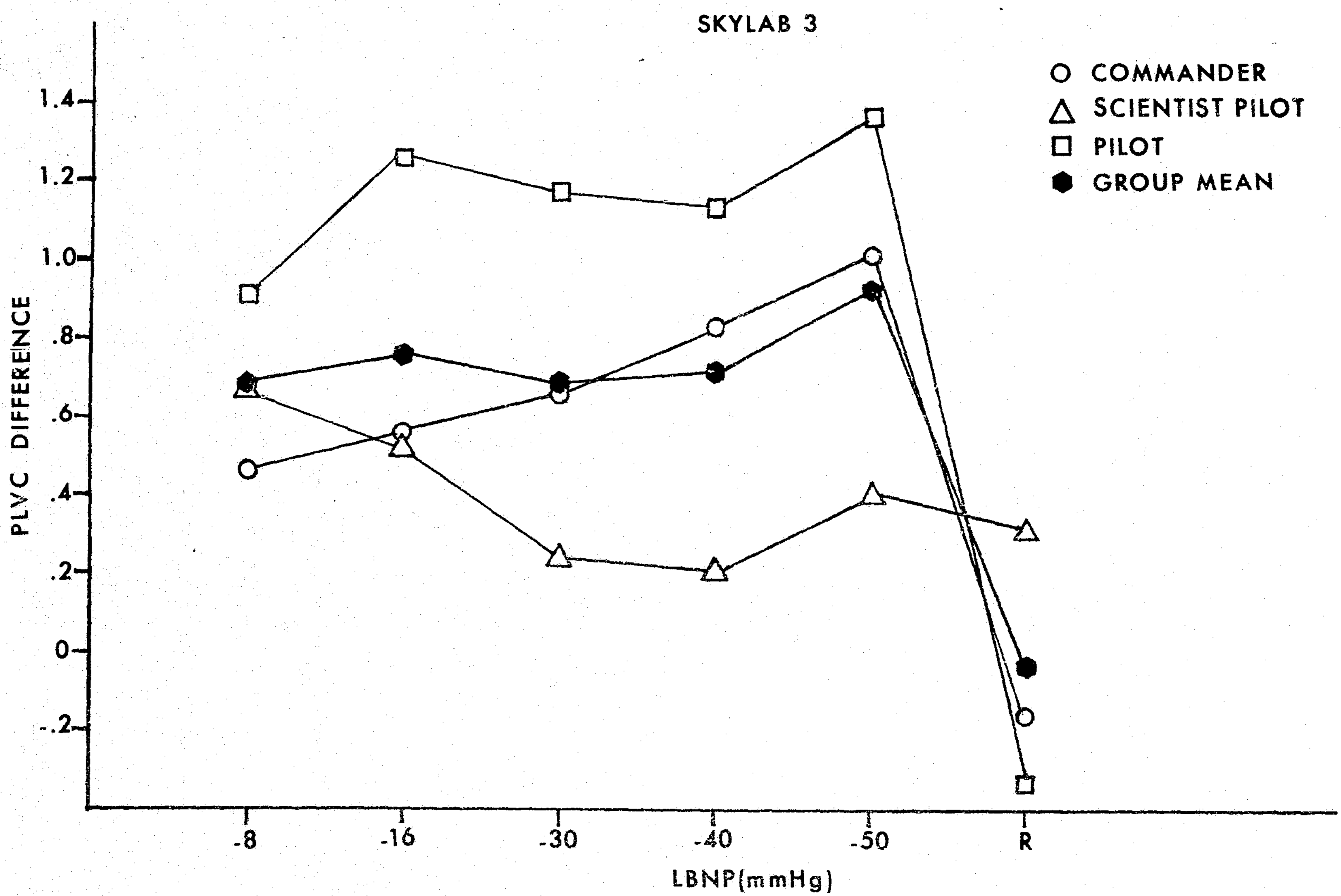


FIGURE 28. DIFFERENCE IN PLVC BETWEEN AVERAGE PREFLIGHT AND IN-FLIGHT CALF VOLUME CHANGE AT EACH LEVEL OF NEGATIVE PRESSURE.

TABLE 15. SUMMARY OF AVERAGE DIFFERENCE (DELTA) BETWEEN EOP PLVC VALUES.

SUBJECT	EXPR PHASE	Average PLVC Difference (Delta) Between EOP PLVC at Various Levels of Negative Pressure					
		0 TO -8	-8 TO -16	-16 TO -30	-30 TO -40	-40 TO -50	-50 TO REC
CDR	Preflight	.10 ±.14 6	.46 .11 6	.81 .11 6	.69 .22 6	.75 .13 6	2.56 .47 6
CDR	In-flight	.61* ±.20 15	.56 .24 15	.90 .29 15	.78 .14 14	.92* .13 11	3.78* .48 10
CDR	Postflight	.14# ±.20 8	.70* .23 8	1.07 .34 8	.96 .39 8	.93 .27 8	3.61* .49 8
SPT	Preflight	.07 ±.04 5	.96 .25 5	1.62 .30 5	1.08 .22 5	1.00 .32 5	4.53 .43 5
SPT	In-flight	.74* ±.25 16	.81 .30 15	1.36 .35 15	1.10 .26 15	1.18 .26 15	4.48 .74 14
SPT	Postflight	-.03# ±.12 8	.98 .24 8	1.81# .26 8	1.40* .23# 8	1.32 .44 8	4.94 .80 8
PLT	Preflight	-.01 ±.07 5	.34 .24 5	1.13 .17 5	1.20 .17 4	1.09 .40 4	2.84 .27 4
PLT	In-flight	.93* .24 15	.66* .18 15	1.08 .19 15	1.12 .14 15	1.28 .29 15	4.49* .71 15
PLT	Postflight	.12# .15 8	.64* .11 8	1.34# .17 8	1.10 .22 8	1.07 .22 8	3.42# .75 8

* Indicates significant difference (P<.05) from preflight.

# Indicates significant difference (P<.05) from in-flight.

level of negative pressure obtained on an individual crewmember is fairly constant for preflight, in-flight and postflight for all levels of negative pressure except for the -8 mm Hg level and the recovery data. The significance of using the delta analysis is that each change in leg volume in response to a change in negative pressure is independently considered rather than being considered as the cumulative change in leg volume up to that particular part of the LBNP profile. The in-flight increase at -8 mm Hg for all crewmembers is very evident for all crewmembers as shown in Table 15 and also in the graphical display of the deltas (Figure 29). The use of the delta technique also affects the statistical analysis of EOP PLVC. For example, use of the commander's EOP PLVC values indicated significantly different in-flight values at all levels of LBNP from -8 through -50 mm Hg while statistical analysis using delta values indicated statistically different deltas only at -8 and -50 mm Hg levels. The same situation occurs for the other crewmembers. Therefore, the delta technique provides a more useful analysis for determining where significant changes in leg volume response occurred. Table 16 summarized the percentage of the total leg volume change occurring at each delta as well as the percentage of total leg volume change occurring per millimeter of Hg negative pressure at each delta. This data illustrates that for each individual crewmember the percentage of the total leg volume change at each level of negative pressure was very similar for the preflight and postflight phases. However, all three crewmembers experienced an in-flight volume increase at the -8 mm Hg negative pressure level that ranged from 13 to 18 percent of the total leg volume change recorded at -50 mm Hg level. In addition to the increased volume change at the -8 mm Hg level the crewmembers in general experienced an in-flight decrease in the percent of total volume that occurred at the other (-16 through -50 mm Hg) negative pressure levels compared to preflight and postflight values.

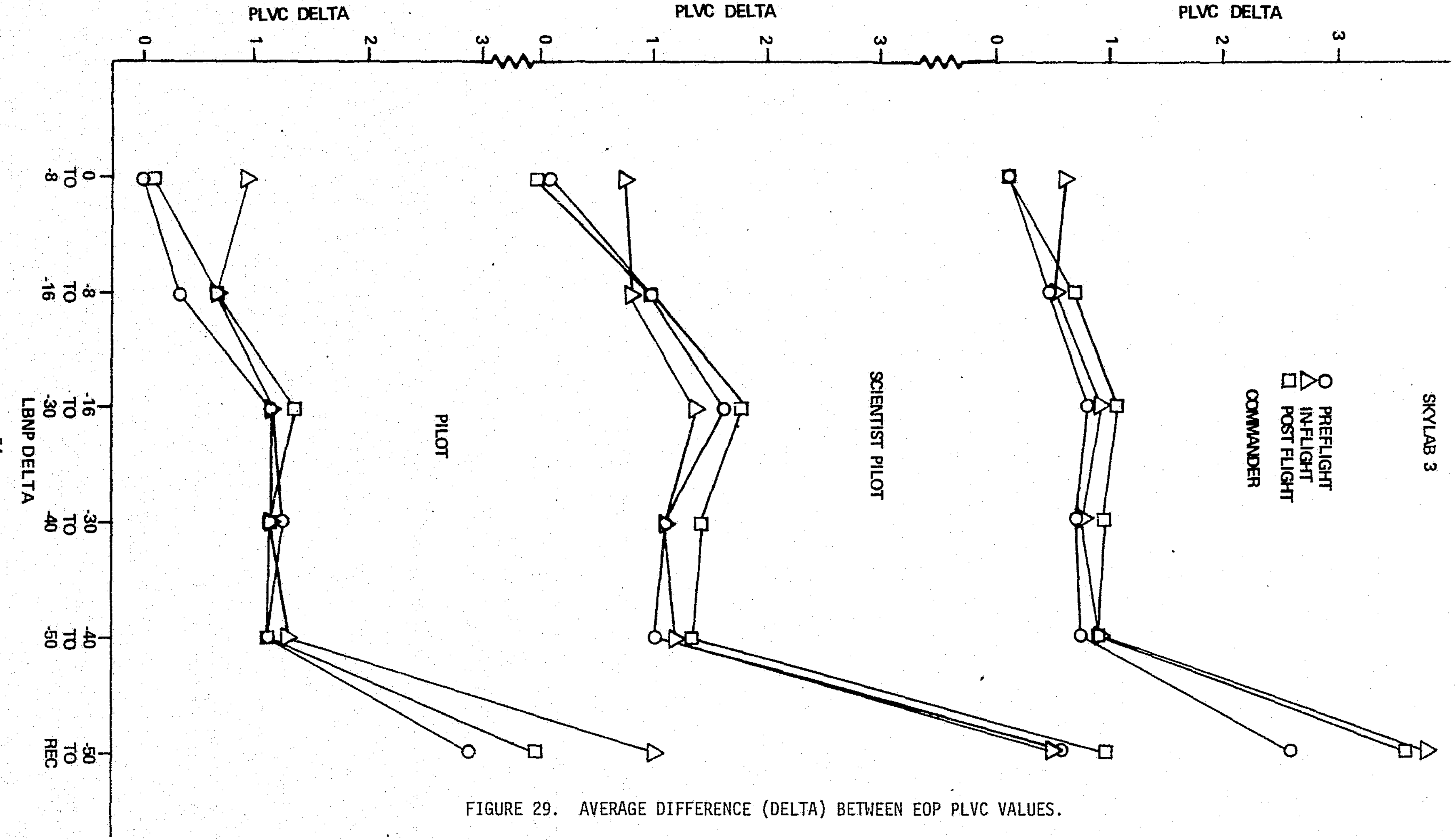


FIGURE 29. AVERAGE DIFFERENCE (DELTA) BETWEEN EOP PLVC VALUES.

TABLE 16. SUMMARY OF THE AVERAGE PERCENTAGE OF THE TOTAL LEG VOLUME CHANGE AT SPECIFIC LEVELS OF NEGATIVE PRESSURE.

SUBJECT	EXPR PHASE	Average percentage of the total leg volume change at the indicated levels of negative pressure				
		0 TO -8	-8 TO -16	-16 TO -30	-30 TO -40	-40 TO -50
CDR	Preflight	3.6 (.45)	16.4 (2.05)	28.8 (2.56)	24.6 (2.46)	26.7 (2.67)
CDR	In-flight	16.2 (2.02)	14.8 (1.85)	23.9 (1.71)	20.7 (2.07)	24.4 (2.44)
CDR	Postflight	3.7 (.46)	18.4 (2.30)	28.2 (2.01)	25.3 (2.53)	24.5 (2.45)
SPT	Preflight	1.5 (0.19)	20.3 (2.54)	34.2 (2.44)	22.8 (2.28)	21.1 (2.11)
SPT	In-flight	14.3 (1.79)	15.6 (1.95)	26.2 (1.87)	21.2 (2.12)	22.7 (2.27)
SPT	Postflight	0.0 (0.00)	17.9 (2.24)	33.0 (2.36)	25.6 (2.56)	24.1 (2.41)
PLT	Preflight	0.0 (0.00)	9.1 (1.14)	30.1 (2.15)	32.0 (3.20)	29.1 (2.91)
PLT	In-flight	18.3 (2.29)	13.0 (1.62)	21.3 (1.52)	22.1 (2.21)	25.3 (2.53)
PLT	Postflight	2.8 (0.35)	15.0) (1.88)	31.4 (2.24)	25.8 (2.58)	25.1 (2.51)
GROUP MEAN	Preflight	2.6 (0.32)	15.3 (1.91)	31.0 (2.21)	26.5 (2.65)	25.6 (2.56)
GROUP MEAN	In-flight	16.3 (2.04)	14.5 (1.81)	23.8 (1.70)	21.3 (2.13)	24.1 (2.41)
GROUP MEAN	Postflight	2.2 (0.28)	17.1 (2.14)	30.9 (2.21)	25.6 (2.56)	24.6 (2.46)

Numbers in parentheses indicate percentage of the total volume change per mm Hg change in negative pressure.

Slope of the Change in Calf Volume.

In order to appropriately characterize and compare the nature of the calf volume response induced by various levels of negative pressure, it is necessary to consider the rate of change in calf volume. If one assumes that the rapidly occurring change in a leg exposed to a change in negative pressure is due mostly to the physical filling of the veins and that the delayed, slower change in volume occurring at that same decrement in pressure is due to transudation of fluid, then these rates of change can be quantitated in a useful and meaningful way. Choosing a sampling interval or duration for the change in leg volume in response to the change in LBNP is complicated by the considerable variance in the LBNP protocol that occurs in the individual runs. The data tabulated in Tables 17 to 19 represents the equations of the best fit least squares regression line of PLVC versus time for each level of negative pressure. The algorithm used for these computations involved taking ten data samples of PLVC and time beginning one sample after the EOP time. This algorithm was used each time the LBNP was decremented or for the run off (R.O.) data when chamber pressure was being returned to ambient pressure. The computation results in equations relating the change in PLVC to time and is independent of the rate of change in LBNP pressure. The average preflight, in-flight and postflight S1 slope data computed in this manner is tabulated for each astronaut by level of negative pressure in Table 20. The S1 slope data shows an extreme amount of variation and large standard deviations, partially because of the capricious nature of the system, but mostly due to the fact that this type of computation does not consider the rate and magnitude variation in negative pressure. The graphical display of the average S1 slope values and the results of the comparison of average preflight and in-flight values are shown in Figures 30 to 32. The recovery or run off slope values are read from the axes at the right side of the graphs.

The average S1 slope values as shown on the preflight histograms indicate a low slope value at -8 mm Hg for all crewmembers and highly variable

TABLE 17. EQUATIONS FOR THE BEST FIT REGRESSION LINE OF PLVC VERSUS TIME FOR THE S1 SLOPE OF CALF VOLUME AT ALL LEVELS OF NEGATIVE PRESSURE (COMMANDER).

RUN	DAY	CODE	DATA	NSAMP	-8		-16		-30		-40		-50		R.D.	
					B0	B1	B0	B1	B0	B1	B0	B1	B0	B1	B0	B1
1	80	1	S1	10	-6.255	1.304	-19.075	3.231	-22.466	3.347	-17.554	1.965	-17.102	1.297	63.595	-3.016
2	113	1	S1	10	0.603	-0.100	-14.600	2.446	-14.745	2.177	-18.674	1.902	-23.508	1.681	157.147	-7.754
3	150	1	S1	10	-1.223	0.262	-21.350	3.582	-17.513	2.598	-27.718	2.902	-21.265	1.580	130.225	-6.329
4	178	1	S1	10	-3.458	0.713	-14.060	2.368	-19.597	2.883	-15.709	1.715	-21.517	1.581	82.802	-3.991
5	193	1	S1	10	0.129	-0.020	-16.710	2.791	-21.497	3.124	-10.550	1.185	-7.316	0.621	54.480	-2.583
6	204	1	S1	10	-2.259	0.508	-9.521	1.636	-8.969	1.396	-10.214	1.165	-31.569	2.248	82.548	-3.985
7	214	2	S1	10	-3.916	0.781	-3.057	0.543	-1.586	0.299	-4.679	0.549	******	*****	81.851	-7.051
8	219	2	S1	10	-9.346	1.880	-4.229	0.853	-7.196	1.208	-13.574	1.546	-2.406	0.320	3.988 #	0.000
9	224	2	S1	10	-6.057	1.206	-3.135	0.567	-12.710	1.922	-2.938	0.439	-7.057	0.612	59.917	-2.853
10	228	2	S1	10	-3.278	0.447	-5.355	0.897	-9.676	1.463	-6.750	0.862	-4.575	0.489	233.782	-12.709
11	232	2	S1	10	-9.915	2.050	-9.322	1.684	-15.652	2.556	4.700	-0.108	-16.066	1.314	45.733	-2.095
12	235	2	S1	10	-12.208	2.432	-9.360	1.719	-4.586	0.788	-3.316	0.557	-11.309	0.958	25.643	-1.092
13	239	2	S1	10	-13.925	2.793	-10.641	1.853	-1.652	0.404	-14.083	1.612	-20.606	1.573	33.711	-1.489
14	242	2	S1	10	-9.241	1.830	-5.231	0.991	-9.342	1.559	-21.636	2.413	-1.904	0.363	16.336	-0.599
15	244	2	S1	10	-6.508	1.287	-1.036	0.274	-5.607	0.972	-7.957	0.902	2.608	0.818	18.145	-0.725
16	248	2	S1	10	-3.774	0.772	-1.521	0.317	-6.023	0.962	-4.359	0.610	-20.436	1.511	58.800	-2.741
17	251	2	S1	10	-5.171	1.031	-4.305	0.867	-10.517	1.718	-7.182	0.975	-1.116	0.288	29.250	-1.287
18	254	2	S1	10	-3.811	0.774	-5.960	1.118	-0.222	0.332	-4.791	0.704	11.894	-0.535	148.232	-8.103
19	257	2	S1	10	-1.540	0.310	-7.428	1.224	-9.789	1.444	-5.889	0.740	-17.859	1.341	17.408	-0.711
20	260	2	S1	10	-6.457	1.285	-6.370	1.169	-6.136	1.029	4.259	-0.186	-2.665	0.381	20.568	-0.833
21	263	2	S1	10	-5.621	1.134	-5.703	1.069	-5.439	0.969	-34.473	3.674	-8.781	0.790	20.865	-0.852
22	266	2	S1	10	-5.945	1.193	-4.482	0.878	-5.848	0.972	-14.791	1.683	-15.985	1.250	56.991	-2.670
23	268	3	S1	10	-2.439	0.537	-15.813	2.686	-11.780	1.836	-6.375	0.841	-16.566	1.298	312.813	-15.450
24	269	3	S1	10	-1.100	0.239	-12.262	2.056	-6.972	1.069	1.724	-0.071	-29.416	2.867	413.402	-20.590
25	270	3	S1	10	-1.698	0.356	-0.225	0.058	-26.210	3.825	-1.861	0.372	-25.878	1.908	479.317	-23.779
26	272	3	S1	10	-10.168	2.081	-22.180	3.779	-32.881	4.894	-27.035	2.960	-30.338	2.309	375.351	-18.510
27	273	3	S1	10	-12.173	2.472	-12.407	2.141	-13.827	2.144	-7.879	0.986	-10.412	0.863	432.041	-21.456
28	277	3	S1	10	3.673	-0.702	-18.230	3.056	-17.548	2.633	-19.265	2.096	-25.895	1.917	394.242	-19.535
29	284	3	S1	10	-1.871	0.384	-32.060	5.365	-39.149	5.703	-16.073	1.859	-31.986	2.355	563.684	-28.012
30	297	3	S1	10	-1.082	0.206	-21.851	3.662	-25.461	3.765	-23.324	2.553	-21.021	1.620	393.089	-19.515

* Indicates data was not available or could not be calculated.

# Indicates data was not used for statistical analysis.

TABLE 18. EQUATIONS FOR THE BEST FIT REGRESSION LINE OF PLVC VERSUS TIME FOR THE S1 SLOPE OF CALF VOLUME AT ALL LEVELS OF NEGATIVE PRESSURE (SCIENTIST PILOT).

RUN	DAY	CODE	DATA	NSAMP	-8		-16		-30		-40		-50		R.O.	
					B0	B1	B0	B1	B0	B1	B0	B1	B0	B1	B0	B1
1	67	1	S1	10	0.963	-0.258	-0.714	0.089	-17.974	2.680	-24.006	2.607	-3.953	0.500	311.795	-15.331
2	95	1	S1	10	-0.853	0.079	2.447	-0.400	-34.093	4.978	-26.404	2.878	-31.778	3.358	312.575	-15.378
3	178	1	S1	10	-0.834	0.189	-10.931	1.872	-0.610	0.273	-28.273	3.086	-39.983	2.925	144.430	-6.955
4	193	1	S1	10	-0.466	0.116	-4.435	0.736	-24.793	3.708	-22.367	2.467	-37.196	2.722	180.343	-8.774
5	204	1	S1	10	-10.700	2.139	-17.019	2.846	-38.355	5.676	-20.455	2.364	-29.481	2.231	187.689	-9.135
6	213	2	S1	10	-6.631	1.347	-10.195	1.888	-7.808	1.477	-8.630	1.242	******	*****	157.714#	-14.351#
7	216	2	S1	10	-0.845	0.162	-2.251	0.491	-6.992	1.202	1.908	0.142	-0.095	0.292	30.518	-1.253
8	220	2	S1	10	-9.128	1.827	-0.634	0.298	-6.258	1.178	-2.016	0.596	3.461	0.107	10.147	-0.175
9	225	2	S1	10	-9.059	1.799	-12.323	2.221	-19.003	3.039	-23.280	2.727	-10.499	1.874	53.758	-2.337
10	229	2	S1	10	-4.039	0.832	-12.785	2.326	-12.454	2.112	-11.191	1.491	-12.245	1.149	8.294	-0.104
12	235	2	S1	10	-2.067	0.389	0.478	-0.018	-11.297	1.769	-6.009	0.832	-14.040	1.174	118.710	-5.691
13	237	2	S1	10	-8.108	1.644	-20.284	3.400	-6.383	1.127	-14.523	1.709	-13.305	1.172	71.405	-3.305
14	240	2	S1	10	-5.792	1.143	-13.078	2.404	-1.890	0.511	-8.664	1.165	-18.774	1.521	34.657	-1.545
15	243	2	S1	10	-4.528	0.919	-16.902	3.052	-3.466	0.876	-14.123	1.911	-12.937	1.292	66.014	-2.921
16	246	2	S1	10	-15.164	3.049	-4.704#	0.900#	-10.870	1.710	1.467	0.121	-18.836	1.499	20.750	-0.805
17	249	2	S1	10	0.737	-0.152	-8.976	1.625	-3.347	0.655	-10.869	1.308	-16.020	1.363	47.806	-2.129
18	253	2	S1	10	-1.147	0.253	-4.921	0.903	-8.999	1.431	-12.964	1.508	-12.288	1.847	82.526	-3.898
19	255	2	S1	10	-10.347	2.087	-11.900	2.066	-21.524	3.284	0.920	0.202	-2.121	0.370	44.238	-1.986
20	258	2	S1	10	-5.121	1.003	-3.705	0.651	-5.813	0.904	-10.206	1.182	0.140	0.164	20.540	-0.837
21	261	2	S1	10	-3.340	0.671	-10.355	1.899	-24.960	3.795	-6.255	0.891	-10.680	0.967	47.174	-2.103
22	264	2	S1	10	-7.666	1.551	-11.466	2.013	-6.476	1.096	-21.306	2.364	-11.286	0.945	60.339	-2.828
23	266	2	S1	10	-5.924	1.181	-4.286	0.904	-9.362	1.585	0.097	0.335	0.304	0.264	32.751	-1.390
24	268	3	S1	10	6.829	-1.372	-14.093	2.290	-5.631	0.905	-11.278	1.360	-40.617	2.954	489.529	-24.198
25	269	3	S1	10	-2.238	0.455	-24.942	4.183	-36.775	5.426	-36.344	3.979	-36.366	3.704	547.831	-27.198
26	270	3	S1	10	2.513	-0.473	-17.796	2.988	-44.368	6.432	-30.356	3.323	-39.551	3.931	643.282	-31.884
27	272	3	S1	10	-4.326	0.879	-43.363	7.232	-51.754	7.557	-38.879	4.220	-68.359	4.905	700.144#	-35.075#
28	273	3	S1	10	4.903	-0.983	-37.688	6.302	-40.297	5.903	-39.200	4.182	-34.120	2.541	460.891	-23.021
29	277	3	S1	10	4.012	-0.793	-21.107	3.522	-36.213	5.266	-28.535	3.190	-53.294	3.798	728.031	-35.956
30	284	3	S1	10	-0.741	0.155	-40.604	6.767	-48.867	7.156	-51.819	5.454	-45.740	3.310	707.885	-35.181
31	297	3	S1	10	2.137	-0.413	-3.176	0.559	-49.018	7.113	-39.363	4.236	-13.059	1.170	635.760	-31.555

* Indicates data was not available or could not be calculated.

# Indicates data was not used for statistical analysis.

TABLE 19. EQUATIONS FOR THE BEST FIT REGRESSION LINE OF PLVC VERSUS TIME FOR THE S1 SLOPE OF CALF VOLUME AT ALL LEVELS OF NEGATIVE PRESSURE (PILOT).

RUN	DAY	CODE	DATA	NSAMP	-8		-16		-30		-40		-50		R.O.	
					B0	B1	B0	B1	B0	B1	B0	B1	B0	B1	B0	B1
1	79	1	S1	10	0.990	-0.193	-8.636	1.439	-7.603	1.084	-25.779	2.661	-34.287	2.425	232.869	-11.387
2	92	1	S1	10	1.551	-0.301	-9.872	1.637	-11.499	1.674	-29.184	3.038	-19.671	1.486	108.644	-5.255
3	178	1	S1	10	-1.439	0.298	-10.192	1.727	-13.901	2.078	-9.661	1.146	-14.712	1.167	109.979	-5.341
4	193	1	S1	10	-0.922	0.205	-11.955	1.995	-14.468	2.134	-13.694	1.545	******	*****	*******	******
5	204	1	S1	10	-1.981	0.417	-13.287	2.233	-14.823	2.218	-12.369	1.449	-19.563	1.513	91.984	-4.381
6	214	2	S1	10	-11.946	2.390	-7.553	1.360	-6.269	1.073	-2.831	0.490	0.107	0.196	39.098	-1.774
7	219	2	S1	10	-4.083	0.828	-2.634	0.545	-2.977	0.595	-9.279	1.194	-14.859	1.237	27.881	-1.167
8	224	2	S1	10	-9.050	1.826	-4.580	0.792	-13.516	1.995	-6.287	0.825	12.439	-0.657	46.643	-2.196
9	227	2	S1	10	-6.749	1.355	-2.086	0.477	-5.146	0.927	-3.570	0.635	-3.409	0.474	23.001	-0.905
10	231	2	S1	10	-12.395	2.505	-11.311	2.183	-2.464	0.631	-15.864	1.803	-15.701	1.321	43.536	-1.915
11	234	2	S1	10	-7.018	1.423	-8.568	1.632	-9.685	1.646	-5.494	0.854	-22.042	1.734	27.217	-1.106
12	237	2	S1	10	-7.301	1.464	-7.981	1.570	-7.211	1.343	-8.027	1.144	-4.593	0.601	178.605	-8.782
13	241	2	S1	10	-10.595	2.118	-8.034	1.498	-3.548	0.753	-4.975	0.810	-7.558	0.800	33.229	-1.366
14	243	2	S1	10	-4.349	0.878	2.034	-0.238	-4.380	0.711	-13.807	1.570	-13.669	1.130	49.715	-2.239
15	247	2	S1	10	-10.853	2.196	-3.800	0.824	-6.548	1.216	-13.876	1.606	-17.429	1.450	81.219	-3.811
16	250	2	S1	10	-13.560	2.749	-13.585	2.447	-11.043	1.817	-6.433	0.934	-19.035	1.528	64.702	-2.970
17	253	2	S1	10	-8.008	1.604	-4.683	0.935	-3.130	0.685	-10.353	1.312	-5.484	0.638	87.054	-4.082
18	256	2	S1	10	-0.088	0.047	-8.366	1.514	-8.668	1.468	-8.280	1.103	-12.338	1.880	5.056	0.016
19	259	2	S1	10	-25.053	5.043	-24.848	4.323	-18.933	3.001	-28.873	3.186	-25.064	1.964	79.790	-3.691
20	262	2	S1	10	-12.845	2.604	-5.336	1.078	-5.803	1.082	-7.346	1.020	-4.182	0.540	38.769	-1.678
21	266	2	S1	10	-14.043	2.816	-1.775	0.456	-6.505	1.161	-7.242	0.982	-3.580	0.494	39.954	-1.752
22	268	3	S1	10	-5.533	1.126	-10.198	1.773	-14.264	2.190	-22.684	2.478	-11.870	0.992	306.976	-15.175
23	269	3	S1	10	-6.224	1.389	-22.235	3.767	-26.085	3.876	-13.206	1.568	-21.205	1.654	287.749	-14.158
24	270	3	S1	10	-1.342	0.338	-26.006	4.394	-32.205	4.750	-14.352	1.678	-21.201	1.642	306.176	-15.110
25	272	3	S1	10	-6.527	1.361	-19.425	3.295	-23.809	3.546	-26.731	2.912	-31.922	2.382	423.493	-20.932
26	273	3	S1	10	-3.282	0.703	-12.543	2.151	-28.239	4.164	-24.468	2.650	-15.638	1.262	230.607	-11.325
27	277	3	S1	10	0.394	-0.081	-22.634	3.764	-29.274	4.277	-22.533	2.452	-20.729	1.570	372.302	-18.440
28	284	3	S1	10	-0.639	0.142	-26.665	4.453	-28.183	4.160	-65.769	6.808	-30.320	2.278	476.961	-23.654
29	297	3	S1	10	-1.123	0.242	-15.327	2.552	-22.240	3.238	-26.726	2.823	-21.990	1.624	307.341	-15.216

* Indicates data was not available or could not be calculated.

TABLE 20. SUMMARY OF S1 SLOPE (PLVC PER MINUTE) CHANGES INDUCED BY LEVELS OF LOWER BODY NEGATIVE PRESSURE.

SUBJECT	EXPR PHASE	Average S1 Slope Change in Leg Volume, ± S.D. and No. of Runs at Indicated Level of Pressure					
		-8	-16	-30	-40	-50	REC
CDR	Preflight	.45 ± .52 6	2.68 .69 6	2.57 .71 6	1.82 .64 6	1.50 .53 6	-4.61 2.01 6
CDR	In-flight	1.34* ± .68 16	1.00* .47 16	1.16* .60 16	1.07 .97 16	.71* .61 15	-3.05 3.51 15
CDR	Postflight	.64 ± .95 8	2.85# 1.55 8	3.23# 1.59 8	1.45 1.08 8	1.79# .51 8	-20.86*# 3.75 8
SPT	Preflight	.63 ± .96 5	1.03 1.33 5	3.46 2.12 5	2.67 .30 5	2.15 .96 5	-11.12 3.96 5
SPT	In-flight	1.12 ± .79 17	1.63 1.00 16	1.63* .93 17	1.17* .76 17	.90* .49 16	-1.42* 3.06 17
SPT	Postflight	-0.32# ± .76 8	4.23*# 2.36 8	5.72# 2.12 8	3.73# 1.19 8	3.04# 1.07 8	-29.85*# 5.14 7
PLT	Preflight	.09 ± .32 5	1.81 .31 5	1.84 .47 5	1.97 .83 5	1.65 .54 4	-6.59 3.23 4
PLT	In-flight	1.99* ±1.13 16	1.34 1.05 16	1.26 .63 16	1.23* .64 16	.91 .66 16	-2.46* 2.03 16
PLT	Postflight	.64# ± .56 8	3.27*# 1.01 8	3.78*# .79 8	2.92# 1.65 8	1.68# .47 8	-16.75*# 3.99 8

* Indicates significant difference (P<.05) from preflight.
# Indicates significant difference (P<.05) from in-flight.

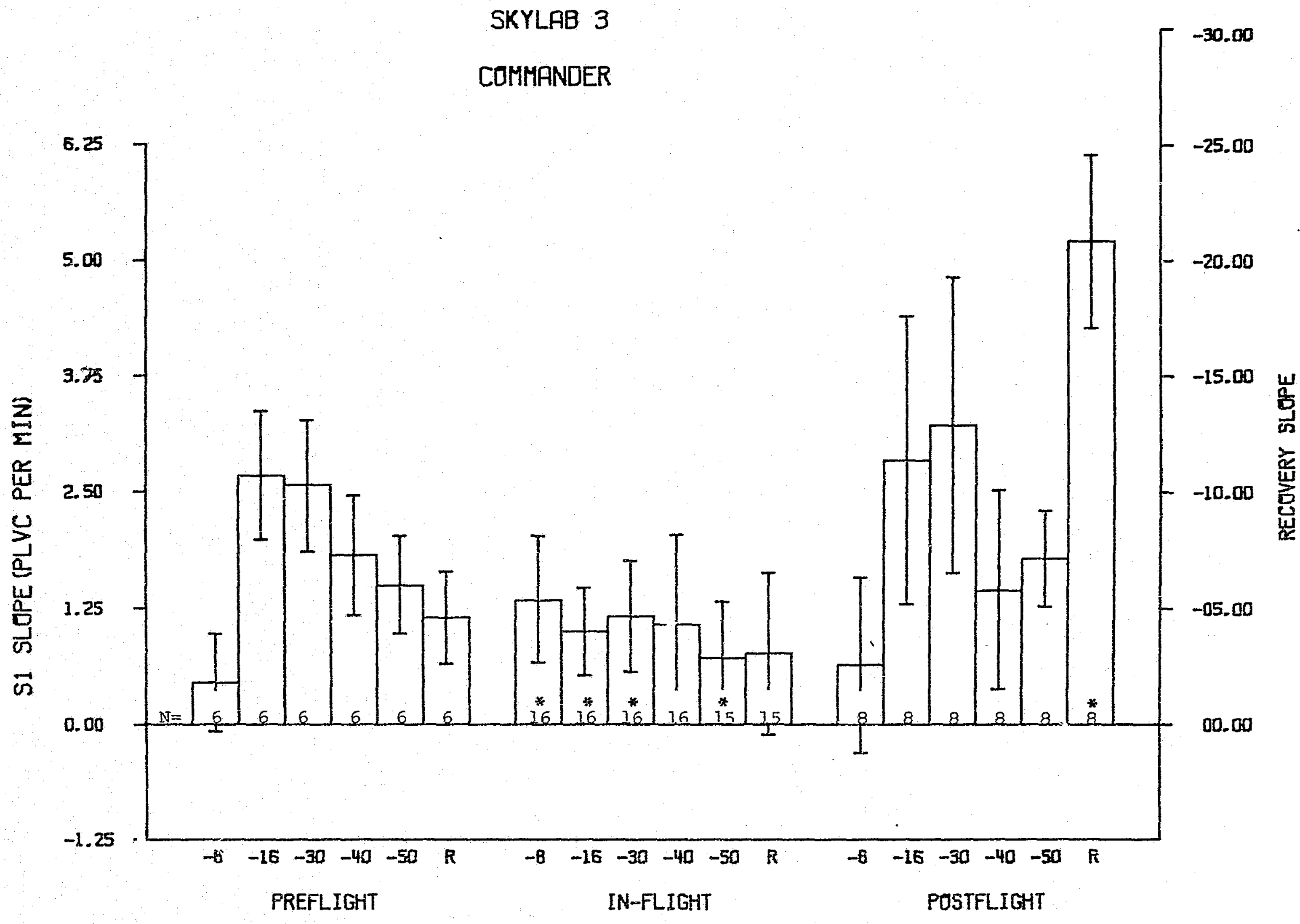


FIGURE 30. HISTOGRAMS SHOWING AVERAGE S1 SLOPE VALUES (± 1 S.D.) FOR ALL LEVELS OF NEGATIVE PRESSURE.

* Indicates a significant difference (P<0.05) from preflight.

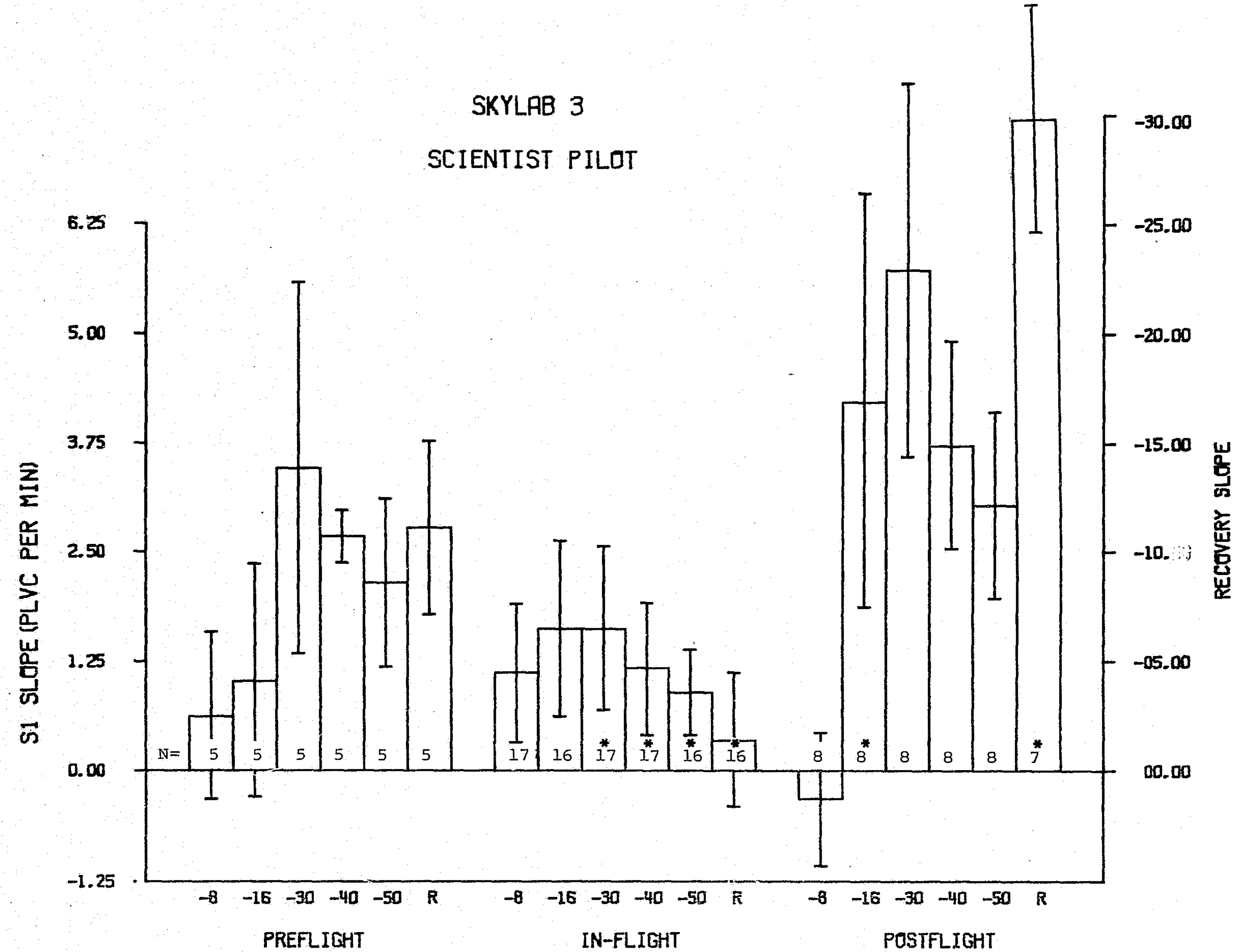


FIGURE 31. HISTOGRAMS SHOWING AVERAGE S1 SLOPE VALUES ($\pm$ 1 S.D.) FOR ALL LEVELS OF NEGATIVE PRESSURE.

* Indicates a significant difference (P<0.05) from preflight.

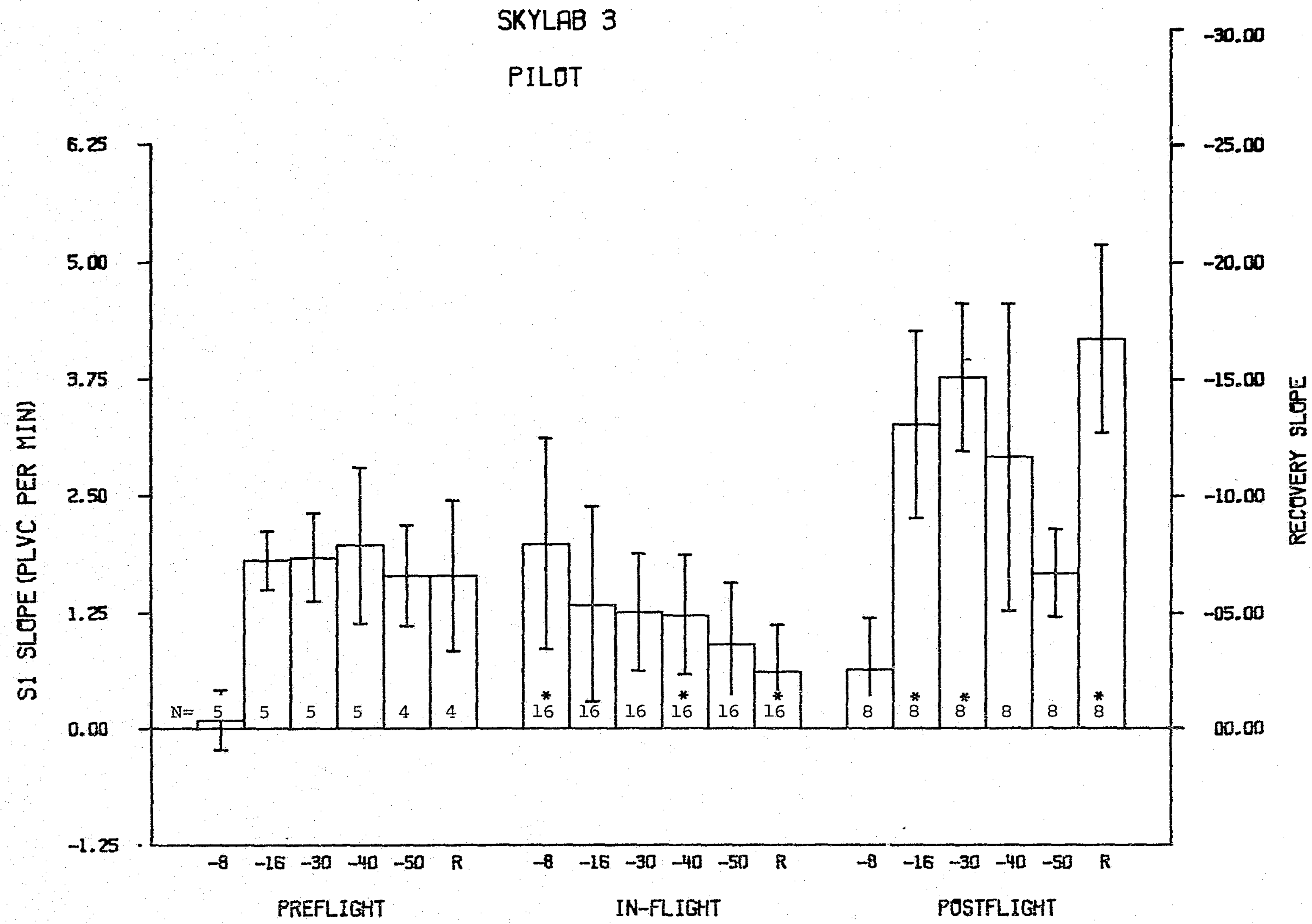


FIGURE 32. HISTOGRAMS SHOWING AVERAGE S1 SLOPE VALUES (± 1 S.D.) FOR ALL LEVELS OF NEGATIVE PRESSURE.

* Indicates a significant difference (P<0.05) from preflight.

slope values for other levels of negative pressure. The commander demonstrated his highest slope value at -16 mm Hg and diminished values at other levels of pressure. The scientist pilot demonstrated a relatively low value at -16 mm Hg and his highest slope value at -30 mm Hg with a large amount of variation at this and other levels. The pilot demonstrated almost constant slope values for the -16 through -50 mm Hg preflight levels (but considerably higher than his -8 mm Hg levels). The in-flight slope averages resembled the preflight data somewhat except for the fact that the -8 mm Hg slopes were much increased and most other slopes were decreased measurably including the recovery slopes. While most in-flight slope values were lower (except for -8 mm Hg), the pressure levels at which significantly lower slope values seemed variable among crewmembers. Significant changes occurred at the -8, -16, -30 and -50 mm Hg levels for the commander; -30, -40, -50 and recovery levels for the scientist pilot and -8, -40 and recovery levels for the pilot. Postflight slope values tended in general to be considerably increased over both preflight and in-flight values. Most of the slope values appear to be highly variable as shown by the large standard deviations. This variation reflects a physiological variation in addition to the variable techniques used for venting the LBNP chamber to ambient pressure.

Table 21 contains the comparison data for the ratio of the in-flight and postflight data to preflight values. The nine fold average increase for the in-flight -8 mm Hg negative pressure level over preflight values dramatically indicates the in-flight alteration. The 2.7 fold increase at the -8 mm Hg postflight indicates that the return to preflight values does not occur immediately. The -16 mm Hg level in-flight average response was only slightly lower than preflight; however, all other levels were considerably lower. The postflight/in-flight ratios indicated a higher postflight value at all pressure levels. Since the S1 slope parameters were computed as the best fit least squares regression line of PLVC versus time for each level of negative pressure, the average preflight, in-flight and postflight S1 intercept values are summarized in Table 22. The average intercept data (Table 22) in combination with the average slope

TABLE 21. RATIO OF IN-FLIGHT AND POSTFLIGHT S1 SLOPE DATA COMPARED TO THE PREFLIGHT BASELINE DATA.

CREW-MEMBER	IN-FLIGHT						POSTFLIGHT					
	Pressure Level						Pressure Level					
	-8	-16	-30	-40	-50	R	-8	-16	-30	-40	-50	R
CDR	3.0	0.4	0.5	0.6	0.5	-0.7	1.4	1.1	1.3	0.8	1.2	+4.5
SPT	1.8	1.6	0.5	0.4	0.4	-0.9	-.5	4.1	1.7	1.4	1.4	+2.7
PLT	22.1	0.7	0.7	0.6	0.6	-0.6	7.1	1.8	2.1	1.5	1.0	+2.6
GROUP MEAN	9.0	0.9	0.6	0.5	0.5	-0.7	2.7	2.3	1.7	1.2	1.2	+3.3

data (Table 20) completely define the change in PLVC as a function of time for each change in negative pressure.

In an effort to analyze the data in a more meaningful manner which would include the rate of change of the negative pressure as well as the rate of change of the calf volume, slopes were computed by using compliance technqiues. Compliance of a system is defined as the change in volume per change in pressure and when applied to the volume change of the calf allows computation of basic pressure volume characteristics. Assessment of pressure-volume properties relates to the characteristics of the overall calf segment and not solely to the intrinsic properties of the veins. Certainly the pressure-volume characteristics of the deep veins will be more affected by surrounding tissue than will the superficial veins. However, in an effort to more adequately characterize the volume changes occurring at the calf, a measure of compliance was calculated. The compliance equations were calculated using the PLVC and LBNP data beginning with the first data point during the interval of change in negative pressure. The algorithm used for this computation

TABLE 22. SUMMARY OF AVERAGE S1 INTERCEPT DATA FOR ALL CREWMEMBERS.

SUBJECT	EXPR PHASE	Average S1 Intercept (PLVC), ± S.D., and Number of Runs at Indicated Levels of Pressure					
		-8	-16	-30	-40	-50	REC
CDR	Preflight	-2.08 ±2.54 6	-15.88 4.15 6	-17.47 5.01 6	-16.74 6.43 6	-20.38 7.98 6	95.08 40.10 6
CDR	In-flight	-6.67 ±3.40 16	-5.45 2.73 16	-7.00 4.14 16	-8.59 9.65 16	-7.75 9.32 15	57.77 59.74 15
CDR	Postflight	-3.08 ±4.70 8	-16.88 9.30 8	-21.73 11.07 8	-12.51 10.43 8	-23.94 7.46 8	420.45 74.84 8
SPT	Preflight	-3.18 ±4.73 5	-6.13 7.86 5	-23.16 14.90 5	-24.30 3.11 5	-28.48 14.33 5	227.32 79.15 5
SPT	In-flight	-5.60 ±3.94 17	-8.98 5.90 16	-9.82 6.47 17	-8.57 7.54 17	-9.33 7.22 16	46.81 28.84 16
SPT	Postflight	1.64 ±3.79 8	-25.36 14.17 8	-39.12 14.72 8	-34.47 11.71 8	-41.39 15.91 8	601.83 102.74 7
PLT	Preflight	-.36 ±1.55 5	-10.79 1.83 5	-12.46 3.00 5	-18.14 8.74 5	-22.06 8.48 4	135.80 65.18 4
PLT	In-flight	-9.87 ±5.60 16	-7.07 6.13 16	-7.24 4.37 16	-9.53 6.34 16	-9.77 9.53 16	54.06 40.14 16
PLT	Postflight	-3.03 ±2.74 8	-19.38 6.13 8	-25.54 5.53 8	-27.06 16.47 8	-21.86 6.69 8	338.90 79.95 8

involved sampling the negative pressure to determine if the pressure change was complete at which time no more samples would be analyzed. If the pressure change for the standard decrements of -8 to -50 mm Hg was not complete in ten samples or if the pressure change associated with the run off was not complete in 25 samples, the sampling was stopped. At this point, the equation of the best fit, least squares regression was computed. This data is tabulated in Tables 23 through 25 for all three crewmembers. The tables indicate the intercept (B0), the slope (B1) and the number of samples (in parentheses) for each level of negative pressure. While these data still show considerable variation among runs, the slope is now expressed as a function of the rate of change in negative pressure. The effect of this computation is to decrease some of the slope values such as the -30 mm Hg values which on previous slope computations were exaggerated because of the 14 mm change in pressure rather than the usual 8 or 10 mm Hg change. The average preflight, in-flight and postflight compliance values are tabulated for each crewmember in Table 26 and graphed as histograms in Figures 33 to 35. The compliance values tended to exhibit a pattern similar to that computed for the S1 slope information (PLVC/minute). The in-flight -8 mm Hg level compliance values tended to be greater than preflight values and the compliance values at other levels or pressure including recovery seemed to be somewhat lower. The individual patterns are slightly different from the S1 slope patterns as would be expected since the rate of change of negative pressure is considered in the compliance computation. Use of this computation does make the postflight data correlate more closely with preflight data; however, significant differences did still occur at -16 and -30 mm Hg levels. The comparison of the average compliance values for the various mission phases is tabulated in Table 27 where the values indicate the ratio or preflight values to the compliance values of in-flight and postflight data.

The average preflight, in-flight and postflight S1 compliance intercepts of the regression lines for PLVC versus level of negative pressure are summarized in Table 28. The S1 compliance intercept data in combination with the S1 slope data (Table 26) completely define the average

TABLE 23. EQUATIONS FOR THE BEST FIT REGRESSION LINE OF PLVC VERSUS NEGATIVE PRESSURE (COMPLIANCE) FOR THE S1 SLOPE OF CALF VOLUME AT ALL LEVELS OF NEGATIVE PRESSURE (COMMANDER).

RUN	DAY	CODE	-8		-16		-30		-40		-50		R.O.	
			B0	B1	B0	B1	B0	B1	B0	B1	B0	B1	B0	B1
1	80	1	0.132	-0.026(5)	-0.052	-0.044(5)	0.360	-0.031(5)	1.285	-0.018(5)	1.302	-0.025(10)	0.678	-0.053(25)
2	113	1	0.079	-0.008(8)	-0.253	-0.035(7)	0.094	-0.019(10)	0.352	-0.024(10)	0.588	-0.024(10)	0.360	-0.040(25)
3	150	1	0.070	-0.006(8)	-0.425	-0.053(6)	0.438	-0.010(7)	0.601	-0.026(7)	1.851	-0.018(8)	1.217	-0.051(25)
4	178	1	0.059	-0.018(6)	-0.052	-0.019(6)	0.046	-0.025(6)	0.797	-0.019(5)	1.447	-0.017(6)	1.560	-0.034(25)
5	193	1	0.023	-0.000(5)	-0.504	-0.049(7)	0.435	-0.002(5)	0.928	-0.012(8)	1.670	-0.008(8)	1.761	-0.023(25)
6	204	1	0.343	0.004(5)	0.099	-0.020(5)	0.575	-0.014(8)	1.035	-0.013(8)	1.001	-0.025(7)	0.848	-0.046(25)
7	214	2	-0.030	-0.006(5)	0.089	-0.010(10)	0.524	-0.005(10)	0.580	-0.007(10)	*****	*****(5)	0.053	-0.024(12)
8	219	2	0.007	-0.021(7)	0.892	-0.004(5)	1.056	-0.010(10)	1.290	-0.017(10)	2.400	-0.000(8)	3.988#	-0.000(25)#
9	224	2	-0.036	-0.007(7)	0.156	-0.009(8)	0.223	-0.026(10)	1.221	-0.007(10)	1.540	-0.013(10)	1.725	-0.026(20)
10	228	2	-0.047	-0.003(7)	0.475	0.003(5)	0.709	-0.013(10)	1.658	-0.007(8)	2.507	-0.005(8)	1.522	-0.044(14)
11	232	2	-0.191	-0.023(7)	0.416	-0.025(6)	1.248	-0.017(6)	3.051	0.008(5)	3.099	-0.006(6)	3.386	-0.019(17)
12	235	2	0.019	0.007(5)	0.634	-0.017(6)	1.173	-0.008(10)	1.523	-0.021(8)	1.948	-0.024(10)	2.536	-0.033(20)
13	239	2	0.004	-0.011(5)	0.648	-0.001(5)	1.212	0.002(6)	1.643	-0.010(5)	2.066	-0.020(8)	2.894	-0.025(25)
14	242	2	-0.106	-0.009(7)	0.856	0.010(5)	1.294	-0.011(6)	1.774	-0.019(5)	2.655	-0.019(5)	2.856	-0.035(25)
15	244	2	-0.054	-0.000(5)	0.528	-0.007(8)	0.995	-0.009(10)	1.515	-0.015(10)	2.879	-0.000(10)	2.852	-0.017(25)
16	248	2	0.019	0.000(5)	0.477	0.001(5)	0.765	-0.010(10)	1.576	-0.010(5)	2.316	-0.008(5)	1.857	-0.028(25)
17	251	2	-0.002	-0.001(7)	0.859	-0.010(5)	1.113	-0.015(10)	2.339	-0.005(7)	3.018	-0.004(10)	2.905	-0.023(25)
18	254	2	0.063	0.000(5)	0.511	-0.020(8)	2.053	-0.003(10)	2.660	-0.014(8)	4.181	0.007(9)	2.731	-0.031(13)
19	257	2	-0.024	-0.006(5)	-0.371	-0.023(9)	-0.001	-0.018(10)	1.149	-0.012(10)	1.415	-0.020(10)	2.410	-0.018(25)
20	260	2	-0.127	-0.019(5)	0.570	-0.004(6)	0.850	-0.010(10)	2.478	0.003(8)	2.819	-0.005(10)	1.327	-0.055(25)
21	263	2	-0.003	-0.018(6)	0.757	-0.006(7)	1.181	-0.008(10)	0.451	-0.053(10)	2.674	-0.010(10)	2.134	-0.039(24)
22	266	2	-0.008	-0.012(5)	0.754	0.001(6)	1.080	-0.008(9)	1.182	-0.023(10)	1.808	-0.018(10)	2.503	-0.026(16)
23	268	3	0.050	-0.038(5)	0.086	-0.023(5)	0.681	-0.019(5)	1.695	-0.011(8)	2.512	-0.010(7)	2.470	-0.031(10)
24	269	3	0.203	0.014(5)	-0.151	-0.023(5)	0.212	-0.013(6)	1.084	0.002(9)	0.734	-0.020(10)	0.030	-0.082(7)
25	270	3	-0.074	-0.023(5)	0.213	0.006(6)	-0.070	-0.033(7)	1.874	-0.000(7)	2.459	-0.008(6)	1.750	-0.051(9)
26	272	3	0.295	-0.000(5)	-0.038	-0.048(5)	0.650	-0.038(7)	1.702	-0.026(5)	3.242	-0.025(8)	3.801	-0.064(7)
27	273	3	0.029	-0.028(5)	0.153	-0.028(5)	0.868	-0.017(7)	1.687	-0.010(6)	2.140	-0.009(8)	1.486	-0.049(7)
28	277	3	0.180	0.004(5)	-0.474	-0.050(7)	0.520	-0.019(7)	0.874	-0.025(5)	2.091	-0.018(5)	2.388	-0.055(5)
29	284	3	0.045	-0.001(5)	-0.908	-0.086(6)	0.163	-0.049(8)	2.161	-0.011(5)	1.986	-0.031(5)	1.448	-0.071(10)
30	297	3	-0.041	0.000(5)	-0.427	-0.036(5)	0.314	-0.023(5)	1.375	-0.022(6)	2.559	-0.014(5)	2.605	-0.037(6)

* Indicates data was not available or could not be calculated.

# Indicates data was not used for statistical analysis.

TABLE 24. EQUATIONS FOR THE BEST FIT REGRESSION LINE OF PLVC VERSUS NEGATIVE PRESSURE (COMPLIANCE) FOR THE S1 SLOPE OF CALF VOLUME AT ALL LEVELS OF NEGATIVE PRESSURE (SCIENTIST PILOT).

RUN	DAY	CODE	-8 B0	-8 B1	-16 B0	-16 B1	-30 B0	-30 B1	-40 B0	-40 B1	-50 B0	-50 B1	R.O. B0	R.O. B1
1	67	1	-0.325	0.001(5)	-0.258	-0.007(5)	0.520	-0.020(8)	1.526	-0.022(6)	3.698	0.003(5)	1.331	-0.064(22)
2	95	1	-0.135	-0.025(5)	0.051	0.001(5)	0.069	-0.031(6)	1.749	-0.020(5)	2.701	-0.018(5)	8.502	-0.090(25)
3	178	1	0.024	-0.013(5)	0.170	-0.017(5)	1.305	-0.000(7)	1.475	-0.035(8)	2.113	-0.042(9)	2.172	-0.073(25)
4	193	1	0.039	-0.009(5)	-0.089	-0.008(5)	0.610	-0.030(6)	1.970	-0.018(7)	2.713	-0.022(6)	1.391	-0.077(25)
5	204	1	0.162	0.012(5)	-0.261	-0.033(9)	0.561	-0.045(7)	2.475	-0.022(6)	2.745	-0.029(10)	1.798	-0.077(25)
6	213	2	0.087	-0.002(5)	0.941	-0.012(7)	2.292	-0.010(8)	3.082	-0.012(8)	*****	*****(5)	2.562#	-0.050(12)#
7	216	2	-0.032	-0.000(5)	0.752	0.001(5)	1.256	-0.009(8)	3.252	-0.002(9)	4.282	0.000(5)	4.124	-0.029(25)
8	220	2	-0.045	-0.019(5)	1.108	-0.002(5)	1.768	-0.012(10)	3.917	0.000(7)	5.014	-0.001(10)	5.109	-0.039(25)
9	225	2	-0.038	-0.000(5)	0.842	-0.011(5)	1.831	-0.020(9)	3.187	-0.022(6)	5.175	-0.010(7)	4.863	-0.055(21)
10	229	2	0.102	-0.009(8)	0.561	-0.046(8)	2.152	-0.013(7)	3.486	-0.008(6)	4.284	-0.016(7)	4.453	-0.045(25)
12	235	2	-0.069	0.012(5)	0.353	-0.002(5)	0.847	-0.009(7)	2.057	-0.007(6)	3.028	-0.012(8)	3.300	-0.027(25)
13	237	2	0.079	-0.011(6)	0.293	-0.052(7)	1.295	-0.010(10)	2.233	-0.019(7)	3.679	-0.013(8)	3.915	-0.035(25)
14	240	2	-0.096	-0.009(5)	0.292	-0.030(6)	1.441	-0.001(9)	1.975	-0.014(8)	2.707	-0.016(6)	3.182	-0.031(25)
15	243	2	0.014	-0.013(6)	1.150	-0.038(7)	2.568	-0.005(9)	4.232	-0.019(5)	5.407	-0.020(6)	5.433	-0.055(25)
16	246	2	-0.039	-0.044(8)	0.423#	-0.022(6)#	0.995	-0.011(10)	2.587	-0.003(8)	2.654	-0.022(10)	4.058	-0.013(25)
17	249	2	-0.002	0.003(5)	0.723	-0.006(5)	1.827	-0.004(9)	2.598	-0.015(8)	3.317	-0.024(6)	3.648	-0.039(25)
18	253	2	0.099	-0.005(8)	0.267	-0.023(5)	0.747	-0.015(10)	1.569	-0.020(9)	2.771	-0.014(8)	2.172	-0.053(23)
19	255	2	-0.031	-0.031(5)	0.890	-0.012(5)	0.989	-0.032(10)	2.779	-0.004(5)	3.477	-0.002(6)	2.954	-0.038(19)
20	258	2	-0.108	-0.003(5)	0.027	-0.012(6)	0.258	-0.012(6)	1.217	-0.014(7)	2.381	-0.005(7)	2.638	-0.026(25)
21	261	2	0.052	0.005(6)	0.751	-0.022(5)	0.920	-0.030(6)	2.292	-0.010(5)	3.674	-0.004(5)	3.384	-0.037(25)
22	264	2	-0.018	-0.021(5)	0.319	-0.020(6)	0.993	-0.009(10)	1.721	-0.011(5)	2.576	-0.006(7)	2.383	-0.037(21)
23	266	2	-0.045	-0.014(9)	0.832	-0.021(5)	1.438	-0.014(10)	3.407	-0.001(7)	4.314	0.001(5)	2.832	-0.044(25)
24	268	3	0.050	0.031(7)	-0.446	-0.022(5)	0.534	-0.010(7)	1.405	-0.029(5)	1.734	-0.041(5)	2.244	-0.082(9)
25	269	3	0.024	-0.005(6)	-0.493	-0.057(5)	0.217	-0.051(9)	2.097	-0.026(5)	3.363	-0.020(5)	2.837	-0.054(9)
26	270	3	-0.044	-0.034(6)	-0.166	-0.030(5)	0.239	-0.048(8)	1.653	-0.037(5)	2.888	-0.037(6)	2.983	-0.068(10)
27	272	3	-0.104	-0.024(5)	-0.914	-0.085(5)	0.470	-0.044(7)	2.360	-0.031(6)	3.586	-0.039(5)	3.446	-0.094(8)
28	273	3	0.111	0.017(5)	-1.053	-0.103(6)	-0.001	-0.056(8)	1.540	-0.037(8)	3.014	-0.024(6)	3.265	-0.046(6)
29	277	3	0.053	0.004(5)	-0.895	-0.075(6)	0.052	-0.045(10)	1.860	-0.026(5)	2.011	-0.042(8)	1.942	-0.079(9)
30	284	3	0.042	0.000(5)	-0.576	-0.054(6)	0.453	-0.041(6)	1.370	-0.041(5)	2.834	-0.025(5)	1.992	-0.069(11)
31	297	3	0.048	-0.002(5)	0.208	-0.000(5)	0.314	-0.030(5)	2.701	-0.013(5)	3.547	-0.021(5)	2.069	-0.119(9)

* Indicates data was not available or could not be calculated.

# Indicates data was not used for statistical analysis.

TABLE 25. EQUATIONS FOR THE BEST FIT REGRESSION LINE OF PLVC VERSUS NEGATIVE PRESSURE (COMPLIANCE) FOR THE S1 SLOPE OF CALF VOLUME AT ALL LEVELS OF NEGATIVE PRESSURE (PILOT).

RUN	DAY	CODE	-8 B0	-8 B1	-16 B0	-16 B1	-30 B0	-30 B1	-40 B0	-40 B1	-50 B0	-50 B1	R.O. B0	R.O. B1
1	79	1	0.024	0.001(6)	-0.354	-0.033(6)	-0.121	-0.013(7)	0.326	-0.019(6)	0.709	-0.034(5)	1.921	-0.043(22)
2	92	1	0.033	-0.000(5)	-0.151	-0.007(5)	-0.027	-0.012(5)	-0.057	-0.036(6)	1.884	-0.015(6)	1.318	-0.049(25)
3	178	1	0.028	-0.006(5)	-0.148	-0.017(6)	0.293	-0.010(5)	1.339	-0.011(5)	1.974	-0.017(8)	1.677	-0.046(25)
4	193	1	0.107	-0.000(5)	-0.137	-0.016(5)	0.259	-0.012(6)	1.151	-0.018(7)	*****	*****(0)	*****	*****(0)
5	204	1	-0.079	-0.023(5)	-0.074	-0.019(5)	0.379	-0.018(8)	1.667	-0.014(8)	2.365	-0.019(6)	2.048	-0.048(25)
6	214	2	-0.054	-0.020(6)	0.286	-0.020(7)	0.878	-0.015(10)	2.108	0.001(5)	2.877	-0.004(10)	2.537	-0.027(25)
7	219	2	-0.051	-0.021(6)	0.517	-0.005(5)	1.148	0.000(7)	1.676	-0.021(8)	2.877	-0.016(8)	3.037	-0.028(25)
8	224	2	-0.021	-0.027(6)	0.622	-0.003(7)	0.495	-0.034(8)	0.951	-0.025(10)	3.156	0.010(7)	2.287	-0.021(25)
9	227	2	-0.048	-0.019(5)	0.843	-0.014(10)	1.049	-0.019(10)	2.347	-0.013(10)	3.288	-0.010(10)	3.733	-0.026(25)
10	231	2	0.060	-0.028(6)	0.963	-0.049(6)	1.763	-0.008(10)	2.024	-0.027(10)	3.085	-0.022(8)	3.927	-0.035(25)
11	234	2	0.080	-0.014(5)	0.880	-0.028(7)	1.515	-0.017(10)	2.575	-0.014(9)	2.709	-0.028(10)	3.934	-0.026(25)
12	237	2	-0.045	-0.009(5)	0.715	-0.028(6)	1.502	-0.013(10)	2.696	-0.010(7)	3.901	-0.007(10)	1.248	-0.084(25)
13	241	2	-0.004	-0.002(5)	0.854	-0.012(5)	1.801	-0.008(10)	2.707	-0.013(10)	3.774	-0.015(9)	4.427	-0.034(25)
14	243	2	0.013	-0.010(7)	0.459	-0.003(5)	0.497	-0.007(10)	1.618	-0.011(8)	2.909	-0.006(5)	3.090	-0.039(25)
15	247	2	-0.004	-0.035(9)	0.933	-0.013(5)	1.733	-0.007(6)	2.288	-0.021(6)	3.520	-0.015(7)	3.604	-0.038(25)
16	250	2	0.084	-0.019(5)	0.938	-0.015(6)	1.280	-0.018(10)	2.569	-0.010(7)	2.863	-0.024(8)	3.778	-0.034(25)
17	253	2	-0.040	-0.015(5)	0.854	-0.005(5)	1.392	-0.012(8)	2.196	-0.016(6)	3.614	-0.011(8)	3.457	-0.043(25)
18	256	2	0.126	-0.005(5)	0.922	-0.010(5)	1.377	-0.013(9)	2.558	-0.005(7)	3.407	-0.010(6)	4.363	-0.023(25)
19	259	2	0.001	-0.056(6)	0.456	-0.067(8)	1.393	-0.034(10)	1.943	-0.033(7)	3.324	-0.026(10)	4.306	-0.038(18)
20	262	2	-0.020	-0.038(5)	0.805	-0.016(5)	1.630	-0.005(8)	2.660	-0.003(5)	3.564	-0.007(6)	3.467	-0.041(25)
21	266	2	-0.218	-0.041(5)	0.839	-0.004(5)	1.347	-0.008(8)	1.774	-0.021(6)	3.509	-0.004(6)	3.662	-0.031(23)
22	268	3	0.005	-0.015(5)	-0.040	-0.037(5)	0.633	-0.020(8)	1.160	-0.028(6)	2.278	-0.016(5)	2.498	-0.035(8)
23	269	3	0.071	-0.027(5)	0.133	-0.028(5)	0.472	-0.032(8)	2.014	-0.014(6)	3.018	-0.014(5)	3.530	-0.043(7)
24	270	3	4.324#	0.477(5)#	-0.307	-0.059(5)	0.233	-0.039(5)	1.730	-0.020(6)	2.971	-0.011(5)	3.048	-0.036(8)
25	272	3	0.298	-0.004(5)	0.061	-0.032(5)	0.527	-0.033(10)	1.522	-0.030(6)	3.190	-0.016(5)	3.020	-0.068(7)
26	273	3	0.309	0.006(5)	0.062	-0.027(6)	0.066	-0.039(6)	1.398	-0.019(5)	2.837	-0.011(6)	3.197	-0.047(8)
27	277	3	-0.020	-0.000(5)	-0.520	-0.047(5)	0.071	-0.032(6)	1.338	-0.023(6)	2.184	-0.018(6)	2.054	-0.052(8)
28	284	3	0.076	-0.000(5)	-0.508	-0.051(5)	0.260	-0.034(7)	2.054	-0.013(6)	2.982	-0.020(5)	2.028	-0.101(8)
29	297	3	0.099	0.001(5)	-0.129	-0.013(5)	0.214	-0.014(5)	0.847	-0.022(6)	1.555	-0.019(5)	1.767	-0.041(9)

* Indicates data was not available or could not be calculated.

# Indicates data was not used for statistical analysis.

TABLE 26. SUMMARY OF S1 SLOPE COMPLIANCE (PLVC/mm Hg) CHANGES INDUCED BY LOWER BODY NEGATIVE PRESSURE.

SUBJECT	EXPR PHASE	Average S1 Slope Compliance Changes, ± S. D. and No. of Runs at Indicated Level of Negative Pressure					
		-8	-16	-30	-40	-50	REC
CDR	Preflight	-0.009 ±0.011 6	-0.037 0.015 6	-0.017 0.010 6	-0.019 0.006 6	-0.020 0.007 6	-0.041 0.017 6
CDR	In-flight	-0.008 ±0.009 16	-0.008* 0.010 16	-0.011 0.006 16	-0.013 0.013 16	-0.010* 0.009 15	-0.030* 0.010 15
CDR	Postflight	-0.009 ±0.018 8	-0.036# 0.027 8	-0.026# 0.012 8	-0.013 0.011 8	-0.017 0.008 8	-0.055# 0.017 8
SPT	Preflight	-0.007 ±0.014 5	-0.013 0.013 5	-0.025 0.017 5	-0.023 0.007 5	-0.022 0.017 5	-0.076 0.009 5
SPT	In-flight	-0.010 ±0.014 17	-0.019 0.016 16	-0.013* 0.008 17	-0.011* 0.007 17	-0.010* 0.008 16	-0.038* 0.011 16
SPT	Postflight	-0.002 ±0.021 8	-0.053*# 0.034 8	-0.041# 0.015 8	-0.030# 0.009 8	-0.031# 0.009 8	-0.076# 0.023 8
PLT	Preflight	-0.006 ±0.010 5	-0.018 0.009 5	-0.013 0.003 5	-0.020 0.010 5	-0.021 0.009 4	-0.047 0.003 4
PLT	In-flight	-0.022* ±0.014 16	-0.018 0.018 16	-0.014 0.009 16	-0.015 0.009 16	-0.012 0.010 16	-0.036 0.015 16
PLT	Postflight	-0.006# ±0.011 7	-0.037*# 0.014 8	-0.030*# 0.009 8	-0.021 0.006 8	-0.016 0.003 8	-0.053# 0.029 8

* Indicates significant difference (P<.05) from preflight.
# Indicates significant difference (P<.05) from in-flight.

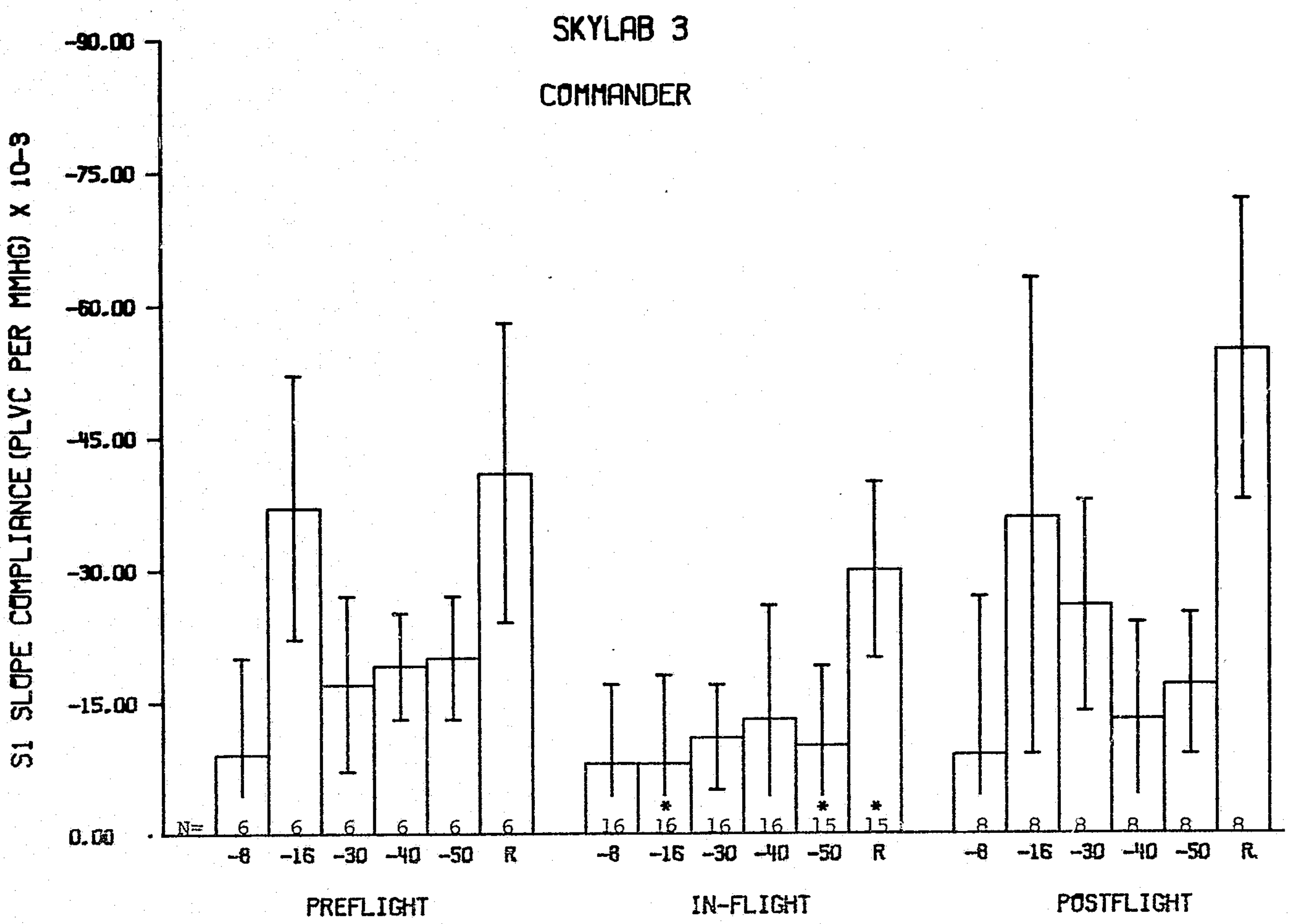


FIGURE 33. HISTOGRAMS SHOWING AVERAGE S1 SLOPE COMPLIANCE VALUES (± 1 S.D.) FOR ALL LEVELS OF NEGATIVE PRESSURE.

* Indicates a significant difference ($P<0.05$) from preflight.

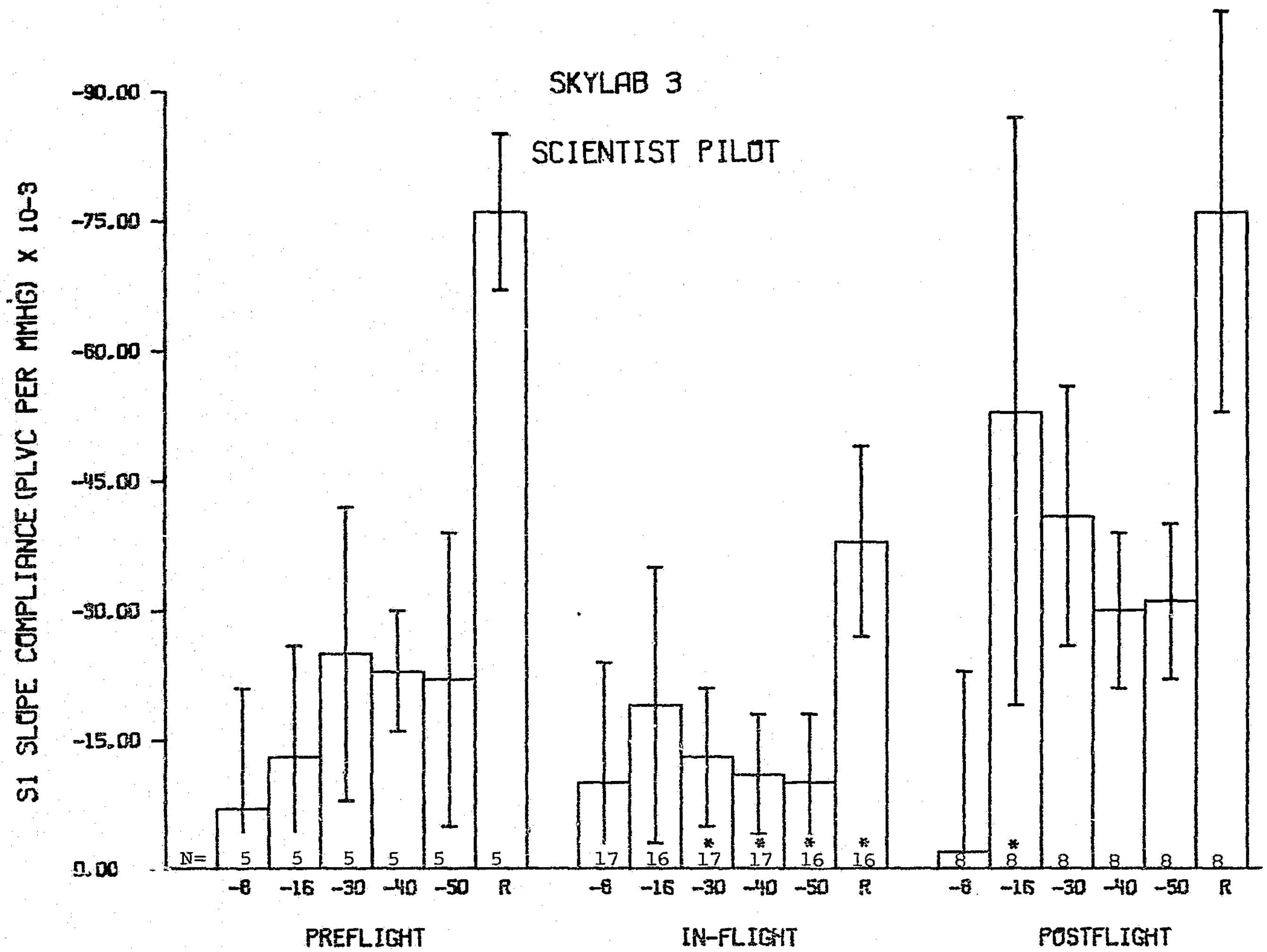


FIGURE 34. HISTOGRAMS SHOWING AVERAGE S1 SLOPE COMPLIANCE VALUES ($\pm$ 1 S.D.) FOR ALL LEVELS OF NEGATIVE PRESSURE.

* Indicates a significant difference (P<0.05) from preflight.

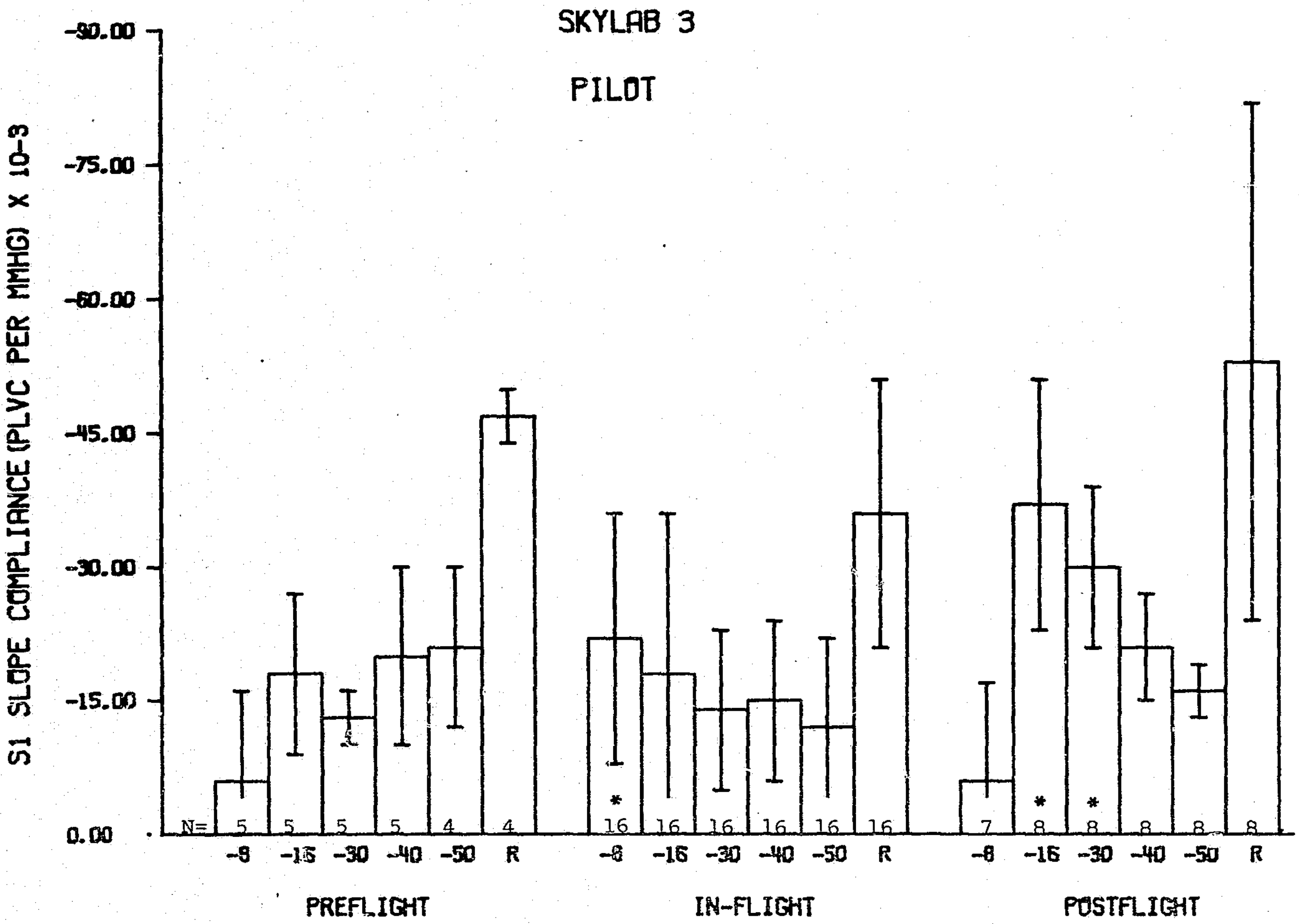


FIGURE 35. HISTOGRAMS SHOWING AVERAGE S1 SLOPE COMPLIANCE VALUES ($\pm$ 1 S.D.) FOR ALL LEVELS OF NEGATIVE PRESSURE.

* Indicates a significant difference (P< 0.05) from preflight.

TABLE 27. RATIO OF IN-FLIGHT AND POSTFLIGHT S1 COMPLIANCE DATA COMPARED TO THE PREFLIGHT BASELINE DATA.

CREW-MEMBER	In-flight						Postflight					
	Pressure Level						Pressure Level					
	-8	-16	-30	-40	-50	R	-8	-16	-30	-40	-50	R
CDR	0.9	0.2	0.6	0.7	0.5	0.7	1.0	1.0	1.5	0.7	0.9	1.3
SPT	1.4	1.5	0.5	0.5	0.5	0.5	0.3	4.1	1.6	1.3	1.4	1.0
PLT	3.7	1.0	1.1	0.8	0.6	0.8	1.0	2.1	2.3	1.1	0.8	1.1
GROUP MEAN	2.0	0.9	0.7	0.7	0.5	0.7	0.8	2.4	1.8	1.0	1.0	1.1

rate of volume change as a function of the magnitude change in negative pressure.

The S1 slope is represented by the rate of change in calf volume while the negative pressure is changing. The S2 slope is the rate of change in calf volume occurring after a change in negative pressure and or the period of time while the negative pressure is constant. The algorithm used for the Skylab data involved computing regression lines for PLVC versus time using a specific amount of time for negative pressure, control and recovery periods. The times and samples are listed by period in Table 29. The individual S2 slope data (PLVC/minute) for each crewmember are tabulated in Tables 30 through 32. The average data tabulated in Table 33 and graphed by mission phase in Figures 36 through 38 demonstrate the severe variation occurring particularly in the -8 and -16 mm Hg S2 slope data. The preflight control values demonstrate a negative slope for all three crewmembers reflecting the decrease in leg volume or "drainage" condition as a result of the horizontal position. In zero gravity this alteration of initial leg

TABLE 28. SUMMARY OF AVERAGE S1 COMPLIANCE INTERCEPT DATA FOR ALL CREWMEMBERS.

SUBJECT	EXPR PHASE	Average S1 compliance intercept (PLVC), ± S.D. and Number of runs at indicated levels of pressure					
		-8	-16	-30	-40	-50	REC
CDR	Preflight	.12 ±.12 6	-.20 .24 6	.32 .21 6	.83 .33 6	1.32 .46 6	1.07 .54 6
CDR	In-flight	-.03 ±.06 16	.52 .33 16	.97 .47 16	1.63 .71 16	2.50 .70 15	2.25 .83 15
CDR	Postflight	.09 ±.12 8	-.19 .38 8	.42 .32 8	1.56 .42 8	2.22 .72 8	2.00 1.10 8
SPT	Preflight	-.05 ±.19 5	-.08 .19 5	.61 .44 5	1.84 .40 5	2.79 .57 5	1.44 .62 5
SPT	In-flight	-.01 ±.07 17	.63 .34 16	1.39 .61 17	2.68 .84 17	3.67 .99 16	3.65 .98 16
SPT	Postflight	.02 ±.06 8	-.54 .42 8	.28 .19 8	1.87 .48 8	2.87 .68 8	2.65 .70 8
PLT	Preflight	.02 ±.07 5	-.17 .10 5	.16 .22 5	.89 .72 5	1.75 .66 4	1.74 .32 4
PLT	In-flight	-.01 ±.08 16	.74 .21 16	1.30 .40 16	2.17 .49 16	3.29 .35 16	3.45 .83 16
PLT	Postflight	.12 ±.13 7	-.16 .26 8	.31 .21 8	1.51 .41 8	2.63 .56 8	2.64 .64 8

TABLE 29. LENGTH OF TIME AND NUMBER OF SAMPLES USED FOR S2 SLOPE COMPUTATION.

Period	Length of Time Used	No. of Samples
Control	2 min	150
-8	20 sec	25
-16	20 sec	25
-30	1 min	75
-40	2 min	150
-50	2 min	150
Recovery	2 min	150

TABLE 30. EQUATIONS OF BEST FIT REGRESSION LINE OF PLVC VERSUS TIME FOR THE S2 SLOPE OF CALF VOLUME AT ALL LEVELS OF NEGATIVE PRESSURE (COMMANDER).

RUN	DAY	CODE	CONTROL		-8		-16		-30		-40		-50		RECOVERY	
			B0	B1	B0	B1	B0	B1	B0	B1	B0	B1	B0	B1	B0	B1
1	80	1	0.377	-0.046	0.196	0.033	2.407	-0.206	1.885	-0.002	1.933	0.032	2.012	-0.040	1.062	-0.027
2	113	1	0.265	-0.044	0.314	-0.044	0.093	0.032	0.795	0.029	0.821	0.050	0.951	-0.060	0.878	-0.031
3	150	1	0.035	0.004	0.254	-0.035	-1.930	0.363	0.862#	0.054#	1.844	0.047	0.942	-0.125	-0.712	0.075
4	178	1	0.353	-0.062	0.098	-0.001	0.553	-0.010	1.182	0.020	1.081	0.071	0.649	-0.119	1.389	-0.033
5	193	1	0.001	-0.001	-0.399	0.063	1.786	-0.186	1.169	0.015	0.775	0.079	0.208	-0.129	-0.160	0.013
6	204	1	0.392	-0.066	1.231	-0.160	1.725	-0.136	1.525	-0.010	0.948	0.071	1.071	-0.085	0.547	-0.048
7	214	2	0.184	-0.043	1.942	-0.298	-0.840	0.203	1.020	-0.020	*****	*****	*****	*****	-0.504	-0.008
8	219	2	0.018	-0.014	-0.588	0.236	3.305	-0.308	1.312	0.057	2.048	0.018	1.608#	-0.123#	-2.591	0.150
9	224	2	0.002	-0.005	1.672	-0.245	-1.176	0.268	0.599	0.084	1.101	0.060	0.111	-0.142	*****	*****
10	228	2	-0.090	-0.003	1.315	-0.140	-3.971	0.679	0.077	0.181	1.710	0.067	-0.092#	-0.187#	1.949	-0.083
11	232	2	-0.219	0.034	-0.195	0.156	-0.586	0.275	1.835	0.094	2.218	0.075	2.655	-0.087	2.826	-0.101
12	235	2	0.311	-0.067	-0.919	0.287	1.591	-0.039	0.187	0.208	2.399	0.037	-0.758	-0.239	1.739	-0.055
13	239	2	-0.201	0.038	0.814	-0.037	0.603	0.078	0.833	0.117	1.313	0.103	1.333	-0.133	2.999	-0.098
14	242	2	-0.349	0.076	-0.505	0.206	-1.141	0.369	1.820	0.062	2.289	0.048	2.867	-0.078	2.323	-0.102
15	244	2	-0.053	-0.001	-0.703	0.211	-0.900	0.301	1.701	0.030	1.462	0.090	1.933	-0.085	-0.387	0.022
16	248	2	-0.135	0.029	-2.425	0.461	-0.951	0.257	0.092	0.174	1.651	0.066	1.485	-0.104	1.296	-0.074
17	251	2	0.031	-0.007	-2.451	0.563	-0.430	0.266	1.224	0.125	1.877	0.086	3.432	-0.027	1.399	-0.050
18	254	2	-0.450	0.094	-3.968	0.783	-2.343	0.632	1.464	0.169	2.487	0.093	1.825#	-0.142#	-0.127	0.025
19	257	2	-0.019	0.004	1.498	-0.275	2.001	-0.245	0.026	0.155	0.759	0.099	1.681	-0.075	1.410	-0.054
20	260	2	-0.203	0.012	-3.301	0.662	1.809	-0.111	0.573	0.190	1.469	0.104	2.158	-0.088	0.895	-0.031
21	263	2	0.272	-0.047	-1.027	0.292	-1.103	0.344	1.386	0.076	2.492	0.041	2.247	-0.078	1.376	-0.072
22	266	2	0.120	-0.025	-1.591	0.396	0.850	0.050	0.332	0.167	2.101	0.037	0.943	-0.137	0.600	0.005
23	268	3	0.063	-0.016	-1.256	0.281	2.952	-0.278	1.301	0.079	1.527	0.093	1.891	-0.096	1.854	-0.062
24	269	3	0.302	-0.056	-0.709	0.136	-0.287	0.109	0.738	0.020	0.926	0.041	2.193	-0.101	-0.545#	0.001#
25	270	3	-0.071	0.025	0.614	-0.088	1.176	-0.097	0.980	0.089	0.952	0.118	1.190	-0.130	1.569	-0.075
26	272	3	0.306	-0.061	1.586	-0.206	0.590	0.111	1.192	0.133	-0.155	0.297	2.391	-0.164	3.863	-0.086
27	273	3	0.064	-0.006	1.027	-0.112	0.657	0.072	1.204	0.076	1.452	0.072	1.617	-0.073	0.851	-0.047
28	277	3	0.650	-0.123	0.021	-0.004	0.695	0.014	1.601	0.002	0.348	0.166	0.767	-0.163	1.218	-0.051
29	284	3	0.533	-0.105	-0.062	0.011	1.126	-0.027	1.772	0.071	2.215	0.073	2.489	-0.080	1.093	-0.041
30	297	3	0.264	-0.070	0.057	-0.015	1.737	-0.148	0.906	0.118	1.571	0.105	2.369	-0.085	3.985	-0.128

* Indicates data was not available or could not be calculated.

# Indicates data was not used for statistical analysis.

TABLE 31. EQUATIONS OF BEST FIT REGRESSION LINE OF PLVC VERSUS TIME FOR THE S2 SLOPE OF CALF VOLUME AT ALL LEVELS OF NEGATIVE PRESSURE (SCIENTIST PILOT).

RUN	DAY	CODE	CONTROL		-8		-16		-30		-40		-50		RECOVERY	
			B0	B1	B0	B1	B0	B1	B0	B1	B0	B1	B0	B1	B0	B1
1	67	1	-0.090	-0.045	-0.679	0.060	-4.103	0.702	1.750	0.044	0.693	0.188	2.072	0.101	0.717	-0.026
2	95	1	-0.138	0.028	0.248	-0.040	-1.210	0.252	1.023	0.138	2.210	0.075	3.215	0.848	2.869	-0.114
3	178	1	0.199	-0.025	-3.682	0.447	-2.153	0.494	1.417	0.123	1.801	0.143	2.186	0.159	1.868	-0.058
4	193	1	0.319	-0.051	0.648	-0.095	-1.038	0.309	2.426	0.029	2.763	0.058	1.815	0.148	1.730	-0.080
5	204	1	0.287	-0.078	-0.730	0.733	-1.490	0.377	2.638	0.055	3.294	0.044	2.344	0.129	2.608	-0.093
6	213	2	-0.964	0.152	-4.710	0.978	-4.498	1.001	2.059	0.146	*****	*****	*****	*****	1.865	-0.098
7	216	2	0.059	-0.002	-3.674	0.731	-2.490	0.541	-1.579	0.508	0.518	0.252	2.801	0.131	1.554	-0.009
8	220	2	-0.296	0.068	-2.444	0.603	-2.465	0.627	-0.948	0.503	4.011	0.075	0.885	0.298	2.566	-0.133
9	225	2	-0.086	0.010	-5.216	1.040	-3.943	0.873	2.142	0.178	2.294	0.216	3.263	0.189	-1.824	0.102
10	229	2	0.327	-0.075	-3.531	0.781	0.580	0.249	1.624	0.213	3.459	0.090	2.799	0.172	-0.295	0.053
12	235	2	-0.099	0.011	-1.409	0.302	-2.386	0.490	1.196	0.106	2.399	0.076	1.995	0.138	1.174	-0.041
13	237	2	0.065	-0.006	-2.422	0.521	3.837	-0.334	0.937	0.195	2.314	0.124	2.284	0.156	1.582	-0.054
14	240	2	-0.228	0.012	-4.272	0.851	1.766	-0.059	0.563	0.197	2.386	0.067	1.335	0.164	0.430	-0.028
15	243	2	-0.124	0.029	-7.172	1.446	-3.057	0.813	-0.840	0.582	4.300	0.136	4.738 #	0.147 #	3.414	-0.080
16	246	2	0.335	-0.068	2.420	-0.300	-3.510 #	0.653 #	-2.235	0.490	2.569	0.065	0.604	0.202	2.392	-0.042
17	249	2	0.772	-0.154	-4.386	0.862	3.470	-0.198	*****	*****	3.542	0.054	4.452	0.842	1.387	-0.037
18	253	2	0.593	-0.145	-0.713	0.193	-1.161	0.308	0.802	0.136	1.125	0.149	1.151	0.170	0.702	-0.004
19	255	2	-0.122	0.036	3.238	-0.381	0.462	0.154	0.838	0.198	1.241	0.154	1.828	0.136	1.940	-0.057
20	258	2	-0.485	0.051	-0.214	0.065	0.987	-0.067	-0.385	0.213	-0.322	0.195	1.002	0.140	0.404	-0.008
21	261	2	-0.077	0.018	-3.966	0.821	1.582	-0.023	1.659	0.108	-0.212	0.273	2.220	0.145	1.402	-0.026
22	264	2	-0.279	0.044	-1.280	0.390	-2.010	0.450	1.072	0.102	1.742	0.068	1.229	0.134	1.262	-0.065
23	266	2	0.061	-0.023	-7.851	1.492	-0.671	0.352	1.623 #	0.182 #	2.062	0.146	2.701	0.105	1.096	-0.040
24	268	3	-0.413	0.073	-3.429	0.633	-6.065	0.956	0.387	0.191	2.496	0.076	-0.079	0.248	4.151	-0.129
25	269	3	0.017	0.007	-1.887	0.315	-0.280	0.204	1.877	0.098	2.072	0.144	2.480	0.149	2.089	-0.079
26	270	3	0.100	-0.033	1.313	-0.202	4.073	-0.438	2.660	0.017	2.661	0.116	2.962	0.141	4.045	-0.152
27	272	3	0.534	-0.111	-0.006	0.003	1.237	0.012	3.416	-0.007	1.302	0.264	0.265 #	0.368 #	4.312	-0.113
28	273	3	-0.304	0.061	-0.332	0.070	2.371	-0.196	1.578	0.093	1.405	0.172	1.818	0.170	3.228	-0.072
29	277	3	-0.059	0.026	0.242	-0.047	0.255	0.065	1.369	0.127	1.972	0.117	0.722	0.214	-2.403	0.111
30	284	3	0.523	-0.102	6.183	-1.068	-2.571	0.532	2.917	-0.030	2.103	0.120	3.419	0.874	1.599	-0.054
31	297	3	0.147	-0.037	-2.482	0.431	0.283	0.076	1.597	0.148	1.867	0.169	0.842	0.228	3.172	-0.133

* Indicates data was not available or could not be calculated.

# Indicates data was not used for statistical analysis.

TABLE 32. EQUATIONS OF BEST FIT REGRESSION LINE OF PLVC VERSUS TIME FOR THE S2 SLOPE OF CALF VOLUME AT ALL LEVELS OF NEGATIVE PRESSURE (PILOT).

RUN	DAY	CODE	CONTROL		-8		-16		-30		-40		-50		RECOVERY	
			B0	B1	B0	B1	B0	B1	B0	B1	B0	B1	B0	B1	B0	B1
1	79	1	0.136	-0.013	-0.505	0.079	-0.595	0.075	0.274	0.062	0.382	0.125	0.581	0.167	3.007	-0.072
2	92	1	0.221	-0.038	-0.091	0.008	0.007	0.028	0.556	0.060	0.870	0.111	1.618	0.088	3.942	-0.130
3	178	1	0.266	-0.057	0.257	-0.038	-0.258	0.109	0.255	0.147	1.005	0.113	1.501	0.103	2.535	-0.071
4	193	1	0.391	-0.059	0.660	-0.106	-0.425	0.130	0.862	0.080	1.257#	0.089#	*****	*****	*****	*****
5	204	1	0.064	0.001	0.169	-0.008	0.020	0.099	0.721	0.137	1.747	0.091	2.555	0.875	3.217	-0.097
6	214	2	-0.374	0.089	-0.417	0.153	-0.125	0.189	1.357	0.063	1.485	0.100	1.664	0.107	1.233	-0.045
7	219	2	-0.311	0.057	-2.504	0.523	0.085	0.141	-0.609	0.321	1.624	0.127	2.015	0.139	2.397	-0.101
8	224	2	-0.143	0.039	-0.519	0.187	0.145	0.123	0.699	0.111	1.085	0.107	1.083	0.100	1.385	-0.044
9	227	2	0.316	-0.061	-0.369	0.201	-3.563	0.704	-1.482	0.438	2.384	0.087	1.549	0.170	2.160	-0.079
10	231	2	0.245	-0.039	-12.500#	2.394#	0.730	0.162	0.522	0.233	2.512	0.104	1.178	0.218	3.117	-0.090
11	234	2	-0.077	0.014	-4.323	0.925	-0.130	0.286	2.131	0.084	2.973	0.062	1.865	0.167	2.608	-0.073
12	237	2	-0.183	0.031	-6.415	1.593	0.140	0.237	1.708	0.136	1.946	0.108	2.055	0.168	0.914	-0.067
13	241	2	0.232	-0.052	0.536	0.078	-1.265	0.438	-0.030	0.326	2.298	0.136	1.301	0.236	0.916	-0.010
14	243	2	0.113	0.024	1.222	-0.122	-2.945	0.507	-1.144	0.317	0.780	0.163	0.619	0.211	5.316	-0.236
15	247	2	-0.079	0.014	-1.795	0.489	1.815	0.022	0.822	0.226	2.151	0.131	2.355	0.146	1.742	-0.013
16	250	2	0.227	-0.041	-0.074	0.187	0.650	0.128	2.211	0.061	2.405	0.097	2.195	0.154	3.714	-0.114
17	253	2	-0.189	0.031	-4.842	0.970	-3.225	0.703	-0.338	0.311	1.852	0.148	1.675	0.176	2.374	-0.064
18	256	2	0.219	-0.045	1.828	-0.139	0.310	0.187	0.754	0.205	1.828	0.134	1.273	0.207	-1.011	0.075
19	259	2	-0.246	0.043	1.125	0.004	0.855	0.156	2.328	0.069	1.976	0.161	1.675	0.216	2.342	-0.053
20	262	2	-0.064	0.010	-2.390	0.572	0.805	0.114	1.589	0.116	1.672	0.145	1.590	0.186	2.234	-0.057
21	266	2	-0.276	0.047	-2.521	0.686	-1.108	0.381	1.401	0.115	0.793	0.197	1.885	0.160	1.941	-0.048
22	268	3	0.376	-0.073	2.105	-0.316	-1.000	0.268	1.188	0.096	2.068	0.063	2.372	0.871	1.745	-0.042
23	269	3	0.347	-0.057	-0.269	0.103	0.170	0.124	1.085	0.135	2.002	0.107	1.274	0.184	3.696	-0.074
24	270	3	0.533	-0.081	0.304	0.003	1.207	-0.036	1.479	0.090	2.040	0.093	1.436	0.148	4.731	-0.158
25	272	3	0.895	-0.150	0.642	-0.044	0.641	0.060	0.961	0.149	1.803	0.135	1.939	0.160	5.216	-0.191
26	273	3	0.776	-0.139	1.785	-0.248	-0.701	0.223	0.780	0.126	0.828	0.162	0.903	0.186	5.512	-0.145
27	277	3	0.618	-0.143	0.577	-0.109	-0.043	0.100	1.377	0.065	2.005	0.063	1.572	0.112	2.219	-0.072
28	284	3	0.487	-0.086	0.893	-0.147	0.695	0.020	1.199	0.124	2.690	0.075	2.789	0.102	2.846	-0.103
29	297	3	0.691	-0.125	0.187	-0.023	1.480	-0.142	0.585	0.100	1.586	0.050	1.162	0.108	3.724	-0.128

* Indicates data was not available or could not be calculated.

# Indicates data was not used for statistical analysis.

TABLE 33. SUMMARY OF S2 SLOPE CHANGES (PLVC/MINUTE) INDUCED BY LOWER BODY NEGATIVE PRESSURE.

SUBJECT	EXPR PHASE	Average S2 Slope Value, ± S. D. and Number of Runs at Indicated Level of Pressure						
		Control	-8	-16	-30	-40	-50	REC
CDR	Preflight	-0.04 ±0.03 6	-0.02 0.08 6	-0.02 0.21 6	0.01 0.02 5	0.06 0.02 6	0.09 0.04 6	-0.01 0.05 6
CDR	In-flight	0.00* ±0.04 16	0.20 0.33 16	0.19 0.28 16	0.12* 0.07 16	0.07 0.03 15	0.11 0.05 12	-0.04 0.07 16
CDR	Postflight	-0.05# ±0.05 8	0.00 0.15 8	-0.03# 0.14 8	0.07* 0.04 8	0.12# 0.08 8	0.10 0.05 8	-0.07* 0.03 7
SPT	Preflight	-0.03 ±0.04 5	0.14 0.30 5	0.43 0.18 5	0.08 0.05 5	0.10 0.06 5	0.12 0.04 5	-0.07 0.03 5
SPT	In-flight	0.00 ±0.08 17	0.61 0.53 17	0.32 0.40 16	0.26* 0.17 15	0.13 0.07 16	0.15 0.06 15	-0.03 0.05 17
SPT	Postflight	-0.01 ±0.07 8	0.00# 0.50 8	0.15 0.43 8	0.08# 0.08 8	0.15 0.06 8	0.17 0.06 7	-0.08 0.08 8
PLT	Preflight	-0.03 ±0.03 5	-0.01 0.07 5	0.09 0.04 5	0.10 0.04 5	0.11 0.01 4	0.11 0.04 4	-0.09 0.03 4
PLT	In-flight	0.01 ±0.05 16	0.39* 0.42 15	0.28 0.21 16	0.20 0.12 16	0.13 0.03 16	0.17* 0.04 16	-0.07 0.06 16
PLT	Postflight	-0.11*# ±0.04 8	-0.10# 0.14 8	0.08# 0.13 8	0.11 0.03 8	0.09# 0.04 8	0.13# 0.04 8	-0.11 0.05 8

* Indicates significant difference (P<.05) from preflight.
# Indicates significant difference (P<.05) from in-flight.

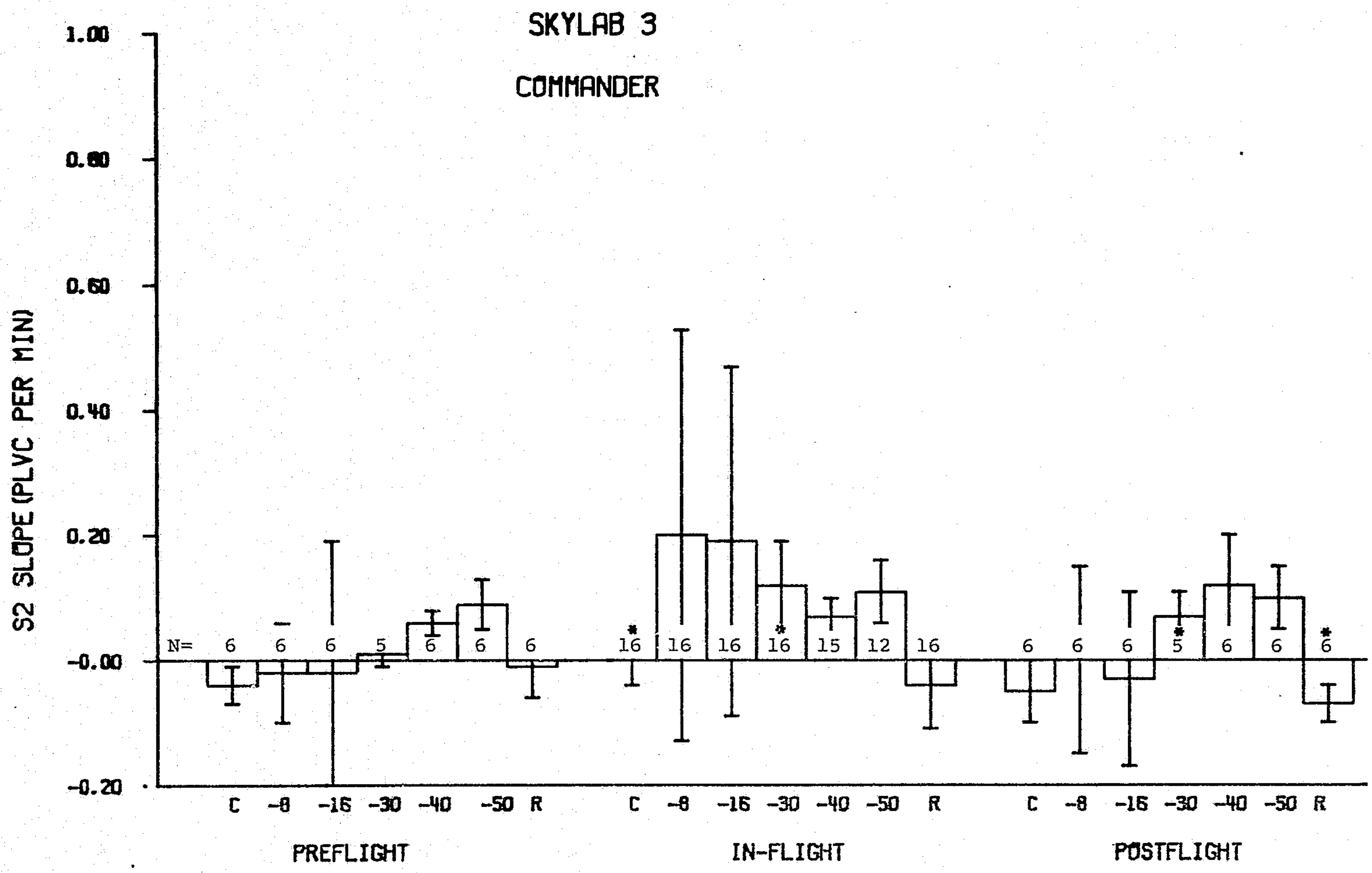


FIGURE 36. HISTOGRAMS SHOWING AVERAGE S2 SLOPE VALUES ($\pm$ 1 S.D.) FOR ALL LEVELS OF NEGATIVE PRESSURE.

* Indicates a significant difference ($P<0.05$) from preflight.

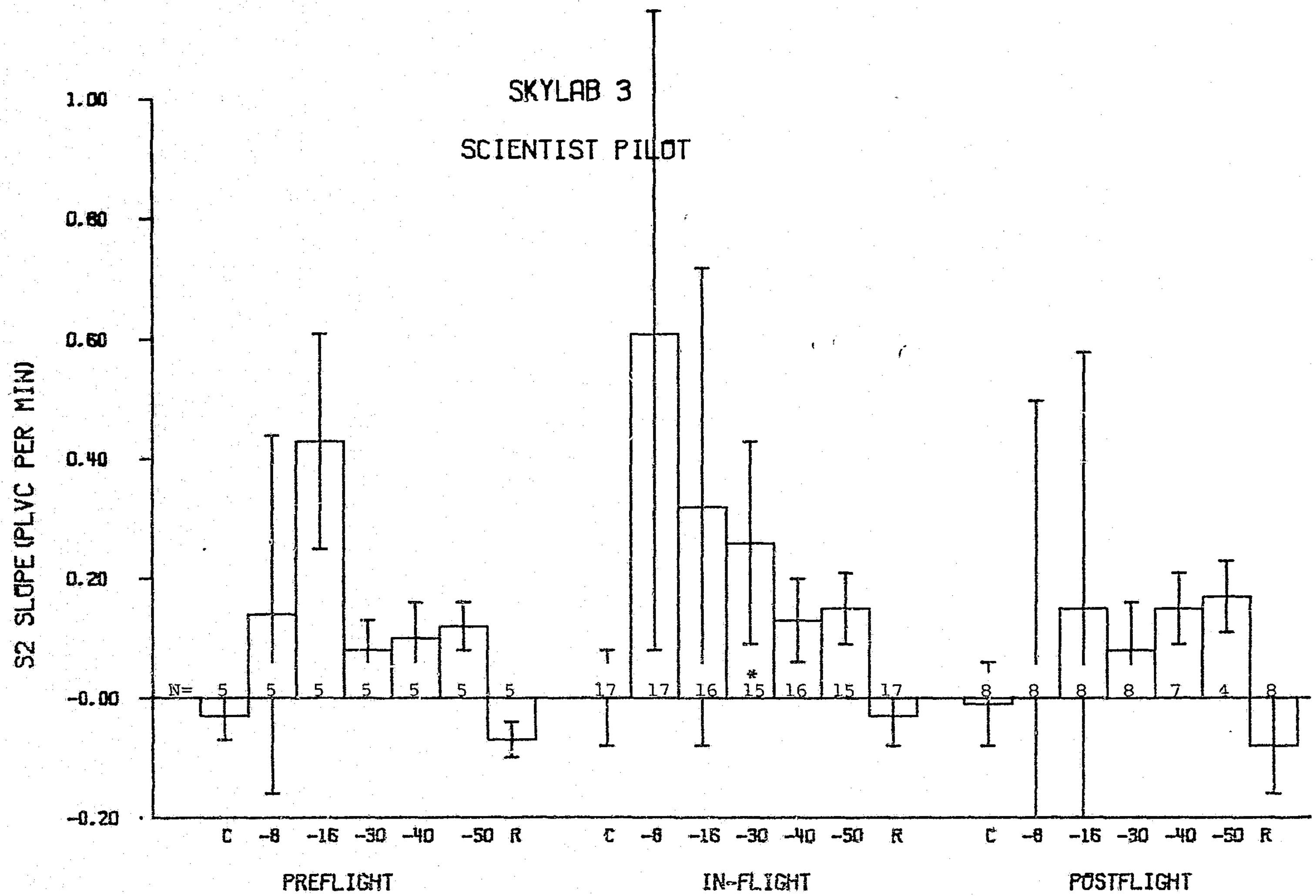


FIGURE 37. HISTOGRAMS SHOWING AVERAGE S2 SLOPE VALUES (± 1 S.D.) FOR ALL LEVELS OF NEGATIVE PRESSURE.

* Indicates a significant difference (P<0.05) from preflight.

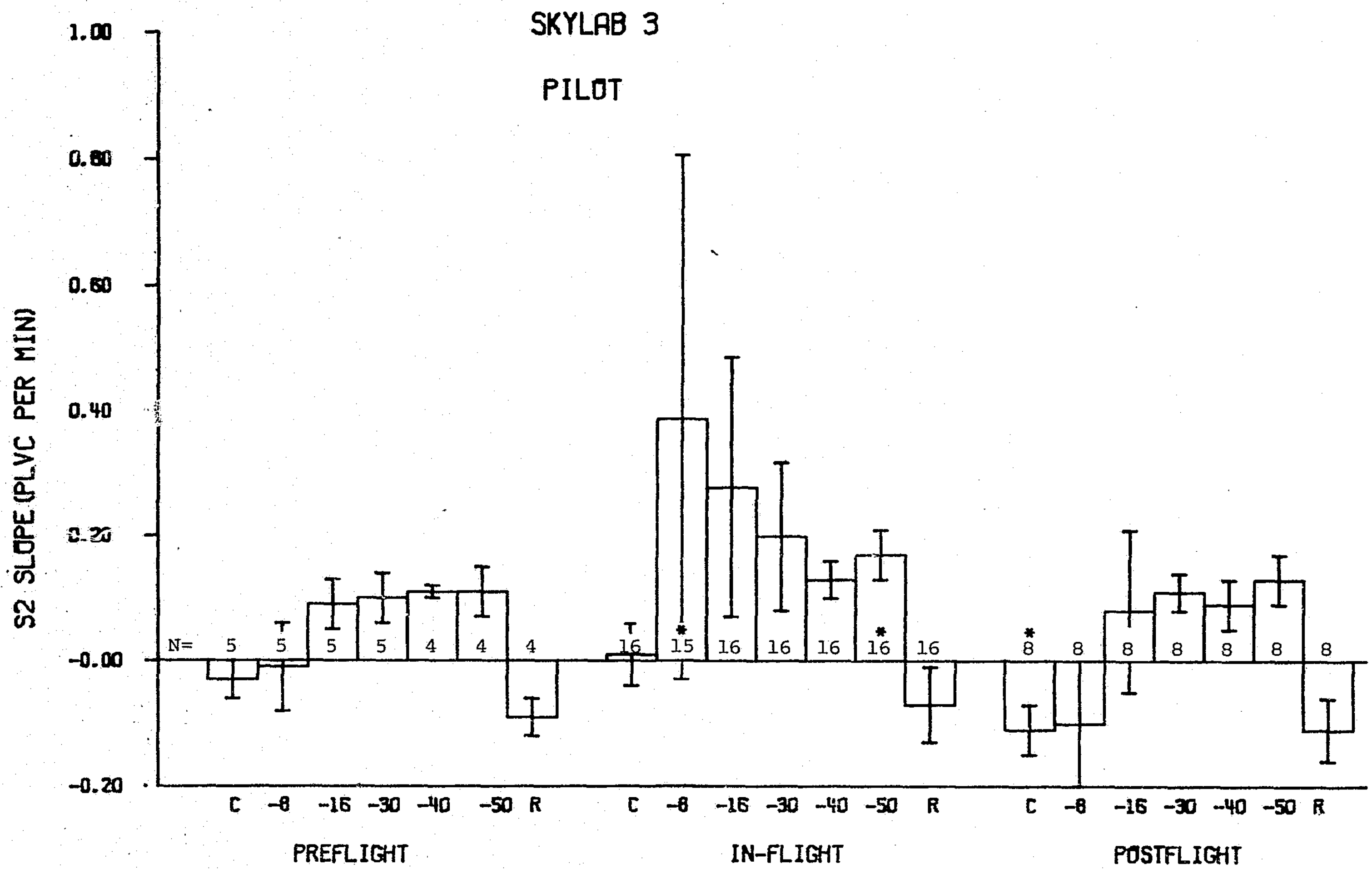


FIGURE 38. HISTOGRAMS SHOWING AVERAGE S2 SLOPE VALUES (± 1 S.D.) FOR ALL LEVELS OF NEGATIVE PRESSURE.

* Indicates a significant difference (P<0.05) from preflight.

volume does not occur but is present again in the postflight average data. The commander and pilot seemed to indicate fairly similar preflight S2 slope patterns; however, the scientist pilot demonstrated much larger S2 slope values particularly at the -8 and 16 mm Hg levels of pressure. The average in-flight S2 values were considerably elevated over preflight or postflight values particularly at the -8 and 16 mm Hg levels of pressure. The variability in the in-flight measurements was very large with extreme variation at -8 and -16 mm Hg levels. In general, the in-flight -40, -50 and recovery slopes were similar to the preflight and postflight measurements. While the -8 and -16 mm Hg in-flight average S2 slopes were considerably greater, only the S2 slopes for -30 mm Hg level for the commander and scientist pilot and the -50 mm Hg level for the pilot were significantly higher. Comparison of the average S2 slope values for the various mission phases is tabulated in Table 34 where the values indicate the ratio of preflight values to the in-flight and postflight data.

The average preflight, in-flight and postflight S2 intercepts of the regression lines for PLVC versus time (minutes) are summarized in Table 35. The S2 intercept data in combination with the S2 slope data (Table 33) completely define the rate of volume change as a function of time at a particular level of negative pressure.

TABLE 34. RATIO OF IN-FLIGHT AND POSTFLIGHT S2 SLOPE DATA IN COMPARISON TO PREFLIGHT VALUES.

SUBJECT	EXPR PHASE	Ratio of Average S2 Slope Data In-flight and Postflight Compared to Average Preflight Values at Indicated Levels of Pressure						
		Control	-8	-16	-30	-40	-50	REC
CDR	In-flight	0.0	11.0	10.5	12.0	1.2	1.2	-4.0
CDR	Postflight	-1.2	0.0	1.0	7.0	2.0	1.1	-7.0
SPT	In-flight	0.0	4.4	0.7	3.3	1.3	1.3	0.6
SPT	Postflight	0.3	0.0	0.3	1.0	1.5	1.4	-1.1
PLT	In-flight	1.3	40.0	3.1	2.0	1.2	1.5	0.8
PLT	Postflight	-3.7	-10.0	0.9	1.1	0.8	1.2	-1.2
GROUP	In-flight	0.4	22.8	4.8	5.8	1.2	1.3	- .9
MEAN	Postflight	-1.5	-3.3	0.7	3.0	1.4	1.2	-3.1

TABLE 35. SUMMARY OF AVERAGE S2 INTERCEPT DATA FOR ALL CREWMEMBERS.

SUBJECT	EXPR PHASE	Average S2 intercept (PLVC) $\pm$ S.D. and number of runs at indicated levels of pressure						
		CON	-8	-16	-30	-40	-50	REC
CDR	Preflight	.24 $\pm$.18 6	.28 .53 6	.77 1.58 6	1.31 .41 5	1.23 .52 6	.97 .60 6	.50 .79 6
CDR	In-flight	-.05 $\pm$.21 16	-.65 1.80 16	-.21 1.81 16	.90 .65 16	1.83 .53 15	1.67 1.18 12	1.13 1.48 16
CDR	Postflight	.26 $\pm$.24 8	.16 .92 8	1.08 .96 8	1.21 .35 8	1.10 .75 8	1.86 .64 8	2.06 1.31 7
SPT	Preflight	.11 $\pm$.21 5	-.84 1.70 5	-2.00 1.25 5	1.85 .68 5	2.15 .99 5	2.33 .54 5	1.96 .84 5
SPT	In-flight	-.03 $\pm$.40 17	-2.80 2.97 17	-.62 2.54 16	.46 1.35 15	2.09 1.38 16	2.04 1.05 15	1.24 1.18 17
SPT	Postflight	.07 $\pm$.34 8	-.05 2.97 8	-.09 3.10 8	1.98 .97 8	1.98 .47 8	1.74 1.29 7	2.53 2.22 8
PLT	Preflight	.22 $\pm$.13 5	.10 .43 5	-.25 .27 5	.53 .27 5	1.00 .57 4	1.56 .81 4	3.18 .59 4
PLT	In-flight	-.04 $\pm$.23 16	-1.43 2.41 15	-.42 1.59 16	.74 1.19 16	1.86 .62 16	1.62 .45 16	2.09 1.38 16
PLT	Postflight	.59 .19 8	.78 .80 8	.31 .87 8	1.08 .30 8	1.88 .53 8	1.68 .64 8	3.71 1.38 8

Calf Circumference

The left calf circumference as tabulated in Tables 3 to 5 and graphed in Figure 39 indicates a fluctuating but generally decreasing preflight baseline with a much steeper decrease on exposure to zero gravity. It is not possible to determine the initial rate of decrease since no measurements were obtained until mission day 5. The extent of the decrease after 5 days in zero gravity was about the same for all crewmembers (3.5 to 4.0% decrease from the last preflight measurement). The leg circumference appeared to stabilize slightly after the large initial decrease and exhibited a downward trend throughout the first half of the in-flight phase. The crewmembers demonstrated relatively stable leg circumferences for the second half of the in-flight phase. Postflight data indicated sizeable increases in leg circumference 2 to 3 days following recovery and concomitant with an increase in body mass. Later postflight changes occurred rather erratically with the exception of the pilot who exhibited an almost steplike increase and then seemed to plateau.

Since accounting for the unknown, transitional nature of the change in calf circumference would have complicated the data analysis, the Skylab 3 calf circumference data were grouped into average preflight, in-flight and postflight categories similar to other parameters. The average data were graphed as histograms and the results of the t-test indicated in Figure 40. Using this type of analysis the mean in-flight left leg circumference was significantly smaller than the preflight averages for all three crewmembers. The average decrease for the in-flight circumference as shown in Table 36 was 7.2%. The average postflight circumferences while greater than the in-flight values were still significantly smaller than the preflight averages. Graphs and regression of the calf circumferences versus mission day are plotted in Figure 41. The regression is computed on the assumption of linear data which is valid for data obtained after the first few days of weightlessness but certainly not for data obtained immediately after entering zero gravity. The slope of the regression lines for the Skylab 3 crewmembers indicates an average decrease of

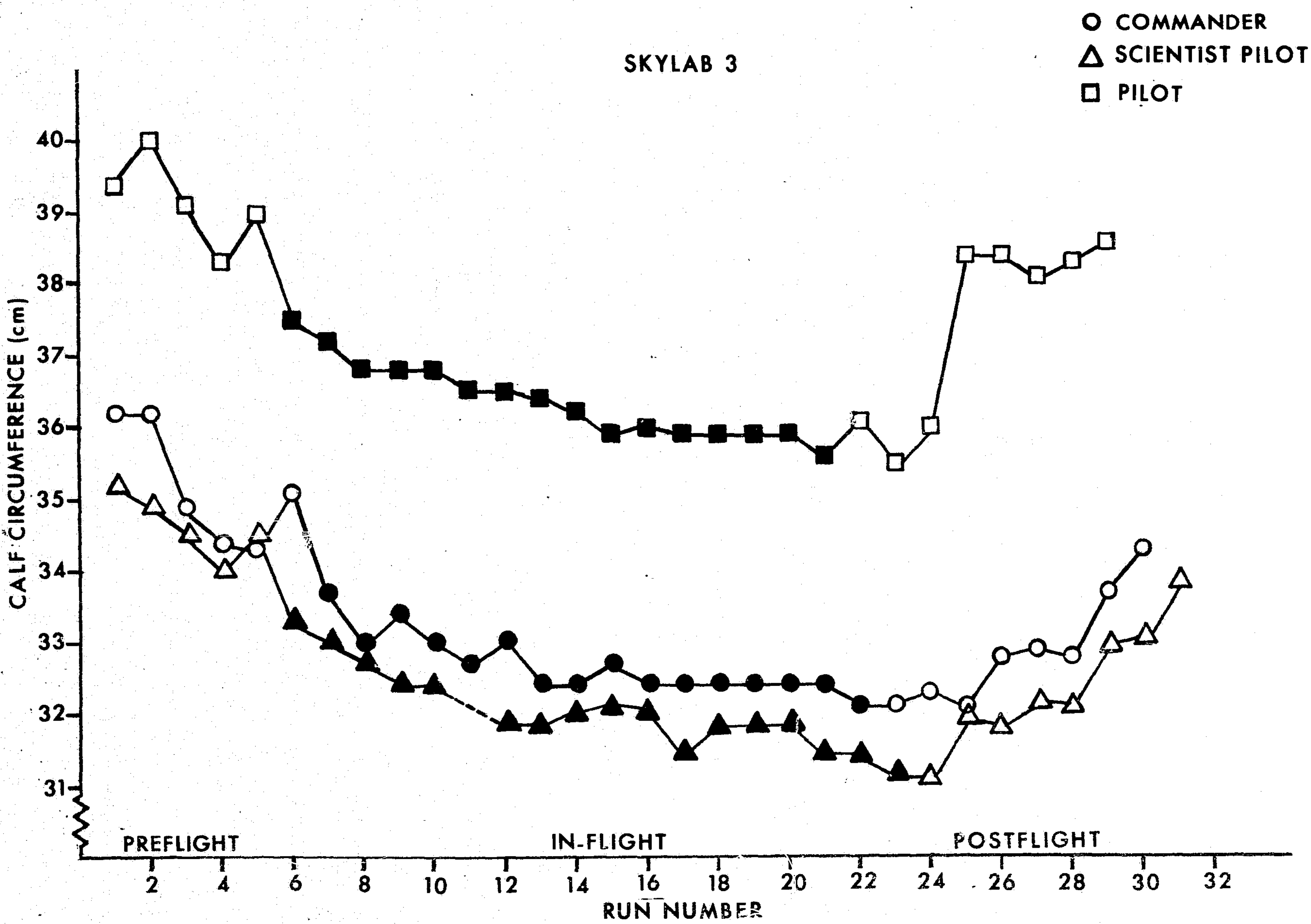


FIGURE 39. GRAPH OF LEFT CALF CIRCUMFERENCE FOR EACH ASTRONAUT FOR ALL MISSION PHASES.

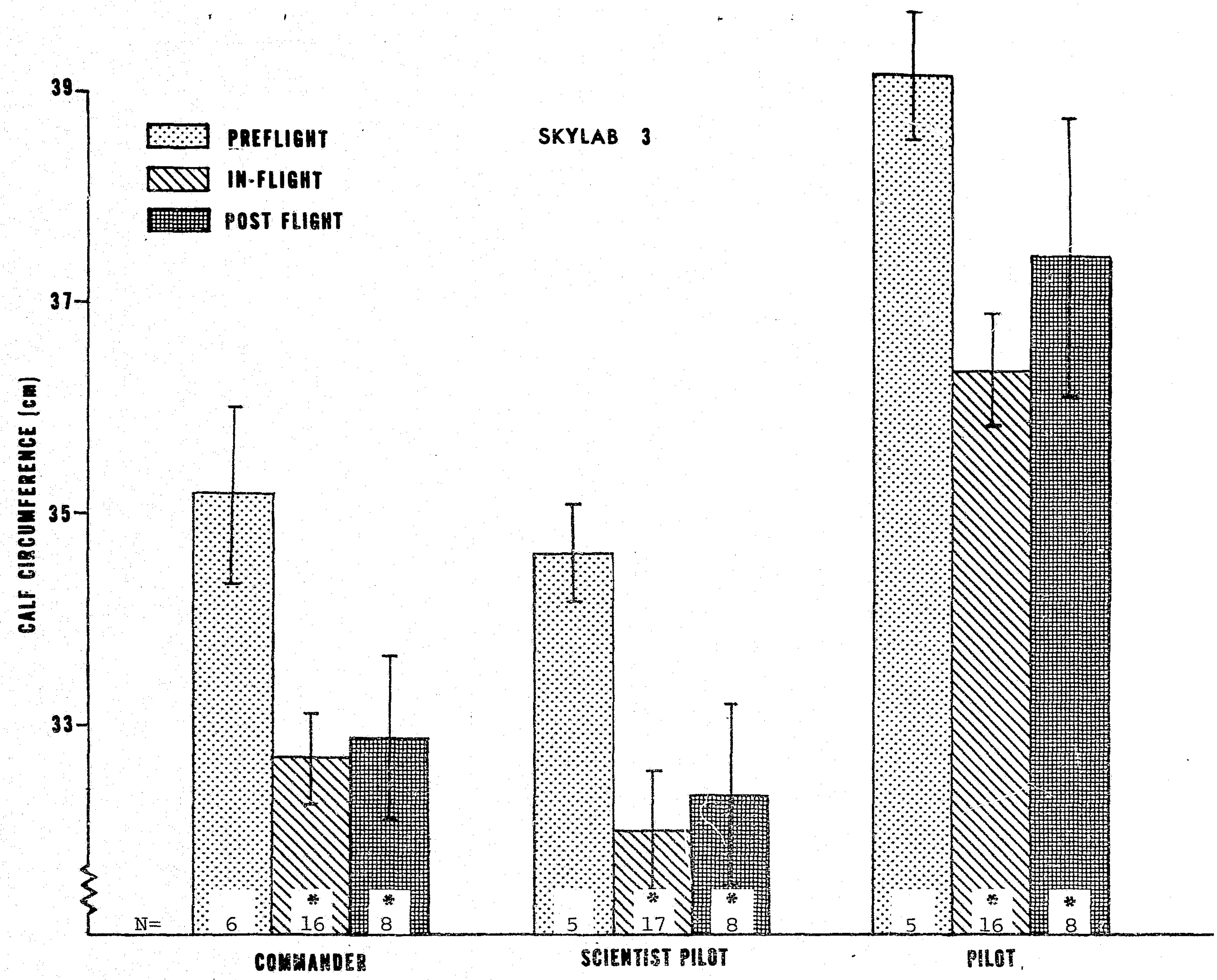


FIGURE 40. HISTOGRAMS OF AVERAGE LEFT CALF CIRCUMFERENCE (+1 S.D.) FOR ALL ASTRONAUTS FOR ALL MISSION PHASE

* Indicates a significant difference (P<0.05) from preflight.

TABLE 36. AVERAGE LEFT CALF CIRCUMFERENCE BY MISSION PHASE AND COMPARISON WITH PREFLIGHT VALUES.

SUBJECT	EXPR PHASE	AVER LEFT CALF CIRCUM (cm)	S.D.	N	% DECREASE FROM PREFLIGHT
CDR	Preflight	35.2	.8	6	---
CDR	In-flight	32.7	.4	16	7.1
CDR	Postflight	32.9	.8	8	6.5
SPT	Preflight	34.6	.4	5	---
SPT	In-flight	32.1	.6	17	7.2
SPT	Postflight	32.3	.9	8	6.6
PLT	Preflight	39.2	.6	5	---
PLT	In-flight	36.4	.5	16	7.4
PLT	Postflight	37.4	1.3	8	4.6

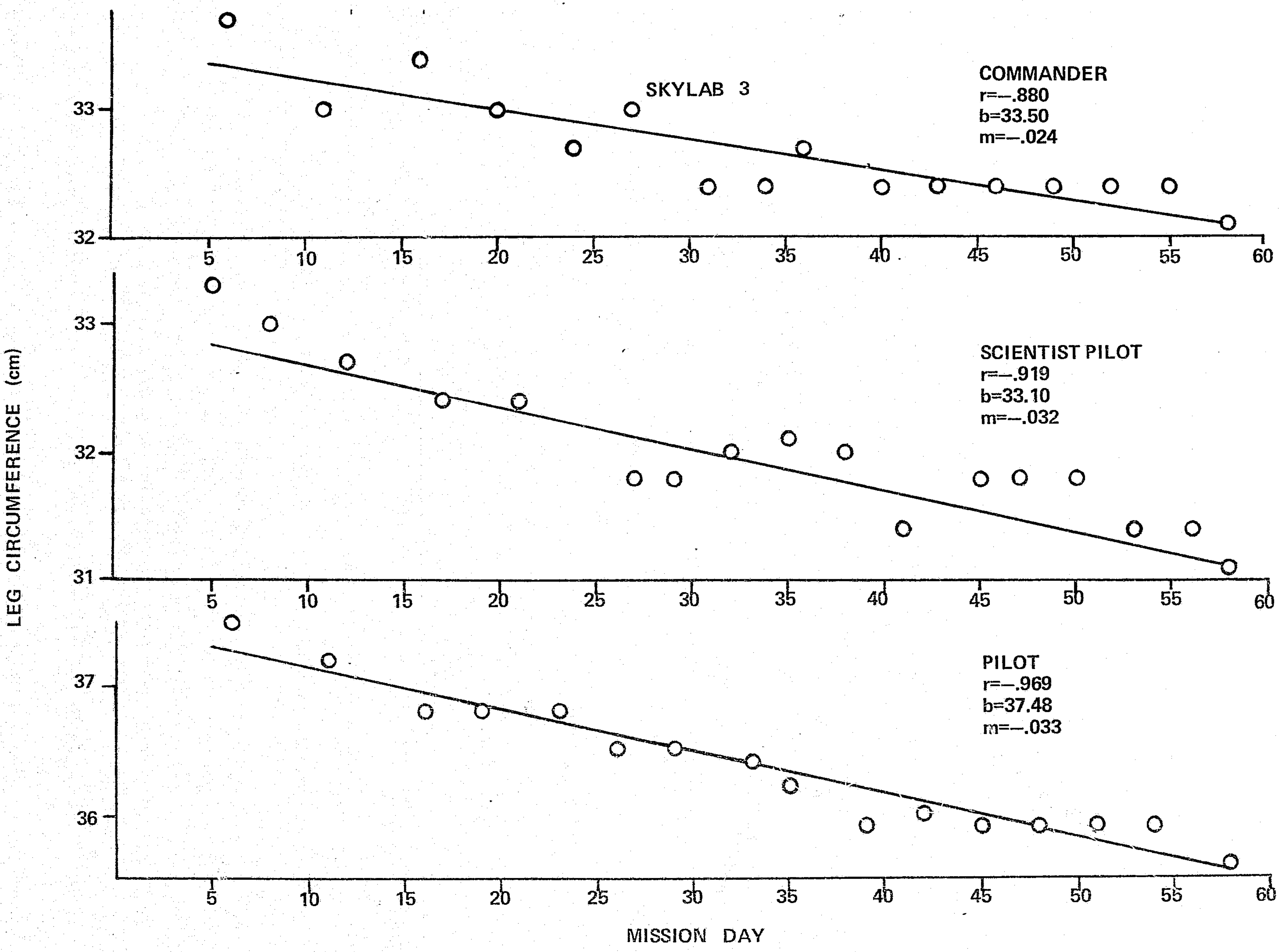


FIGURE 41. GRAPH AND REGRESSION OF IN-FLIGHT LEFT CALF CIRCUMFERENCE VERSUS MISSION DAY.

0.03 cm per day during the in-flight phase exclusive of the rapid initial decrease. However, regression lines calculated for the last 20 in-flight days would yield slopes very close to zero indicating that the astronauts had stabilized at an approximately constant calf circumference. Because of this stabilization of calf circumference toward the end of the mission and the resultant change of slope, it would be erroneous to extrapolate the regression line beyond the actual period of data collection.

Body Mass

The changes in body mass for the various mission phases are tabulated in Tables 3 to 5 and graphed by run number in Figure 42. The varying preflight body mass was followed in all three astronauts by a dramatic decrease in mass upon entering weightlessness or at least by the time of the first measurement. Following the initial fluid shift the average mass decrease was 3.3% by the time of the first measurement. Since no mass measurements were made until mission day 5, the exact nature and rate of mass loss is not known. However, other studies have indicated that a rapid loss of mass would surely occur in the first several days. Subsequent to the initial rapid decrease in mass only very slight decreases in mass were observed throughout the remainder of the in-flight phase. The body mass for all three crewmembers reamined at or lower than in-flight levels for the first two days postflight and then demonstrated a defined increase followed by a slower increase throughout the remainder of the postflight period.

The body mass data were grouped by average preflight, in-flight and postflight phases and graphed as histograms in Figure 43. A t-test analysis indicated that the in-flight body mass was significantly lower than the average preflight values for all crewmembers. Although the postflight data demonstrated an increasing trend, the average value was still considerably lower than preflight values. The average body mass values and the comparison to preflight levels is contained in Table 37. The graph and regression of the body mass versus mission day shown in Figure 44 indicate the nature of the body mass changes for the duration of zero gravity exposure following the initial rapid decrease for which no data is available. The slope of the change was not dramatic with the maximum loss of 0.02 kg per day occurring in the scientist pilot.

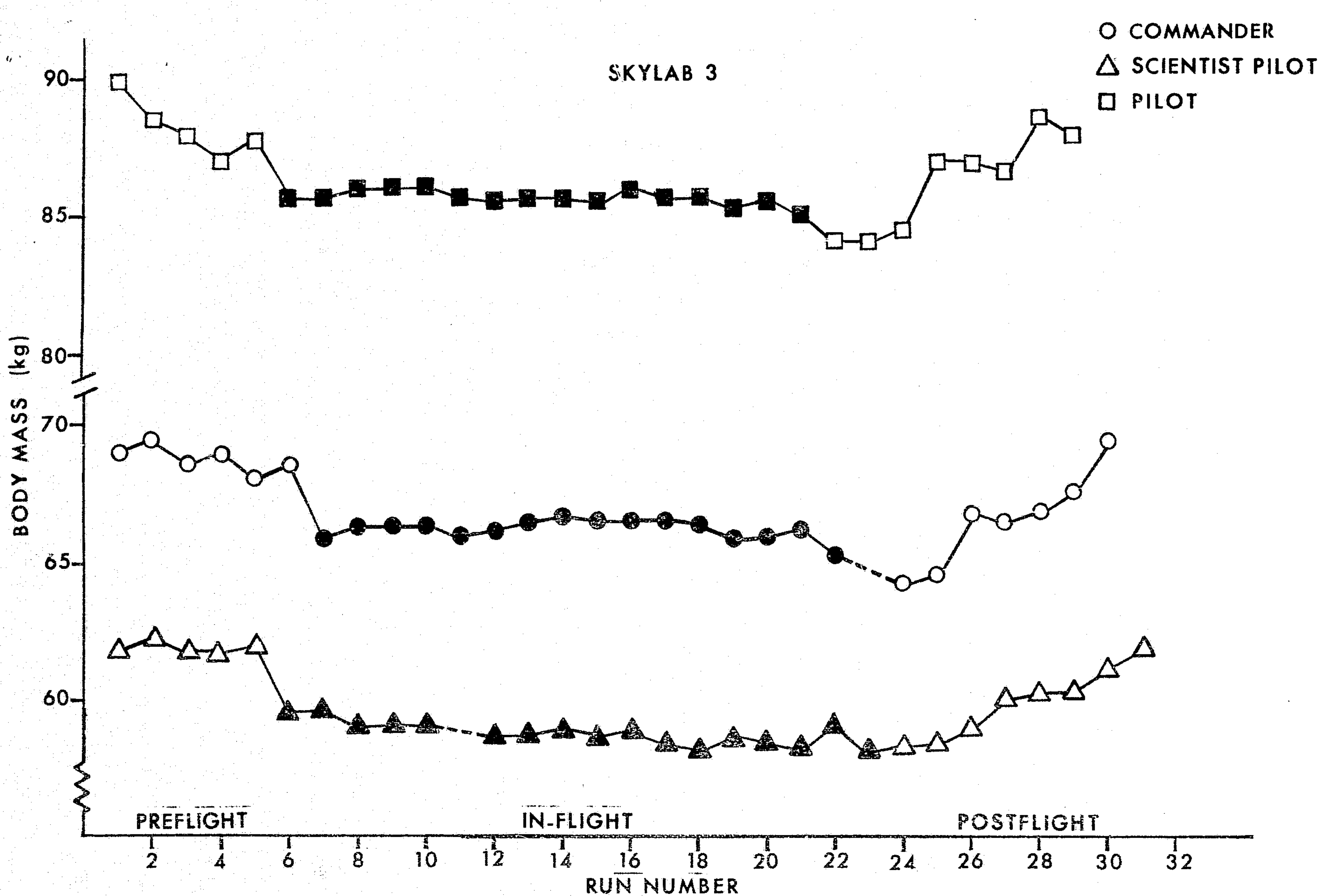


FIGURE 42. GRAPH OF BODY MASS FOR EACH ASTRONAUT FOR EACH MISSION PHASE.

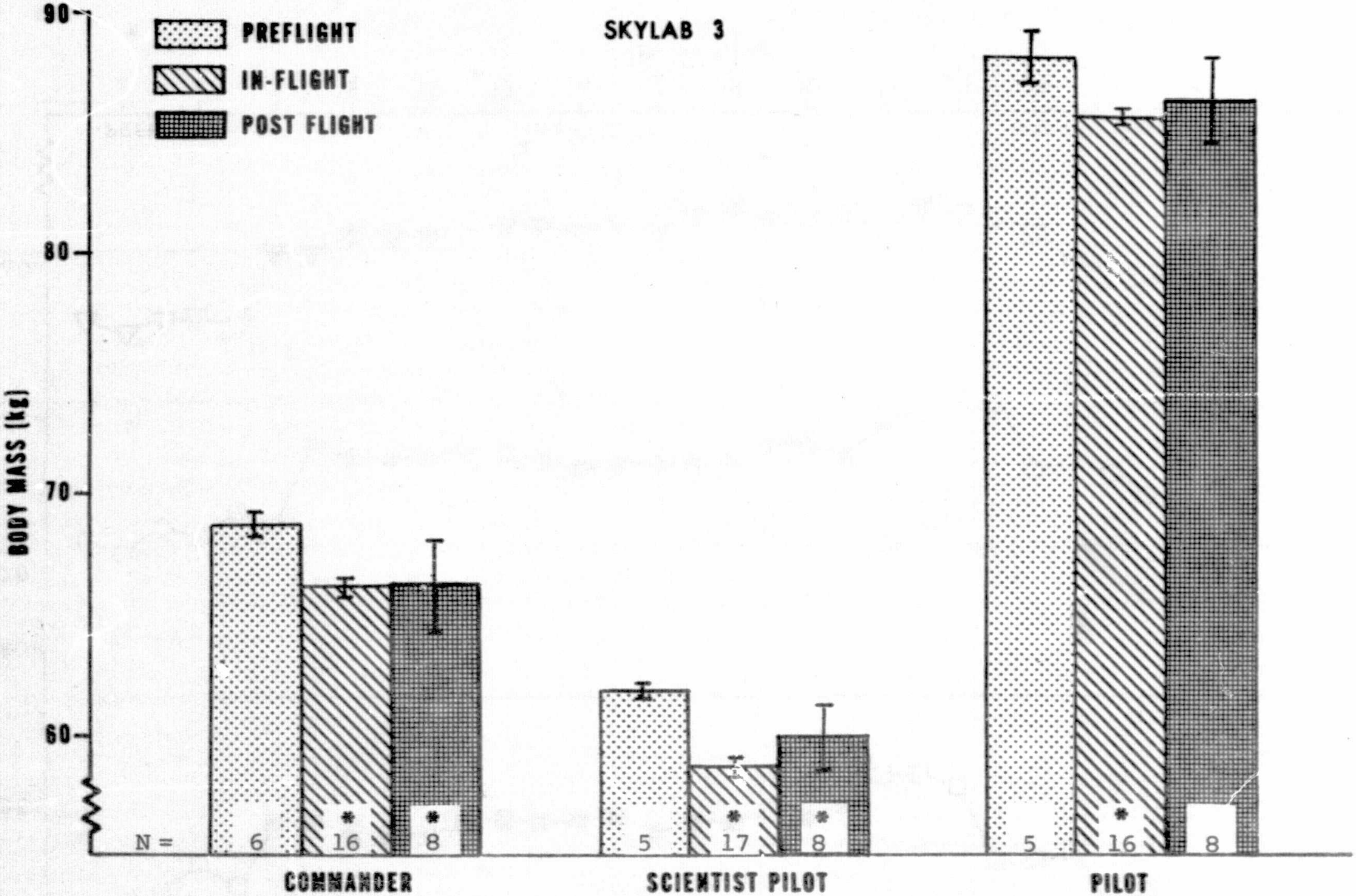


FIGURE 43. HISTOGRAMS OF AVERAGE BODY MASS ($\pm$1 S.D.) FOR ALL ASTRONAUTS FOR ALL MISSION PHASES.

*Indicates a significant difference ($P<0.05$) from preflight.

TABLE 37. AVERAGE BODY MASS VALUES BY MISSION PHASE AND COMPARISON WITH PREFLIGHT VALUES.

SUBJECT	EXPR PHASE	AVERAGE BODY MASS (Kg)	S.D.	N	% DECREASE FROM PREFLIGHT
CDR	Preflight	68.7	.5	6	---
CDR	In-flight	66.1	.3	16	3.8
CDR	Postflight	66.3	1.8	8	3.5
SPT	Preflight	61.8	.2	5	---
SPT	In-flight	58.7	.4	17	5.0
SPT	Postflight	59.8	1.3	8	3.2
PLT	Preflight	88.2	1.0	5	---
PLT	In-flight	85.7	.2	16	2.8
PLT	Postflight	86.3	1.8	8	2.1

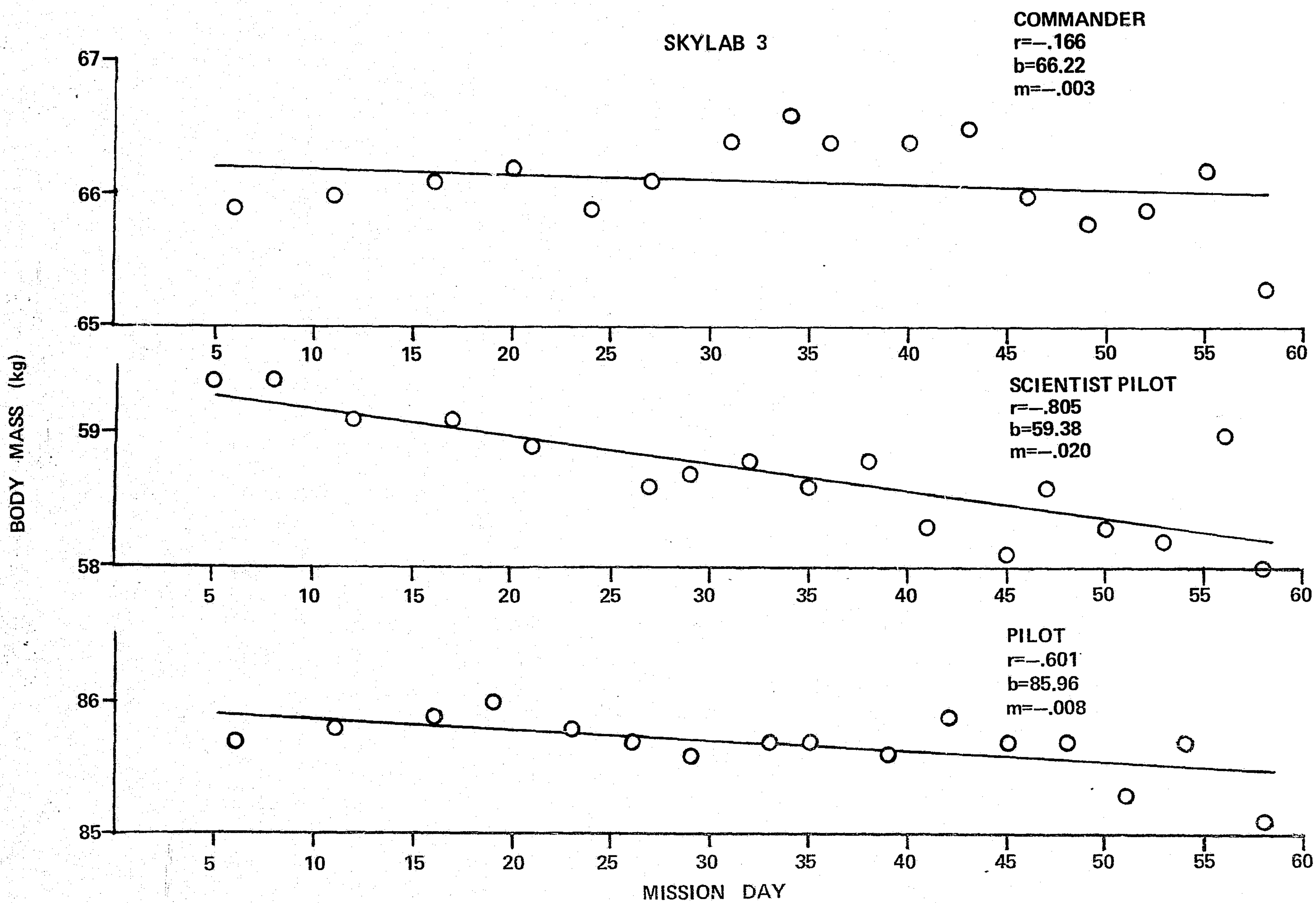


FIGURE 44. GRAPH AND REGRESSION OF IN-FLIGHT BODY MASS VERSUS MISSION DAY.

DISCUSSION

The complete explanation of the nature of the cardiovascular (including leg volume) changes that occurred on the Skylab 3 mission in response to both the weightless environment and the lower body negative pressure (M092) experiment requires more scientific investigation. Although much valuable information and understanding has been obtained from this mission and the Skylab 2 mission relative to the physiological responses and capabilities of man in this new and unique environment, these experiments only begin to explain some of his basic adaptations to space. The leg volume responses described in this report are only part of a large spectrum of neurophysiological, musculoskeletal, biochemical and cardiovascular adjustments required for the transition to and from zero gravity. While the discussion of leg volume responses will be related to other cardiovascular changes where possible, the final cross-correlational and inter-parameter relationships have not been established.

Significant cardiovascular alterations appear to occur very early in the zero gravity adaptation process. A major portion of the 4.1% average decrease in calf circumference recorded on the first measurement (mission day 5) probably occurred much earlier (within the first 48 hours) and represented a 1 to 2 liter loss in fluid from the legs. Earth laboratory tests indicate that the fluid shift from the legs of an individual placed in a 15^{o} head down position is substantially complete within the first 24 hours. This massive vascular and extravascular fluid shift, although not well quantitated for time course on the Skylab 3 mission, must be the primary forcing function for many of the hormonal, biochemical and cardiovascular phenomena important to the adaptation process. The headward transfer of this relatively large volume of fluid from the lower extremities is apparently responsible for the head and nasal congestion and distention of upper body veins which occurs almost simultaneously with the onset of weightlessness. These symptoms continue throughout the flight phase and abruptly disappear a few hours after the reentry with occurrence of the reverse shift of fluid into the lower extremities.

In the classical sense, the increased thoracic fluid should be sensed as an expanded blood volume and initiate the appropriate neurohormonal reflexes for restoration of fluid balance. Concomitantly the increased venous return must transiently affect cardiac parameters and the baroceptors resulting in reflex alterations in cardiovascular dynamics. Many of the compensatory mechanisms must have resulted in transient alterations which were complete before lower body negative pressure testing was initiated. By mission day 5, the fluid shift had precipitated some reduction in total circulating blood volume, some hemoconcentration (12) and a partial emptying of lower extremity veins.

The LBNP device was designed to be a well-controlled stress device, useful in both zero and earth gravity conditions, for assessment of central and peripheral cardiovascular dynamics and assessment of crewmembers orthostatic tolerance status. The cardiovascular response to lower body negative pressure has been studied in considerable detail (5-7, 15-17, 21). Additionally, some attention has been given to the application of long term LBNP as a countermeasure against vascular "deconditioning" (18, 19). Consideration and rationale for the use of these particular incremental levels of negative pressure have been studied (20) although no thorough studies have been performed using constant, incremental, pulse and sinusoid input levels of negative pressure. In the present experiment, the LBNP served as a simulator of orthostatic stress and no anti-deconditioning effect was expected and none was obvious in the experimental data. The LBNP protocol used for all phases of the Skylab program was identical to that used for the Apollo pre and postflight orthostatic evaluation (11). Unlike the Skylab 2 M092 experiments where the -50 mm Hg level of LBNP was not utilized in-flight for 2 of the 3 crewmembers, the full negative pressure profile was used throughout all Skylab 3 mission phases.

The LBNP (M092) experiment served as a very useful stress test since the negative pressure protocol was of sufficient magnitude to cause early termination or presyncopal symptoms in-flight for 2 of the 3 crewmembers while no preflight early terminations (of medical origins) were observed for these crewmembers. The slightly more frequent early terminations in-flight suggests that either the crew's successful adaptation to the weightless environment rendered them slightly less tolerant of this provocative test or that the test as presented in zero gravity comprised a stress slightly different from that of the earth environment. It can be convincingly argued that, although there were wide variations in the rate of change of negative pressure levels which complicated the analysis of calf volume change, these variations would not account for the increased frequency of early terminations or the increased volume changes. The primary variation that occurred in the LBNP profile appeared to be a function of air leakage around the waist seal and in case of the run off or recovery period (return of chamber pressure to ambient) a function of whether the quick release valve (rapid venting) or the normal shutoff valve (slower venting) was used. Rapid venting resulted in momentary decreases in leg volume which approached a rate of 30 to 40% per minute while the normal release of negative pressure usually resulted in decreases of 5 to 15% per minute. While this variation in protocol would certainly influence recovery compliance characteristics and perhaps EOP PLVC recovery data, it obviously had no effect on the leg volume characteristics prior to the recovery portion of each M092 experiment. Notwithstanding this variation in LBNP protocol it appears that the relatively empty veins of the lower extremities constituted the most important reason for the significantly different response in calf volumes observed between preflight and in-flight LBNP tests.

In addition to the slightly increased frequency of in-flight early terminations, the end of period calf volume changes during the in-flight phase verified that the crewmembers had indeed experienced adjustments within the cardiovascular system. The increase in EOP PLVC values apparent on the first LBNP test and persisting throughout the in-flight phase can be attributed to several phenomena. It is readily apparent that the amount of blood within the veins of the lower extremities at the beginning of an LBNP test must be a contributing factor that determines the extent of calf volume change that will be observed on LBNP tests. The large volumes of blood that pooled in the -8 and -16 mm Hg periods provide considerable evidence for a relatively empty venous system in the lower extremities. Since 85% of the total EOP PLVC in-flight increase occurred within the first 2 minutes (-8 and -16 mm Hg) of the LBNP test, support for rapid distention of the partly empty venous reservoirs of the lower body is strong. With less blood being contained within the venous reservoirs of the lower body and with some in-flight diuresis one would expect that the LBNP test in weightlessness would be more stressful than the preflight tests. While the extent of physical filling of the veins probably accounts for a major percentage of the increased calf volume change observed in-flight, there are several other conditions which might have contributed to larger EOP PLVC values. A change in the distensibility of the elastic properties of the leg veins via hormonal, biochemical or neuronal alteration of sympathetic traffic could affect both the rate and magnitude of calf volume change. Lastly, the in-flight PLVC values could seem slightly larger because of the decrease in leg circumference. If only the same amount of blood were pooled in-flight as preflight, the in-flight PLVC would undergo an apparent increase in percent leg volume change due to the 7% decrease in leg circumference. This 10 to 15% decrease in calf volume could significantly affect the apparent PLVC as measured in-flight. All of these factors could contribute to the increased PLVC values observed in-flight; however, future experiments preferably in zero gravity but possibly in bed rest studies must determine their relative influence.

The fact remains that significantly greater leg volume changes occur in-flight in response to the LBNP test. The levels of negative pressure where the significant changes in leg volume occur depends upon how the data is statistically analyzed. Comparison of preflight, in-flight and postflight EOP PLVC by magnitude alone inaccurately emphasizes a volume change due to a volume response at a preceeding negative pressure level. This type of statistical comparison is particularly objectionable in the in-flight M092 experiments where the greatest volume increase over preflight levels occurred at the -8 mm Hg or first negative pressure level. This increased -8 mm Hg level volume would then be reflected in the succeeding EOP PLVC values and therefore present slightly misleading volume changes. The statistical comparison which resulted in significant differences at a particular level of negative pressure indicates only that a significant difference exists and does not reveal whether the significance is due to volume changes during that level of negative pressure or is due to large changes at a succeeding level of pressure.

This report does contain statistical comparisons of the EOP PLVC; however, the results of the statistical comparison which indicates the exact nature of the volume change at each level of negative pressure is contained in Table 15 and represents the least confusing information about statistically significant leg volume changes. The average PLVC delta values were obtained by computing the magnitude differences in EOP leg volumes for the different levels of negative pressure. The previously discussed EOP PLVC comparison (Table 12) resulted in in-flight statistical differences at 12 different LBNP levels (all 5 levels for the commander and pilot and -8 and -16 mm Hg for the scientist pilot). The comparison of EOP PLVC using the PLVC delta analysis (Table 15) resulted in statistical significance at 7 different LBNP levels (CDR, 0 to -8, -40 to -50 and -50 to REC; SPT, 0 to -8; PLT, 0 to -8, -8 to -16 and -50 to REC). The -50 to REC comparison is actually not valid since this comparison includes the -8 and -16 mm Hg leg volume changes and therefore only 5 in-flight EOP deltas were significantly increased. In all crewmembers, the 0 to -8 mm Hg leg volume response was significantly increased as was the -40 to -50 delta in the commander and the -8 to -16 mm Hg delta for the pilot. The delta analysis convincingly suggests that the primary differences between the preflight and in-flight volume change occurred at the -8 and-16 mm Hg negative pressure levels. This information supports the theory of a partially empty lower extremity venous system which is rapidly filled during the initial levels of the LBNP test and which does not undergo significant enlargement at subsequently greater levels of negative pressure.

When the in-flight EOP PLVC and the EOP PLVC deltas were greater than preflight values, either the S1 or the S2 slope or both had to be the causative factor. The graphs of Figures 45 to 47 indicate the relative

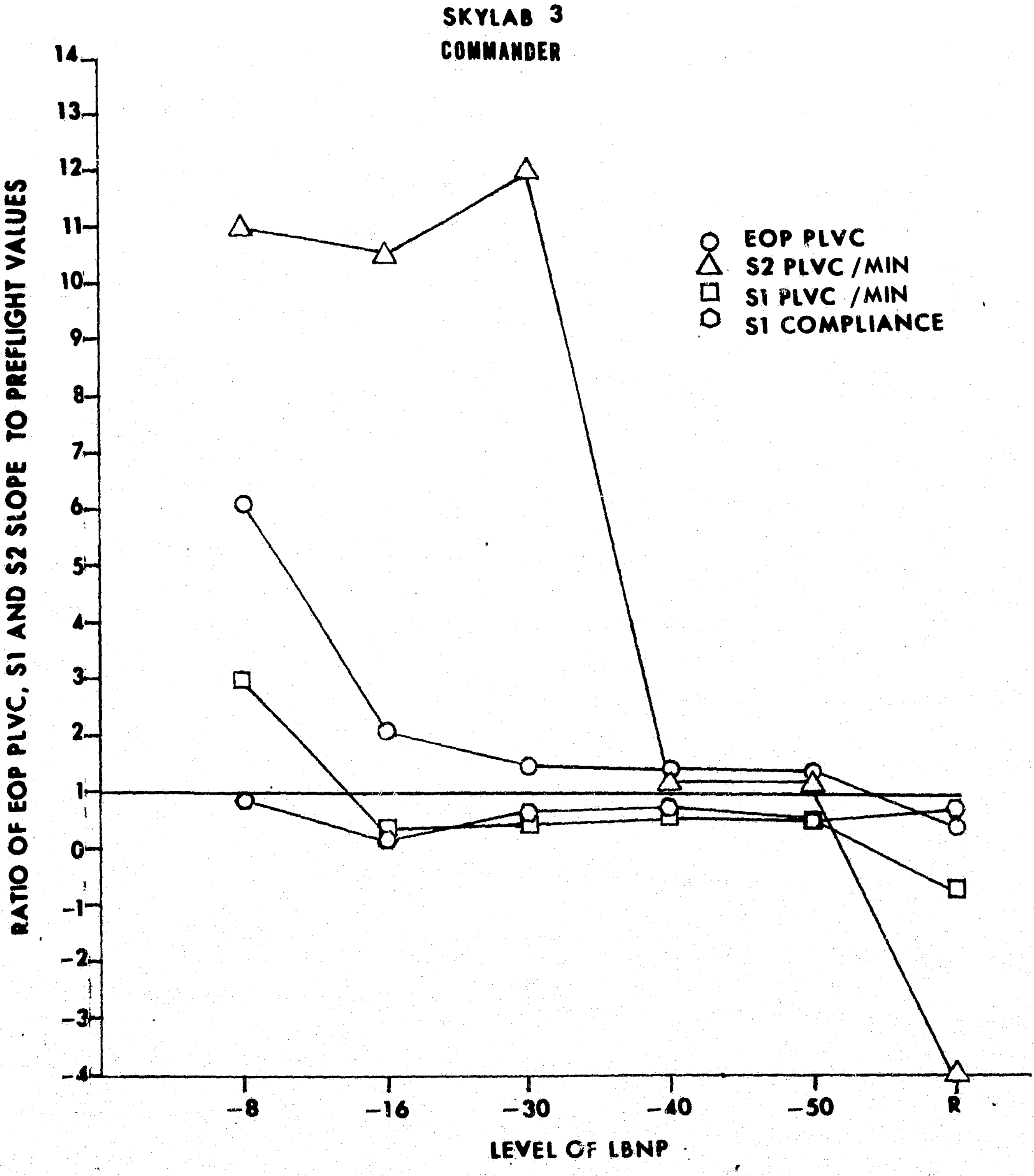


FIGURE 45. SUMMARY OF GRAPH OF IN-FLIGHT EOP PLVC, S1 AND S2 SLOPE DATA RELATIVE TO PREFLIGHT VALUES.

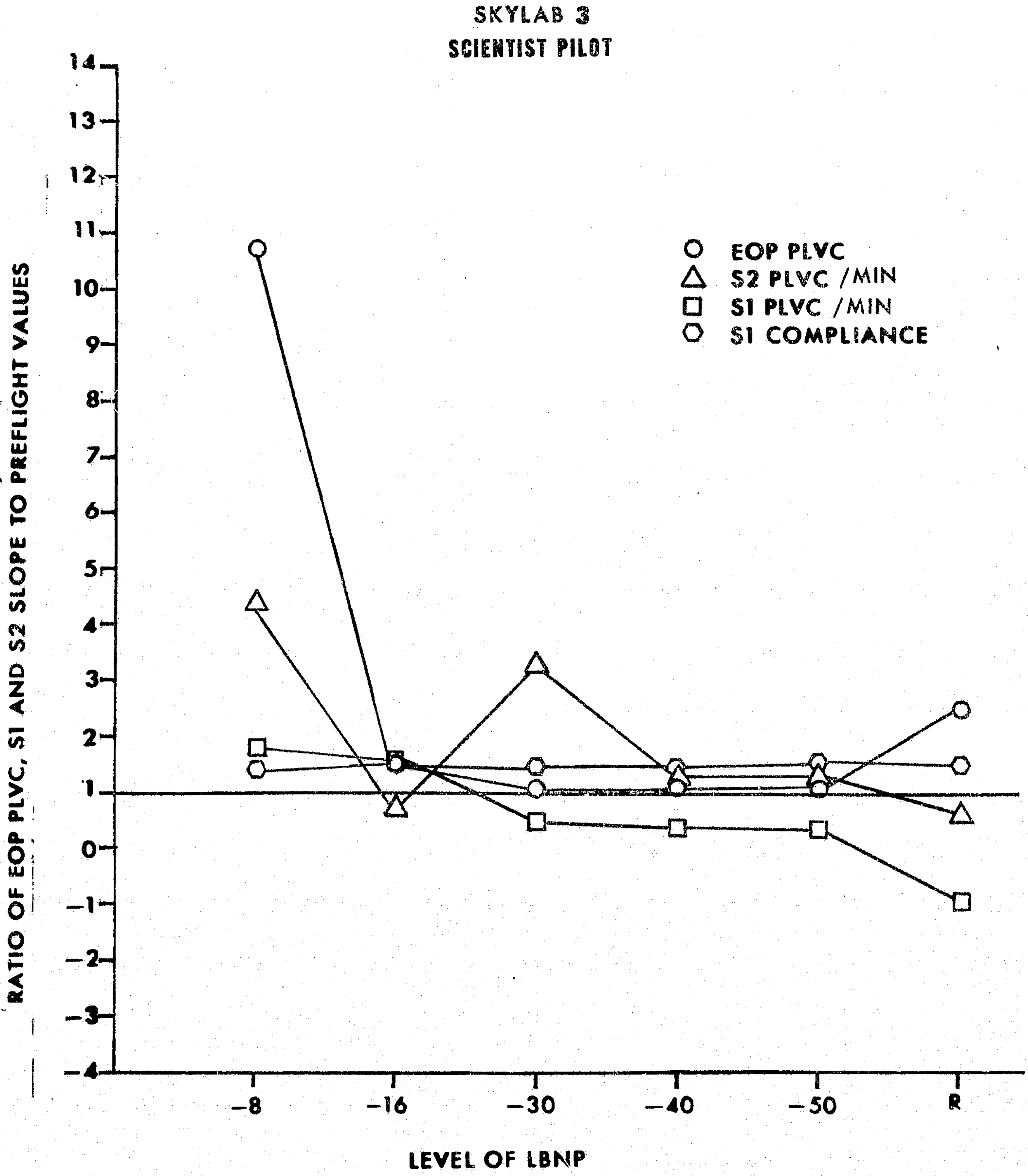


FIGURE 46. SUMMARY GRAPH OF IN-FLIGHT EOP PLVC, S1 AND S2 SLOPE DATA RELATIVE TO PREFLIGHT VALUES.

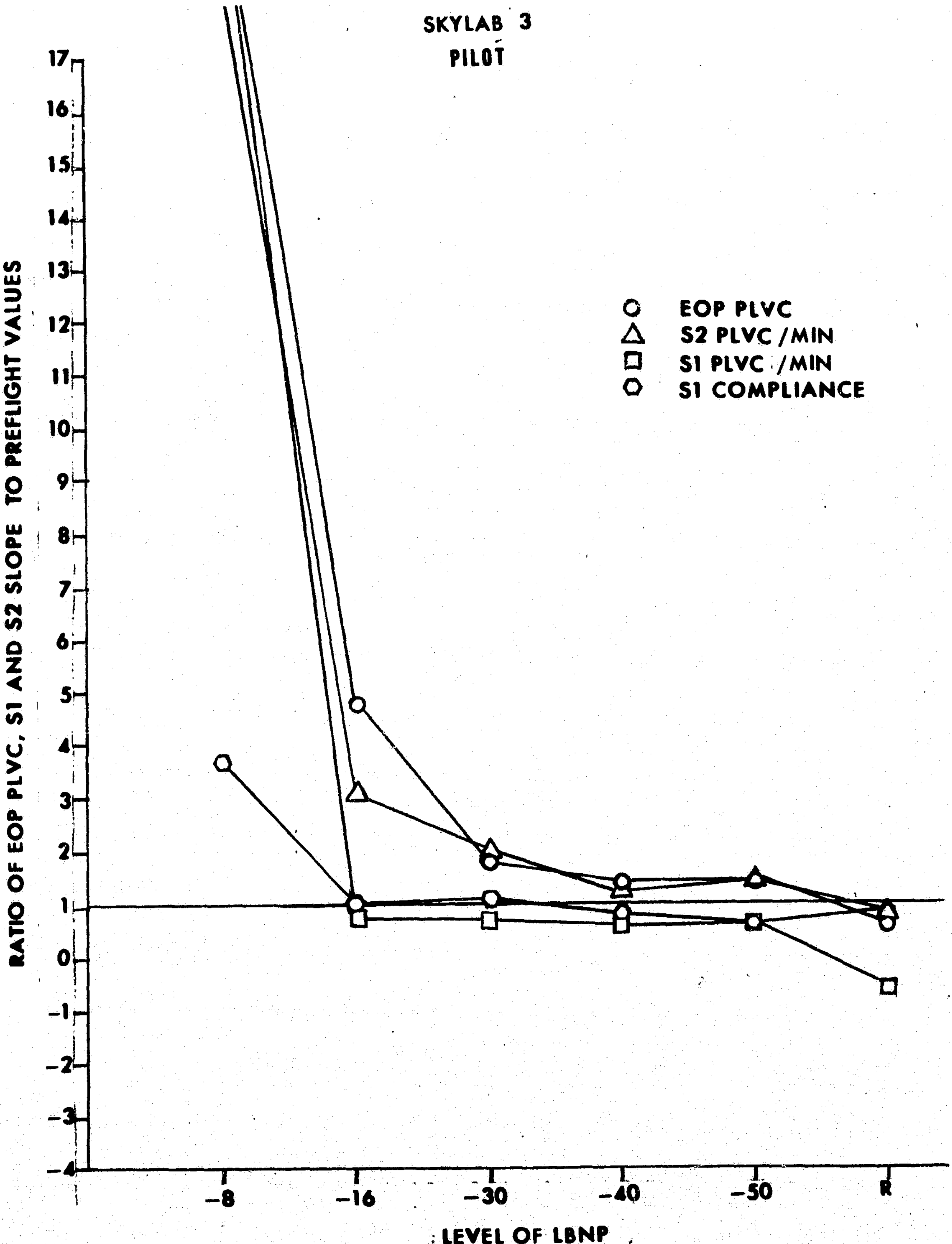


FIGURE 47. SUMMARY GRAPH OF IN-FLIGHT EOP PLVC, S1 AND S2 SLOPE DATA RELATIVE TO PREFLIGHT VALUES.

in-flight change in all of the leg volume parameters in comparison to preflight values for each crewmember. The plotted data represent the average values of EOP PLVC, S1 and S2 slopes for each crewmember expressed as a ratio of his preflight averages. These graphs clearly indicate the relative changes in each parameter from preflight as well as provide an overview of changes occurring in all of the computed values.

Analysis of the ratio type comparison such as graphed in Figure 45 for the commander reveals no increase of in-flight compliance at any LBNP level and indicates that the elevated EOP PLVC occurs necessarily as a result of increased in-flight S2 slope values. Recovery EOP PLVC values are decreased since both the compliance and S1 slope values are decreased in-flight. Slightly different results are revealed in the same type of ratio comparison as shown in Figures 46 and 47 for the scientist pilot and pilot. Figure 46 indicates that a slight increase in compliance at all levels of LBNP occurred for the scientist pilot. Since the S2 slopes were also slightly increased with exception of the -16 mm Hg and the recovery data, the EOP PLVC values were slightly greater than preflight values. Figure 47 indicates that the in-flight compliance for the pilot is either the same or elevated for the -8, -16 and -30 mm Hg levels and that slightly decreased compliance values occurred at the -40, -50 mm Hg and recovery phases. The elevated in-flight EOP PLVC values occurred primarily as a result of the elevated S2 slope data. The slightly decreased EOP PLVC recovery occurred as a result of decreased compliance and decreased S2 slope values.

Figure 48 represents the mission averages for the computed values of EOP PLVC, S1, S1 compliance and S2 slopes. Analysis of these parameters indicates the relative contribution of each parameter toward the leg volume changes observed in-flight. The average data indicates that both the compliance and the S2 slope data contribute to the elevated EOP PLVC values at the -8 mm Hg level of LBNP. However, at all other levels of LBNP, the elevated EOP PLVC values occurred as a result of the elevated S2 slope values. The elevated in-flight recovery value with decreased compliance and S2 slope values is probably best explained by the variable

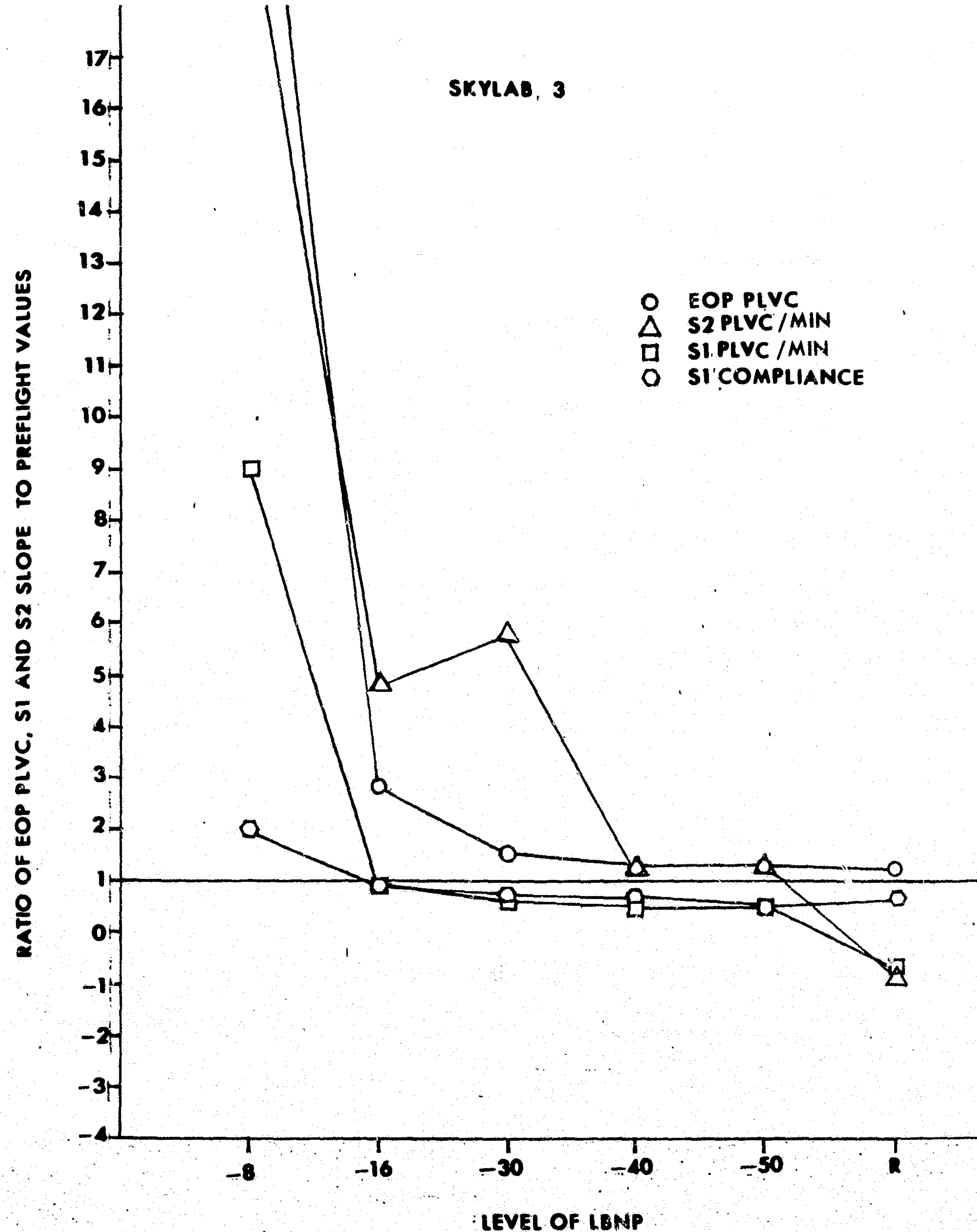


FIGURE 48. SUMMARY GRAPH OF AVERAGE (ALL CREW MEMBERS) IN-FLIGHT EOP PLVC, S1 AND S2 SLOPE DATA RELATIVE TO PREFLIGHT VALUES.

leg volume changes which occurred during the recovery portion of the LBNP profile (i.e., "rebound effect") so that the 2 minute computation of the S2 slope is probably not a highly accurate indicator of the final EOP PLVC for recovery. The increased S1 slope or compliance value at the -8 mm Hg level of pressure must have resulted primarily from the rapid distention of the partially empty lower extremity veins. It is possible that some increase in the S1 slope values at the initial level of negative pressure could have resulted from physiological alterations in venomotor tone or intrinsic changes in smooth muscle properties or changes of a biochemical or hormonal nature. However, changes of this nature cannot be accepted as the principal reason for increased EOP calf volume changes since this type of physiological alteration should manifest its effect at levels of negative pressure other than just -8 mm Hg. The computation of the compliance values for the S1 slopes resulted in values more directly related to the true compliance characteristics of the limb. However, the apparent difference in preflight and in-flight "compliance" values must be viewed cautiously since the comparison cannot be equated directly. While the compliance values computed for the preflight and in-flight -8 mm Hg period represent a specific change in calf volume for a specific change (8 mm Hg) in negative pressure, the difference in the volumes pooled does not necessarily represent a change in compliance . The fact that the amount of blood (i.e., the initial filling state) in the veins prior to the onset of negative pressure is probably not the same, shifts the reference point on the pressure-volume curve such that different compliance values can be obtained without any change in the elastic properties of the vein. In these experiments, if the veins were subjected to lower transmural pressure in-flight such that they tended to become more elliptical in their partially empty state, then the application of negative pressure would certainly result in an apparent increase in compliance over a preflight condition where the veins were more distended. Obviously the initial filling state of the veins must be considered for a true compliance comparison particularly in an area of the pressure volume curve (-8 mm Hg) where large changes in volume can occur with little stretching of the venous smooth muscle.

The elevated S2 slope data accounts for a considerable amount of the increased EOP calf volume. The relative increase in S2 slope values is immediately apparent from observation of the raw data, computed average data for individual crewmembers and the summary data plotted in Figure 48. The explanation for the elevated S2 slope values is not immediately obvious. The S2 slope information obtained from previous tilt-table or LBNP orthostatic tolerance testing was related to the transudation of fluid across the capillary membrane in response to altered transmural conditions. There is evidence in these experiments to support increased fluid shifts from the vascular to extravascular compartments during the in-flight phase. The highly variable, though increased, S2 slope values in combination with a larger residual calf volume during the recovery portion of the experiments indicate that a greater amount of fluid was shifted in-flight. The relative contribution of various factors such as increased compliance, diminished interstitial fluid pressure, the role of supporting tissue and alteration in venomotor tone could not be assessed in these experiments, but most likely all of these factors are of importance and contribute in varying degrees to the EOP PLVC and slope data.

There are many factors which possibly could have affected the outcome of the M092 LBNP experiment. The more strenous exercise protocol, dietary alterations and slightly elevated workshop temperatures were probably contributory to adjustments in water and electrolyte balance and endocrine responses (14). The magnitude of the effect of a number of experiment procedures for blood sampling, EVAs or other routines which prevented rigid adherence to testing schedules is difficult to assess. These factors plus other involved neurohormonal adjustment of adaptation must certainly have altered the crew's LBNP response. Nevertheless, it is remarkable that within the constraints of such a demanding experiment schedule and a small population sample so much information and knowledge has been obtained concerning man's basic adaptability to the new enviromnent of space.

CONCLUSIONS

The Skylab crew exhibited an immediate increase in calf volume in response to the first in-flight lower body negative pressure experiment. The EOP PLVC values were highly variable, tended to remain elevated throughout the in-flight phase and did not demonstrate a significant trend during the zero gravity exposure. EOP PLVC increases were significant at all levels of LBNP for the commander and pilot and at the -8 and -16 mm Hg for the scientist pilot. Analysis of PLVC deltas revealed that the actual significant increases occurred at -8 and -50 mm Hg for the commander, -8 mm Hg for the scientist pilot and -8 and -16 mm Hg for the pilot. This analysis also indicated that approximately 85% of the in-flight increase in calf volume occurred within the first two minutes of the LBNP protocol (during the -8 and -16 mm Hg level of negative pressure). This rapid shift of blood into the lower extremity veins at such small levels of negative pressure strongly suggests a partially empty lower body venous system as an initial condition for the in-flight LBNP tests.

As a result of the increased volume changes, the crewmembers experienced a slightly greater incidence of early termination in-flight. The increase in fluid pooling in the lower body and slightly elevated heart rates indicated a loss of orthostatic tolerance which remained throughout the in-flight phase. The combination of more frequent early terminations, increased calf volume changes and reduced circulating fluid volumes probably indicate that the level of in-flight negative pressure represented a greater cardiovascular stress than did the preflight protocol.

The in-flight S1 slope computations were highly variable but tended to show increased slopes at -8 mm Hg and decreased slopes at most other levels of negative pressure. The runoff or recovery slope values also tended to decrease from preflight values. The increased S1 slope values probably reflected the rapid filling of the partially empty venous reservoirs and in combination with altered S2 slope values influence the filling curve of volume changes at greater levels of negative pressure.

It is interesting to note that no significant increases in S1 compliance were observed for the in-flight data at levels of negative pressure greater than -8 mm Hg and that significant decreases were quite common.

The S2 slope values were extremely variant, increased at most levels and showed the greatest increases at -8, -16 and -30 mm Hg negative pressure levels. The increases probably reflect the diminished interstitial fluid pressure in-flight combined with the effects of the initial rapid filling and distension of the veins during application of LBNP.

In-flight measurements of body mass and calf circumference indicated an early significant reduction in both parameters. As with the Skylab 2 mission, the initial loss of volume from the legs appeared to correlate with the cephalad fluid shift and onset of cranial and cervical congestion. The average in-flight decrease in calf circumference was 7.2% with a decrease of 0.03 cm per day although the circumference was tending to stabilize during the latter in-flight phase. The more extensive exercise program and dietary adjustments helped stabilize the loss in body mass to 3.9%. The average in-flight loss in body mass was 0.01 Kg per day although the commander and pilot had stabilized very well.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the support and assistance from the many people who contributed technical assistance to the collection and processing of the leg volume data obtained from the Skylab Medical Experiments. Particular appreciation is due the NASA-JSC personnel: R. L. Johnson, G. W. Hoffler, A. E. Nicogossian, M. M. Jackson and R. W. Nolte and other members of the cardiovascular laboratory team. The authors would like to acknowledge the assistance of F. L. Zaebst, S. R. Gillespie and R. Krenzer for their role in the early development of the Skylab plethysmographs. Appreciation is extended to Mrs. Dolores T. Tomlinson for assistance with data processing and to Ms. Pat Karasch for typing assistance.

REFERENCES

1. Barnett, R. D., R. J. Gowen, D. R. Carroll and F. L. Zaebst, 1970. A Capacitive Plethysmograph. The Seventh Annual Rocky Mountain Bioengineering Symposium.

2. Barnett, R. D. and R. J. Gowen. 1974. Calibration of Leg Bands Used for the M092 Skylab Mission. Report to NASA-JSC, Houston, TX.

3. Barnett, R. D., C. M. Schade and R. J. Gowen. 1974. Processing of the Leg Volume Data Obtained on the M092 Skylab Missions. Report to NASA-JSC, Houston, TX.

4. Barnett, R. D., R. J. Gowen and D. R. Carroll. 1975. Analysis of Changes in Leg Volume Parameters, and Orthostatic Tolerance in Response to Lower Body Negative Pressure During 28 Days Exposure to Zero Gravity: Skylab 2. Report to NASA-JSC, Houston, TX.

5. Brown, E. J., J. S. Goei, A. D. M. Greenfield, and C. C. Plassaras. 1966. Circulatory Responses to Simulated Gravitational Shifts of Blood in Man Induced by Exposure of the Body Below the Iliac Crest to Sub-atmospheric Pressure. J. Physiol. 183:607-627.

6. Gilbert, C. A., L. A. Bricker, W. T. Springfield, Jr., P. M. Stevens, and B. H. Warren. 1966. Sodium and Water Excretion and Renal Hemodynamics During Lower Body Negative Pressure. J. Appl. Physiol. 21:1699-1704.

7. Gilbert, C. A and P. M. Stevens. 1966. Forearm Vascular Responses to Lower Body Negative Pressure and Orthostasis. J. Appl. Physiol. 21:1265-1272.

8. Gowen, R. J. and R. D. Barnett. 1971. Evaluation of the Design, Verification and Test Capacitive Plethysmograph for Skylab. Report to NASA-JSC, Houston, TX.

9. Gowen, R. J. 1973. Use of a Capacitive Plethysmograph for Detection of Cardiovascular Tone in Zero Gravity. Presented at the Annual Scientific Meeting of Aerospace Medicine Association.

10. Gowen, R. J. and R. D. Barnett. 1973. Leg Volume Changes Obtained from the M092 Experiment During the Skylab Medical Experiments Altitude Test. Report to NASA-JSC, Houston, TX.

11. Hoffler, G. W., R. A. Wolthuis and R. L. Johnson. 1974. Apollo Space Crew Cardiovascular Evaluations. Aerospace Med. 45:807-820.

12. Johnson, P. C., T. B. Driscoll and A. D. Adrian. Skylab Blood Volume Changes. Presented at the Skylab Life Sciences Symposium, August 27-29, 1974. Johnson Space Center, Houston, TX.

13. Johnson, R. L., G. W. Hoffler, A. E. Nicogossian, S. A. Bergman and M. M. Jackson. Lower Body Negative Pressure: Third Manned Skylab Mission. Presented at the Skylab Life Sciences Symposium, August 27-29, 1974. Johnson Space Center, Houston, TX.

14. Leach, C. S., P. C. Rambaut. Biochemical Responses of the Skylab Crewmen. Presented at the Life Sciences Symposium, August 27-29, 1974. Johnson Space Center, Houston, TX.

15. Murray, R. H., J. Krog, L. D. Carlson, and J. A. Bowers. 1967. Cumulative Effects of Venesection and Lower Body Negative Pressure. Aerospace Med. 38:243-247.

16. Samueloff, S. L., N. L. Browse, and J. T. Shepherd. 1966. Response of Capacity Vessels in Human Limbs to Headup Tilt and Suction on Lower Body. J. Appl. Physiol. 21:47-54.

17. Stevens, P. M., and L. E. Lamb. 1965. Effects of Lower Body Negative Pressure on the Cardiovascular System. Am. J. Cardiol. 16:506-515.

18. Stevens, P. M., P. B. Miller, T. N. Lynch, C. A. Gilbert, R. L. Johnson, and L. E. Lamb. 1966. Effects of Lower Body Negative Pressure on Physiologic Changes Due to Four Weeks of Hypoxic Bed Rest. Aerospace Med. 37:466-474.

19. Stevens, P. M., P. B. Miller, C. A. Gilbert, T. N. Lynch, R. L. Johnson and L. E. Lamb. 1966. Influence of Long-term Lower Body Negative Pressure on the Circulatory Function of Man During Prolonged Bed Rest. Aerospace Med. 37:357-367.

20. Wolthuis, R. A., G. W. Hoffler, and R. L. Johnson. 1970. Lower Body Negative Pressure as an Assay Technique for Orthostatic Tolerance: Part II. A comparison of the Individual Response to Incremental vs. Constand Levels of LBNP. Aerospace Med. 41:419-424.

21. Wolthuis, R. A., S. A. Bergman and A. E. Nicogossian. 1974. Physiological Effects of Locally Applied Reduced Pressure in Man. Physiological Reviews 54:566-595.

APPENDIX A

SUMMARY OF PLETHYSMOGRAPHS AND ASSOCIATED CALIBRATION DATA

ORIGINAL PAGE IS
OF POOR QUALITY

LVMS CALIBRATION CURVE DATA

VOLTAGE AT INDICATED VOLUME CHANGE

BAND ID	SER. NO.	BAND SIZE	BAND DESIG.	CAL. NO.	-1 %	0 %	1 %	2 %	3 %	4 %	5 %	CYL. SIZE	DATE OF TEST
AF *	048	14-15	FTTH	3.7	0.26	0.83	1.45	2.16	3.01	3.81	4.66	14.5	21 MAY 73
AG	049	15-16	FTTH	3.7	0.32	0.83	1.32	1.95	2.63	3.34	4.09	15.5	02 APR 73
AM *	055	13-14	FTTH	3.5	0.31	0.83	1.34	1.92	2.47	3.16	3.80	13.5	23 MAY 73
AR	060	13-14	FTTH	3.3	0.24	0.83	1.46	2.10	2.81	3.64	4.48	13.5	22 MAY 73
AS *	061	13-14	FTTH	3.5	0.30	0.83	1.39	1.99	2.61	3.25	4.00	13.5	06 MAR 73
AT	062	13-14	FTTH	4.0	0.22	0.83	1.50	2.15	2.89	3.65	4.48	13.5	22 MAY 73
AV *	064	13-14	FTTH	3.5	0.26	0.83	1.43	2.04	2.70	3.42	4.25	13.5	05 MAR 73
AY *	067	13-14	FTTH	3.9	0.40	0.83	1.34	1.87	2.42	3.02	3.68	13.5	12 FEB 73
AZ *	068	13-14	FTTH	3.9	0.35	0.83	1.36	1.92	2.53	3.20	3.88	13.5	26 JUL 73
BF *	074	15-16	FTTH	3.2	0.34	0.83	1.40	2.00	2.66	3.44	4.24	15.5	12 FEB 73
BL *	080	14-15	FTTH	3.9	0.41	0.83	1.30	1.82	2.42	2.97	3.58	14.5	02 APR 73
BP *	084	14-15	FTTH	3.1	0.27	0.83	1.40	2.00	2.68	3.37	4.11	14.5	26 FEB 73
BQ *	085	14-15	FTTH	3.3	0.31	0.83	1.40	2.04	2.80	3.54	4.33	14.5	22 FEB 73
BS	087	14-15	FTTH	3.5	0.35	0.83	1.33	1.95	2.65	3.33	4.09	14.5	06 MAR 73
BT *	088	14-15	FTTH	3.1	0.33	0.83	1.38	2.04	2.76	3.49	4.27	14.5	02 APR 73
BX *	092	14-15	FTTH	3.4	0.22	0.83	1.46	2.24	3.08	3.90	4.68	14.5	18 MAY 73
BY *	093	14-15	FTTH	3.7	0.39	0.83	1.33	1.92	2.57	3.22	3.92	14.5	02 APR 73
CB *	096	15-16	FTTH	3.4	0.24	0.83	1.46	2.17	2.89	3.76	4.63	15.5	02 APR 73
CO	098	16-17	FTTH	3.3	0.24	0.83	1.53	2.19	2.97	3.82	4.72	16.5	21 MAY 73
CE *	099	16-17	FTTH	2.8	0.19	0.83	1.51	2.22	3.03	3.96	4.81	16.5	12 MAR 73
CG	101	16-17	FTTH	3.2	0.25	0.83	1.41	2.08	2.69	3.51	4.29	16.5	12 MAR 73
CL	106	14-15	FTTH	3.[illegible]	0.32	0.83	1.36	1.98	2.54	3.26	3.98	14.5	02 JUL 73
DB	107	14-15	FTTH	2.[illegible]	0.35	0.83	1.34	1.94	2.60	3.27	3.98	14.5	07 MAR 73

* INDICATES BANDS LATER USED AS MLU LEG BANDS

IVMS CALIBRATION CURVE DATA

VOLTAGE AT INDICATED VOLUME CHANGE

BAND ID	SER. NO.	BAND SIZE	BAND DESIG.	CAL. NO.	-1 %	0 %	1 %	2 %	3 %	4 %	5 %	CYL. SIZE	DATE OF TEST
AL	054	16-17	MLU	2.9	0.21	0.83	1.46	2.13	2.86	3.68	4.53	16.5	09 APR 73
AP	058	13-14	MLU	3.0	0.37	0.83	1.33	1.84	2.41	3.07	3.64	13.5	13 MAR 73
AU	063	13-14	MLU	3.2	0.26	0.83	1.45	2.08	2.88	3.68	4.50	13.5	28 AUG 73
CY	065	13-14	MLU	3.6	0.36	0.83	1.36	1.90	2.49	3.12	3.82	13.5	10 APR 73
BA	069	14-15	MLU	3.1	0.31	0.83	1.38	1.92	2.58	3.25	3.96	14.5	20 MAR 73
BB	070	14-15	MLU	3.3	0.34	0.83	1.36	1.98	2.72	3.48	4.23	14.5	09 APR 73
BC	071	14-15	MLU	3.6	0.26	0.83	1.48	2.24	3.12	3.96	4.70	14.5	29 AUG 73
BD	072	15-16	MLU	3.4	0.25	0.83	1.51	2.19	2.93	3.73	4.59	15.5	16 APR 73
BE	073	15-16	MLU	3.0	0.28	0.83	1.40	2.01	2.66	3.38	4.11	15.5	04 APR 73
BG	075	16-17	MLU	3.2	0.28	0.83	1.44	2.08	2.78	3.53	4.29	16.5	09 APR 73
BH	076	16-17	MLU	3.6	0.22	0.83	1.49	2.25	3.07	4.07	4.88	16.5	22 MAR 73
CC	097	15-16	MLU	3.0	0.22	0.83	1.47	2.17	2.88	3.71	4.56	15.5	04 APR 73
CF	099	12-13	MLU	3.6	0.42	0.83	1.36	1.91	2.45	3.07	3.90	12.5	28 AUG 73
CG	101	12-13	MLU	3.9	0.41	0.83	1.33	1.84	2.41	3.05	3.73	12.5	27 JUL 73

ORIGINAL PAGE IS
OF POOR QUALITY

ORIGINAL PAGE IS
OF POOR QUALITY

EVMS CALIBRATION CURVE DATA

BAND ID	SER. NO.	BAND SIZE	BAND DESIG.	CAL. NO.	-1 %	0 %	1 %	2 %	3 %	4 %	5 %	CYL. SIZE	DATE OF TEST
					VOLTAGE AT INDICATED VOLUME CHANGE								
AC	045	12-13	FLT.	4.5	0.46	0.83	1.33	1.85	2.33	2.95	3.70	12.5	06 SEP 73
AD	046	14-15	FLT.	3.4	0.30	0.83	1.35	2.14	2.70	3.40	4.16	14.5	07 DEC 72
AJ	052	12-13	FLT.	3.5	0.46	0.83	1.30	1.75	2.23	2.79	3.49	12.5	06 SEP 73
AN	056	13-14	B.U.	3.7	0.41	0.83	1.29	1.83	2.37	2.94	3.54	13.5	05 FEB 73
AQ	059	13-14	B.U.	3.2	0.15	0.83	1.57	2.36	3.12	3.92	4.79	13.5	06 FEB 73
AX	066	13-14	FLT.	3.7	0.41	0.83	1.32	1.87	2.44	3.06	3.75	13.5	05 DEC 72
BJ	078	14-15	FLT.	3.2	0.46	0.83	1.30	1.85	2.48	3.10	3.75	14.5	05 DEC 72
BK	079	14-15	FLT.	3.6	0.41	0.83	1.29	1.83	2.43	3.04	3.68	14.5	06 DEC 72
BU	089	14-15	FLT.	3.5	0.34	0.83	1.36	1.97	2.66	3.32	4.06	14.5	07 DEC 72
BV	090	14-15	FLT.	3.6	0.41	0.83	1.29	1.79	2.41	3.01	3.76	14.5	06 DEC 72
BZ	094	15-16	FLT.	3.3	0.32	0.83	1.39	1.97	2.61	3.33	4.13	15.5	06 DEC 72
CA	095	15-16	FLT.	3.7	0.26	0.83	1.45	2.10	2.84	3.64	4.52	15.5	05 DEC 72
CH	102	13-14	FLT.	3.2	0.39	0.83	1.32	1.82	2.34	2.94	3.61	13.5	04 DEC 72
CI	103	13-14	FLT.	4.5	0.36	0.83	1.33	1.83	2.35	2.94	3.60	13.5	05 DEC 72
CJ	104	13-14	FLT.	3.5	0.51	0.83	1.23	1.67	2.14	2.69	3.25	13.5	07 DEC 72
CO	109	12-13	FLT.	3.6	0.54	0.83	1.33	1.85	2.32	2.95	3.66	12.5	06 SEP 73
CP	110	15-16	FLT.	3.6	0.33	0.83	1.37	1.96	2.63	3.38	4.15	15.5	06 DEC 72
CR	112	16-17	FLT.	3.6	0.32	0.83	1.42	2.00	2.67	3.39	4.14	16.5	06 DEC 72
CS	113	12-13	FLT.	3.8	0.44	0.83	1.36	1.68	2.42	3.02	3.63	12.5	21 JUN 73
CT	114	12-13	FLT.	4.6	0.46	0.83	1.32	1.80	2.28	2.80	3.33	12.5	20 JUN 73
CU	115	16-17	FLT.	3.2	0.36	0.83	1.41	2.03	2.72	3.52	4.36	16.5	06 DEC 72
CV	116	16-17	FLT.	3.1	0.41	0.83	1.33	1.84	2.44	3.14	3.80	16.5	07 DEC 72
CX	117	14-15	FLT.	3.4	0.45	0.83	1.24	1.72	2.27	2.81	3.36	14.5	06 DEC 72
CY	118	12-13	FLT.	3.4	0.46	0.83	1.35	1.89	2.45	3.12	3.93	12.5	06 SEP 73

LVMS CALIBRATION CURVE DATA

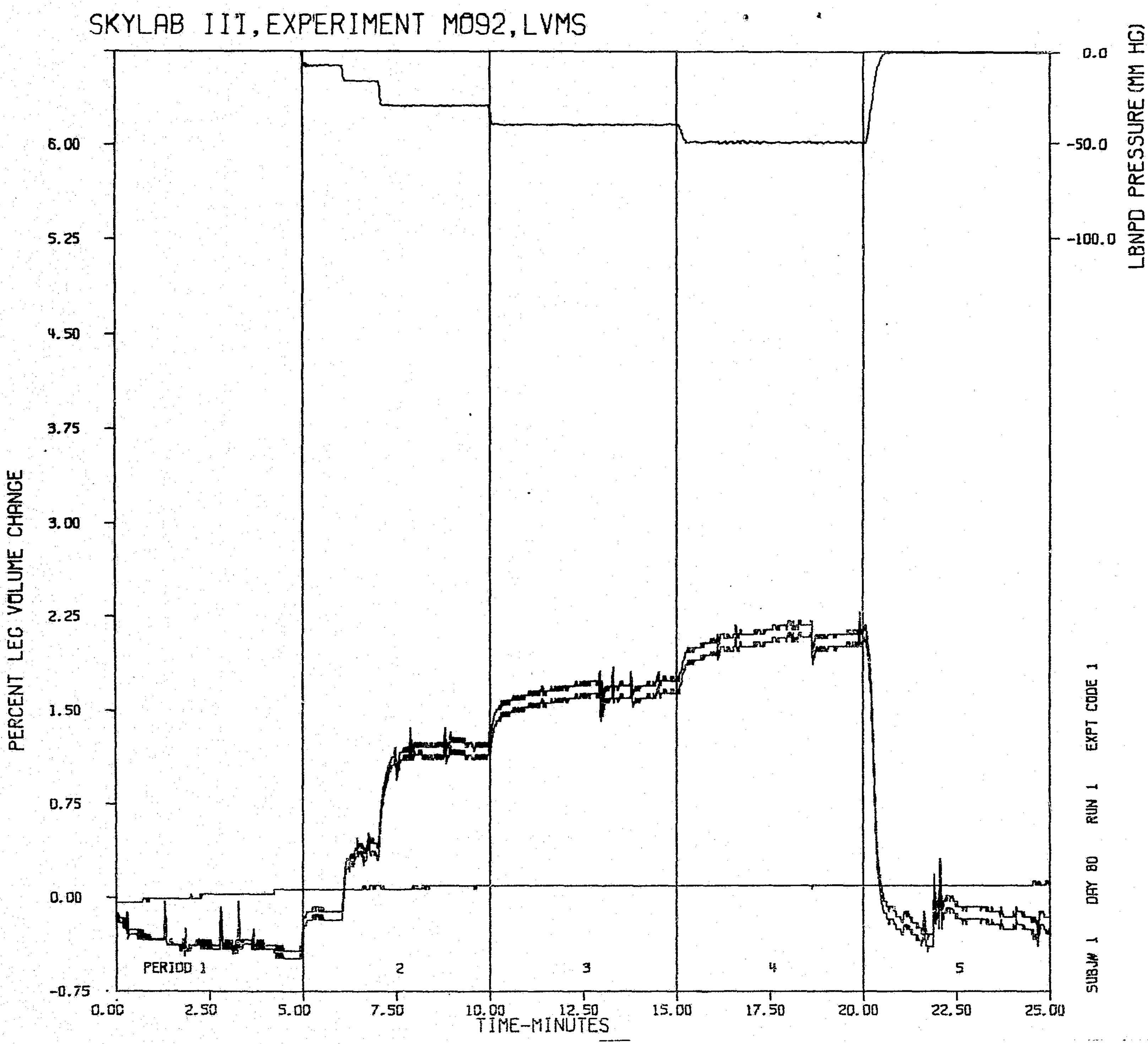
VOLTAGE AT INDICATED VOLUME CHANGE

BAND ID	SER. NO.	BAND SIZE	BAND DESIG.	CAL. NO.	-1 %	0 %	1 %	2 %	3 %	4 %	5 %	CYL. SIZE	DATE OF TEST
AA *	043	12-13	DVTU	3.5	0.33	0.83	1.34	1.89	2.42	3.04	3.66	12.5	13 JUN 73
AB	044	13-14	DVTU	3.4	0.32	0.83	1.38	2.01	2.60	3.29	4.11	13.5	02 JUL 73
AH	050	15-16	DVTU	2.7	0.16	0.83	1.57	2.37	3.15	4.08	4.98	15.5	11 SEP 73
AI	051	15-16	DVTU	3.3	0.26	0.83	1.46	2.15	2.88	3.72	4.60	15.5	29 AUG 73
AK	053	13-14	DVTU	3.2	0.31	0.83	1.41	2.00	2.67	3.45	4.18	13.5	25 JUL 73
AO	057	12-13	DVTU	4.1	0.44	0.83	1.30	1.79	2.32	2.94	3.58	12.5	30 JUL 73
BI	077	16-17	DVTU	3.3	0.23	0.83	1.51	2.24	3.07	3.99	4.79	16.5	03 JUL 73
CZ	081	14-15	DVTU	3.0	0.34	0.83	1.38	2.06	2.87	3.60	4.41	14.5	03 JUL 73
BN	082	14-15	DVTU	3.5	0.29	0.83	1.50	2.16	3.03	3.87	4.52	14.5	02 JUL 73
BO	083	14-15	DVTU	3.5	0.35	0.83	1.39	2.07	2.82	3.56	4.26	14.5	03 JUL 73
CF	100	16-17	DVTU	3.7	0.23	0.83	1.48	2.18	3.09	4.02	4.86	16.5	24 MAY 73
CK	105	14-15	DVTU	3.1	0.29	0.83	1.43	2.12	2.94	3.71	4.53	14.5	03 JUL 73
CN	108	14-15	DVTU	3.7	0.32	0.83	1.41	2.14	2.98	3.73	4.47	14.5	03 JUL 73

* INDICATES BANDS LATER USED AS MLU LEG BANDS

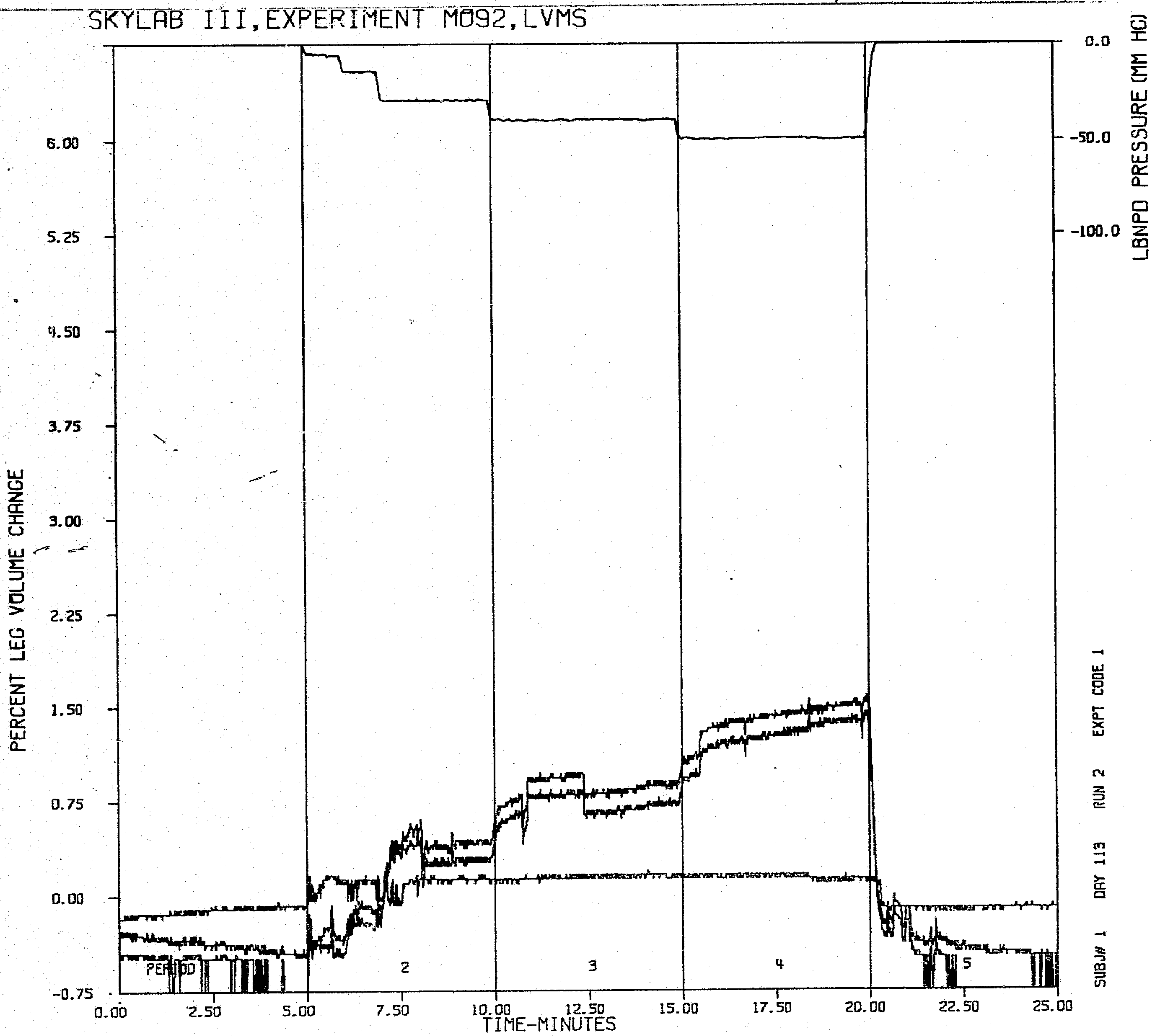
ORIGINAL PAGE IS
OF POOR QUALITY

APPENDIX B



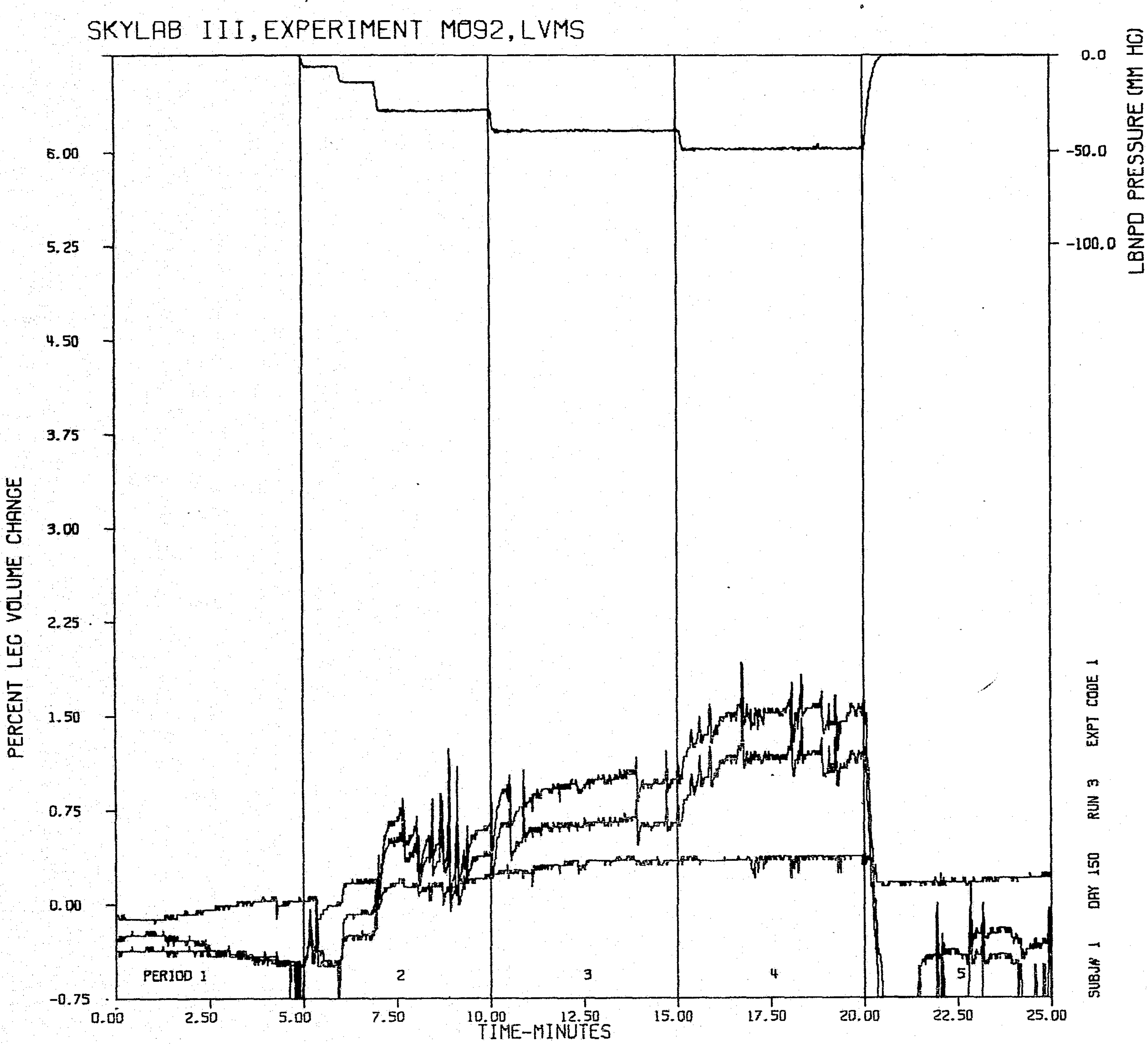
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 1
DAY 80
RUN 1
EXPT CODE 1

B-1

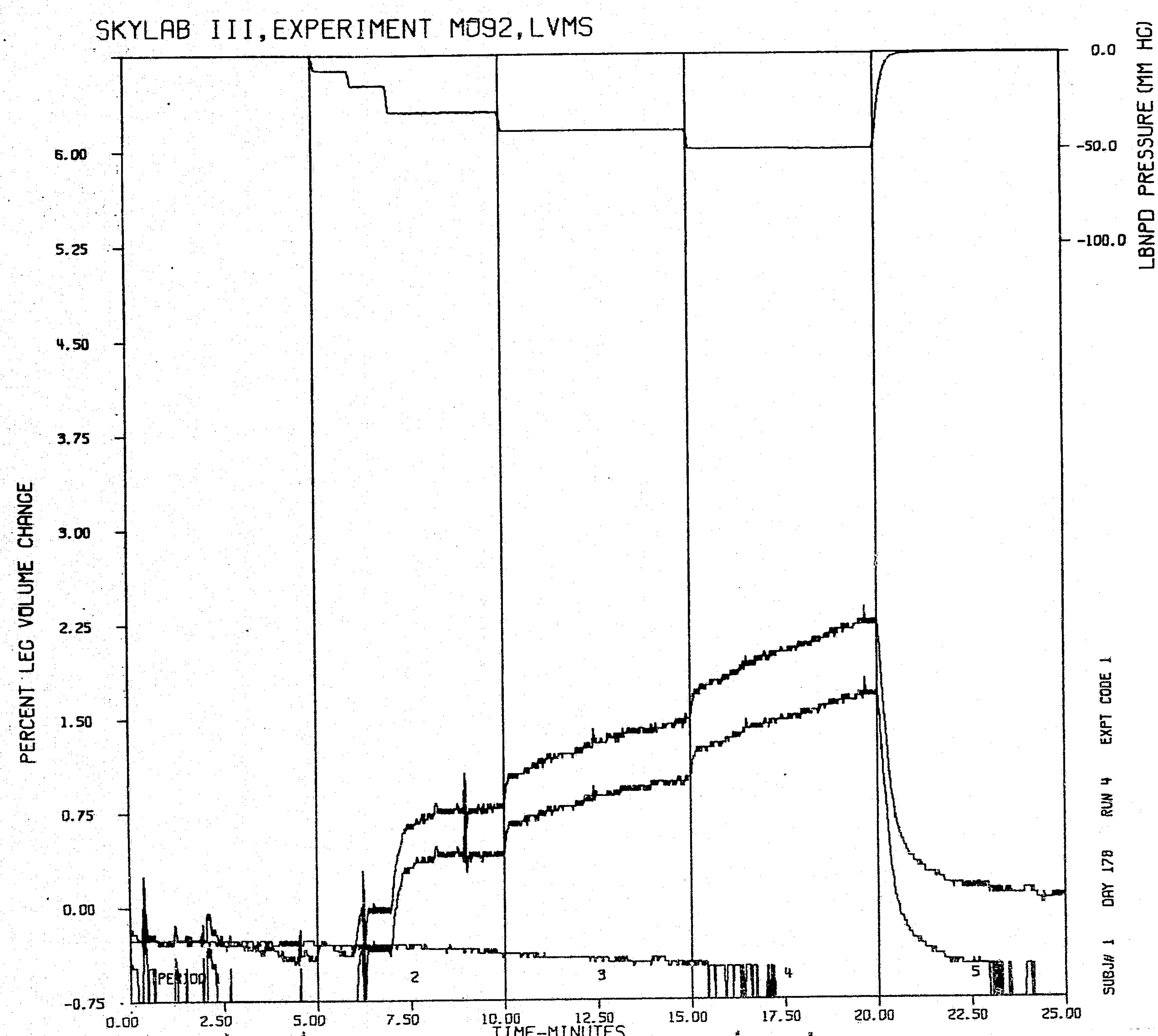


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
TIME-MINUTES
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD
2
3
4
5
EXPT CODE 1
RUN 2
DAY 113
SUBJ# 1

B-2

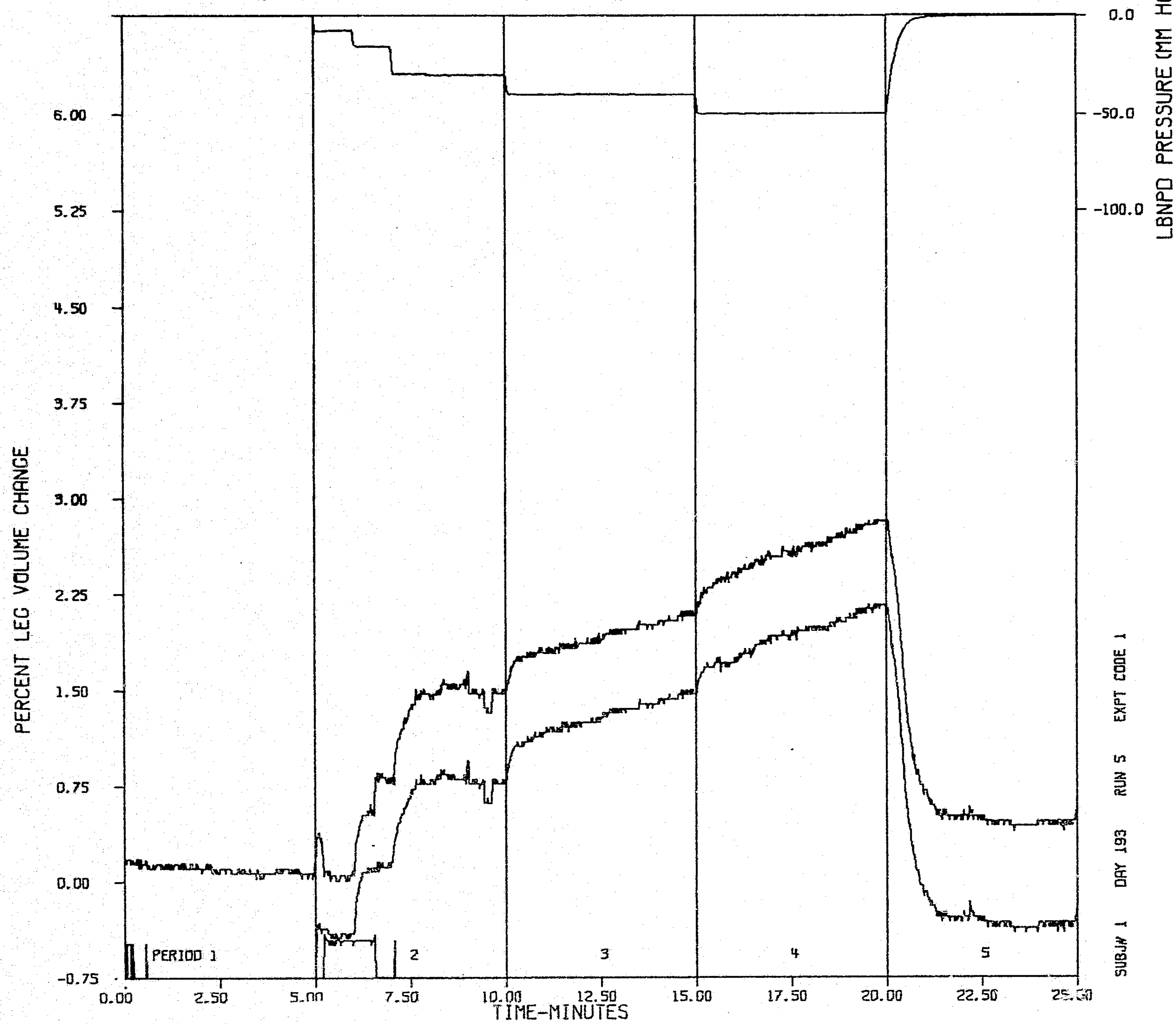


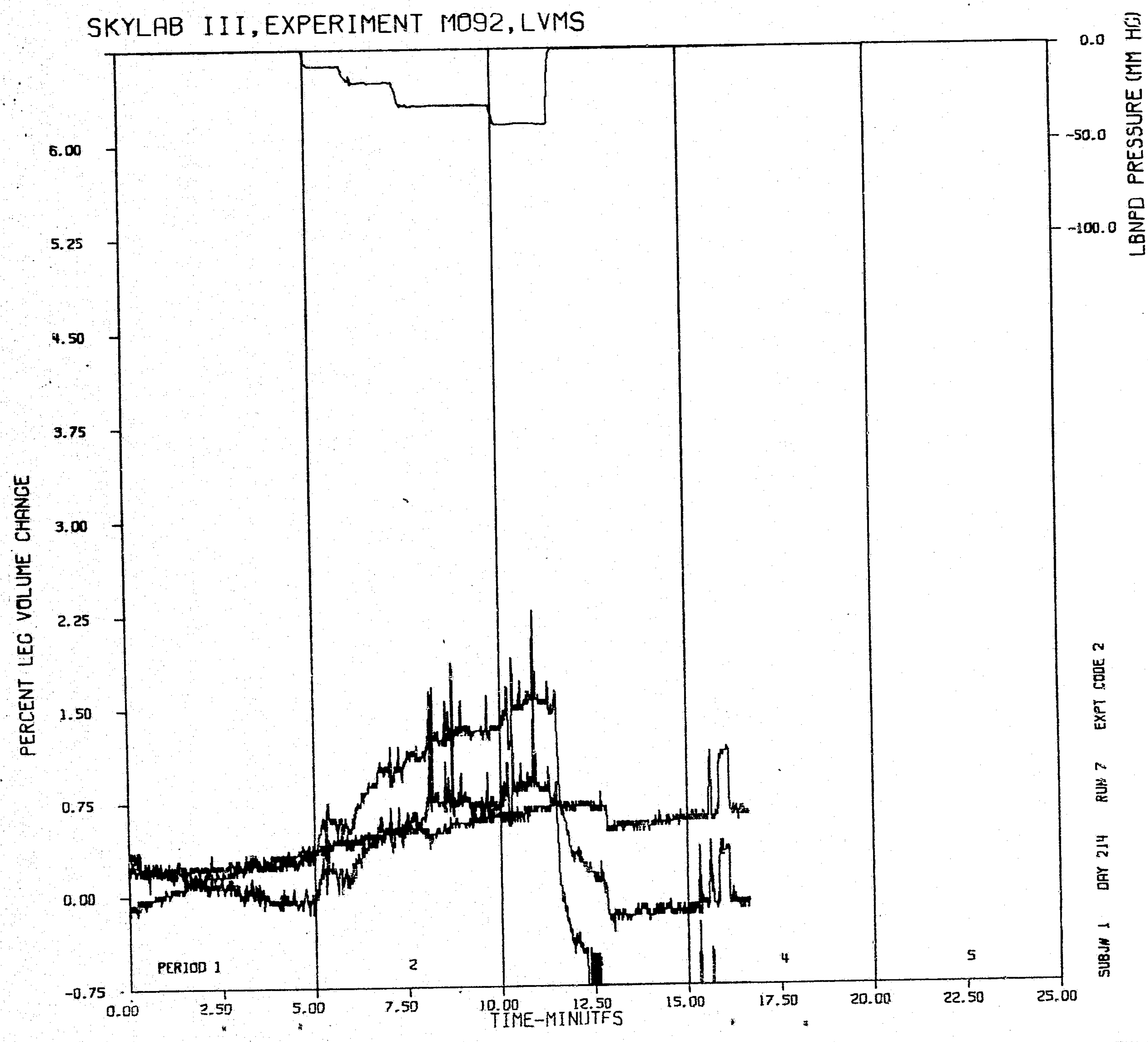
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 1 DAY 150 RUN 3 EXPT CODE 1

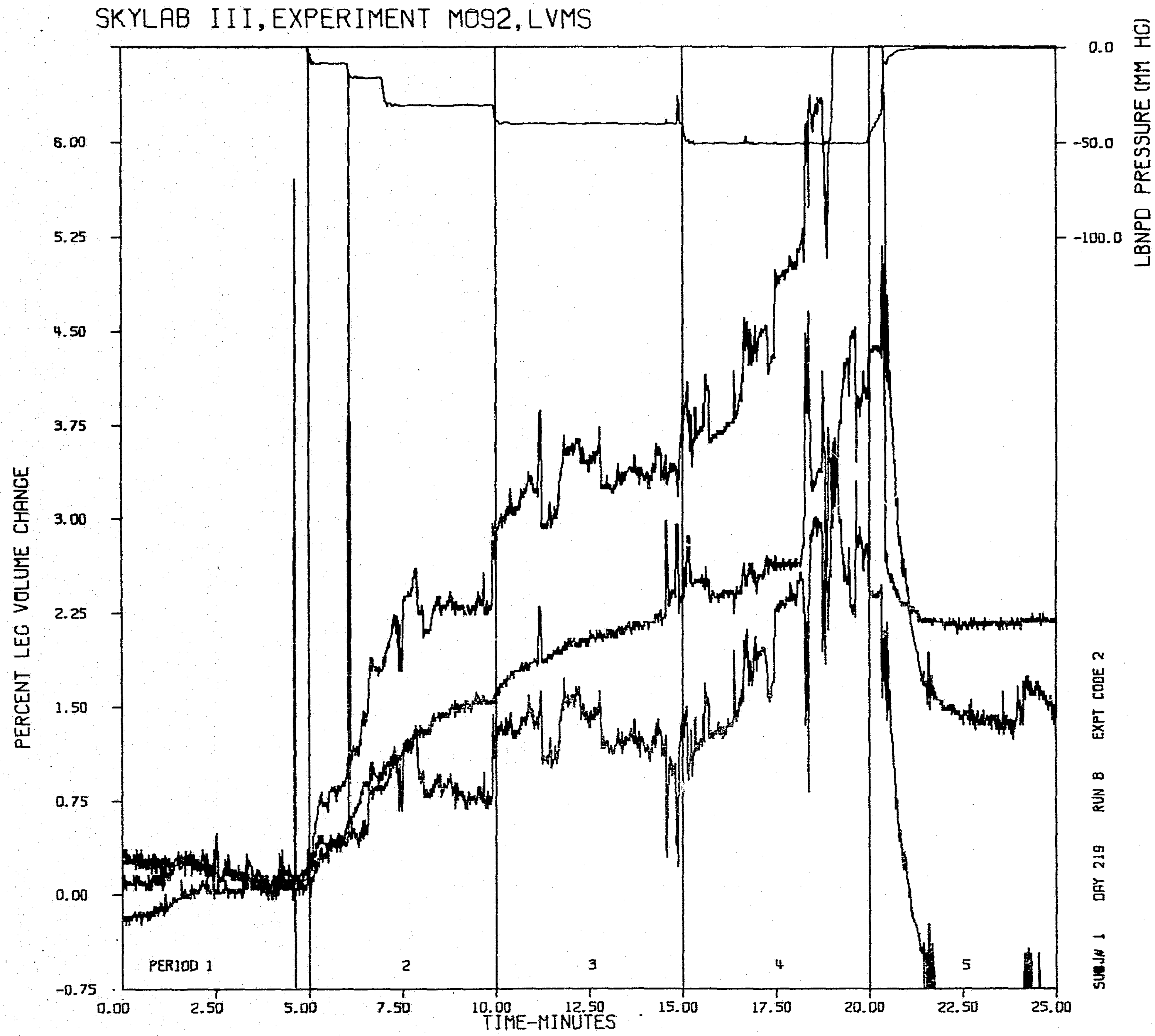


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
SUBJ# 1 DAY 178 RUN 4 EXPT CODE 1
PERIOD 1
2
3
4
5

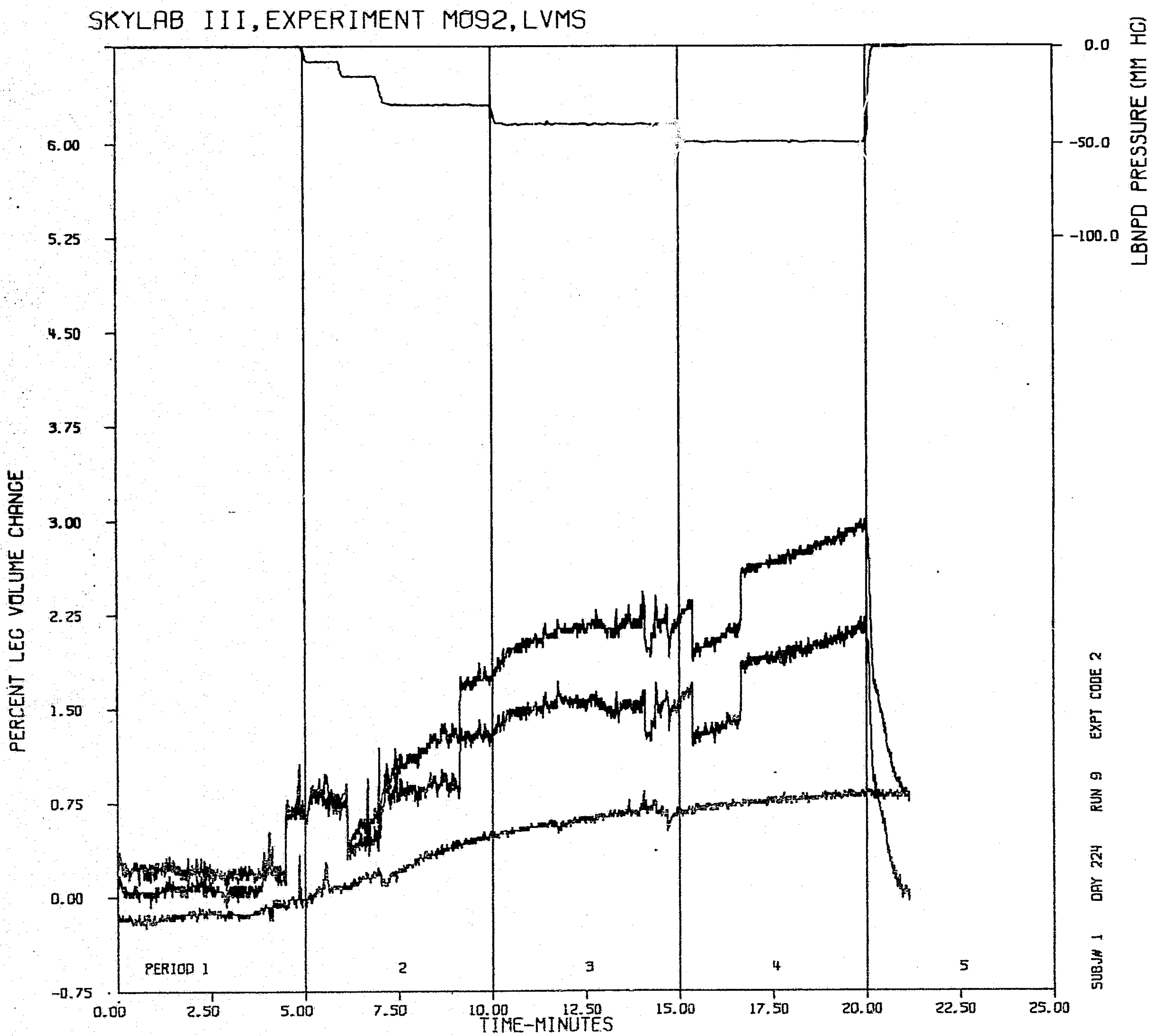
SKYLAB III, EXPERIMENT M092, LVMS



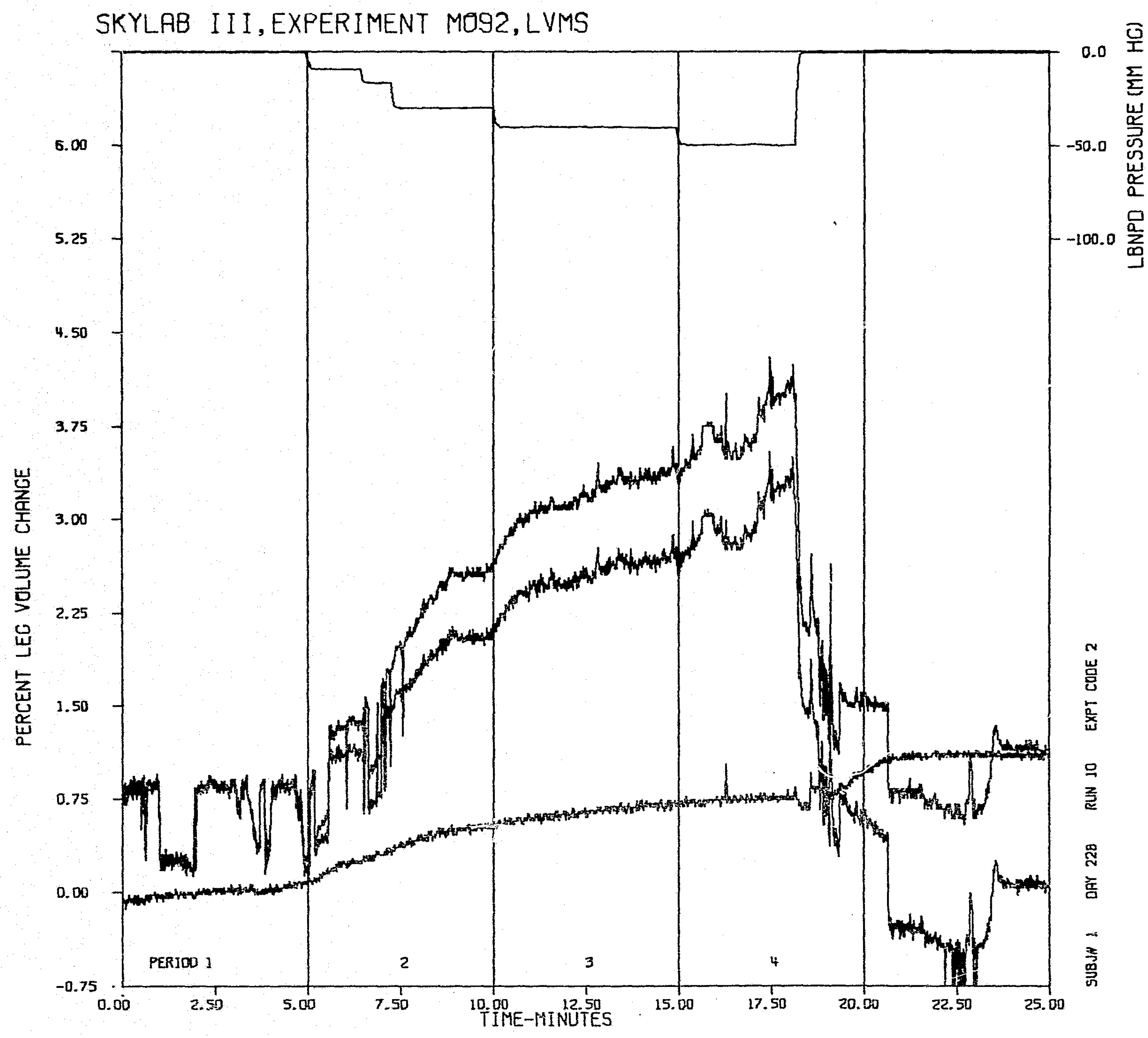

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 1 DAY 214 RUN 7 EXPT CODE 2

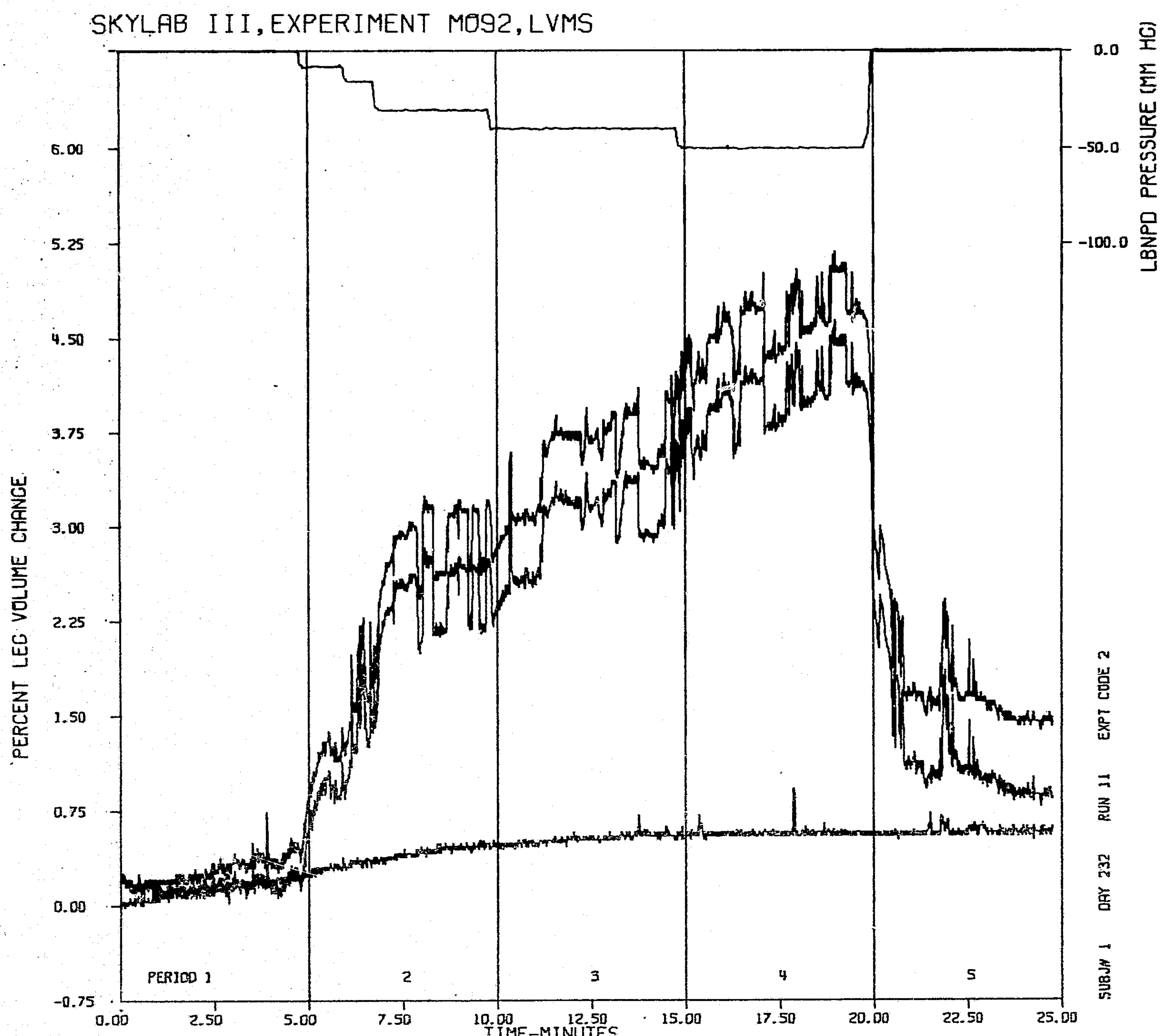


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 1 DAY 219 RUN 8 EXPT CODE 2

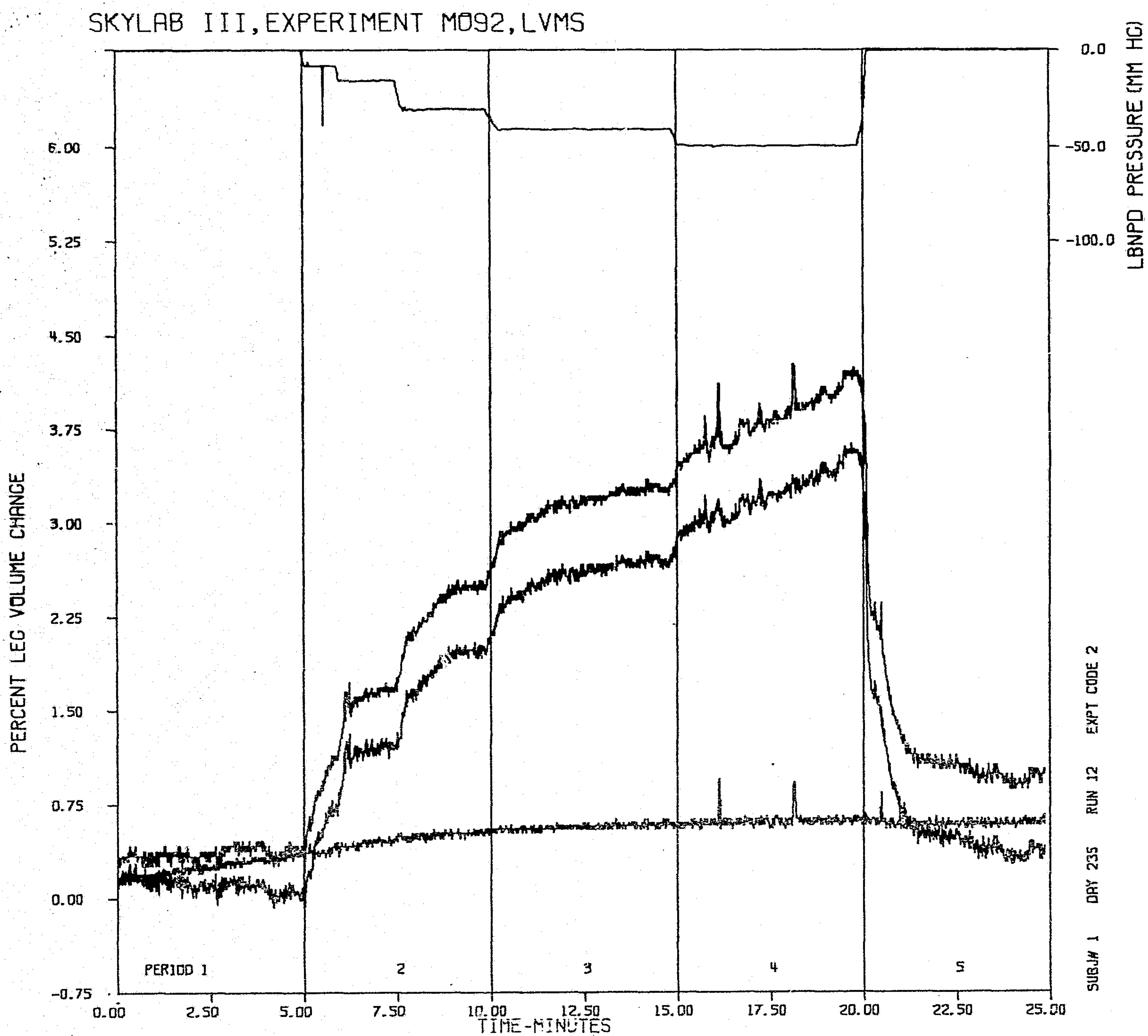

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 224 RUN 9 EXPT CODE 2
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00

B-8

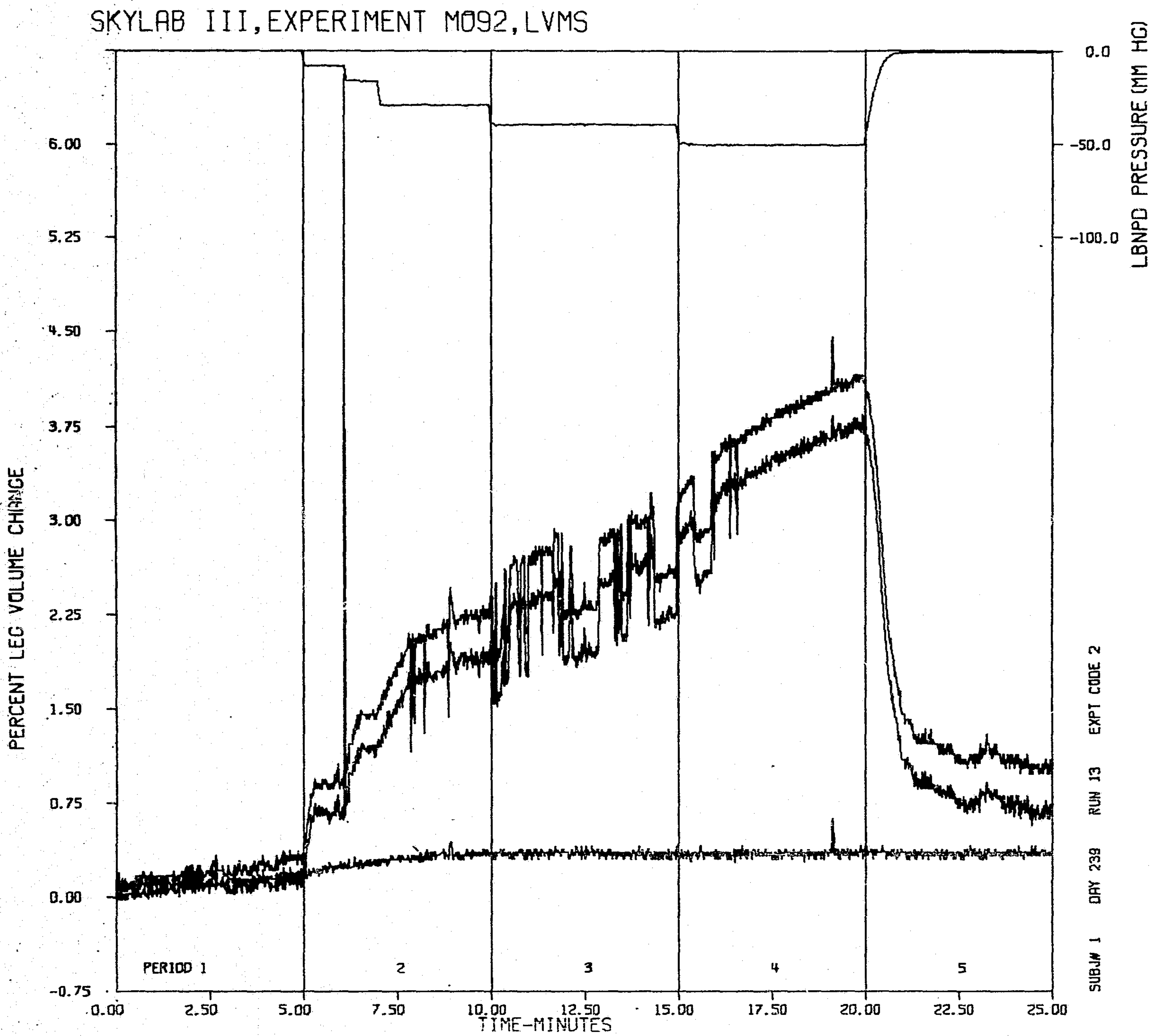

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
EXPT CODE 2
RUN 10
DAY 228
SUBJ# 1

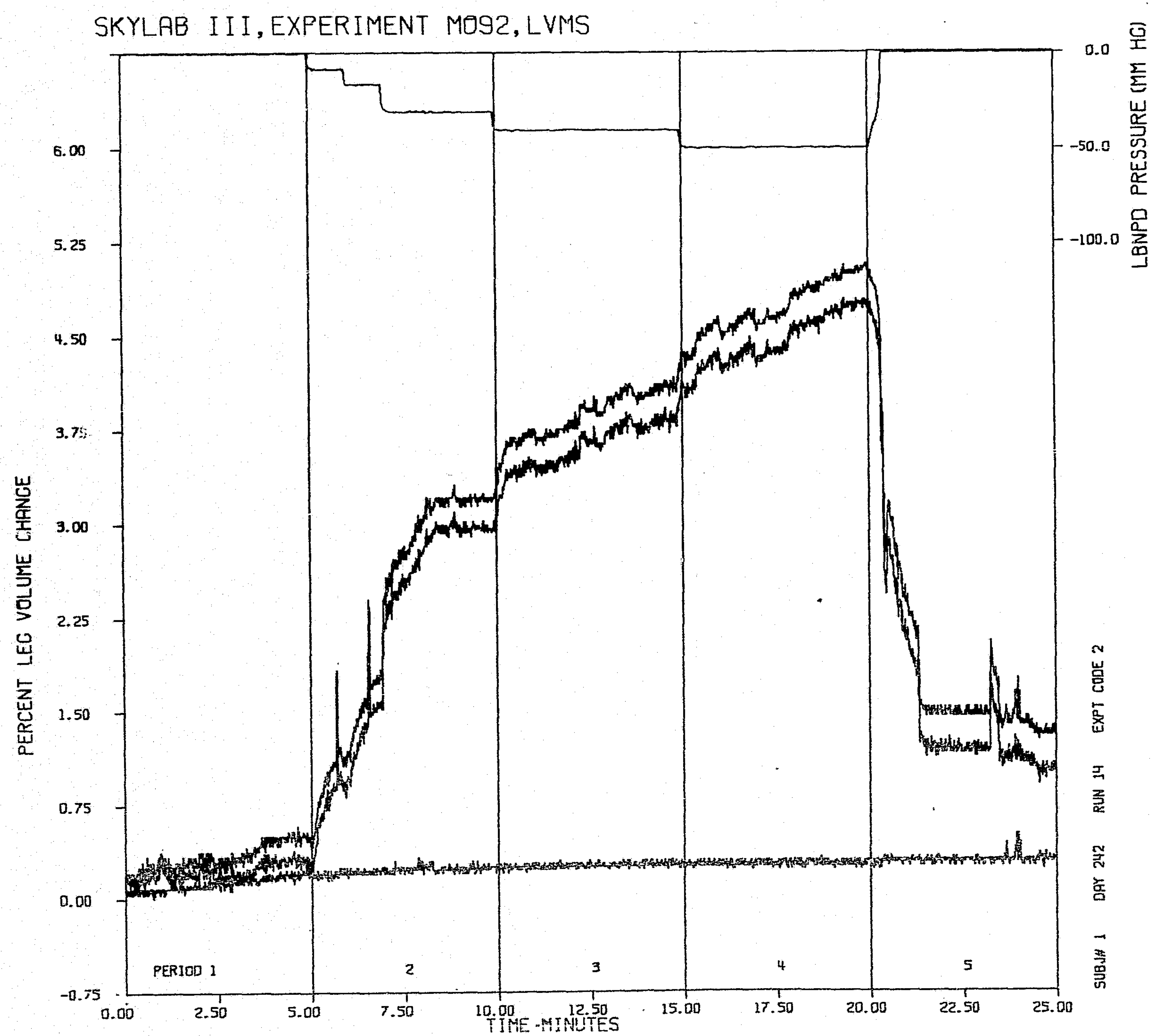


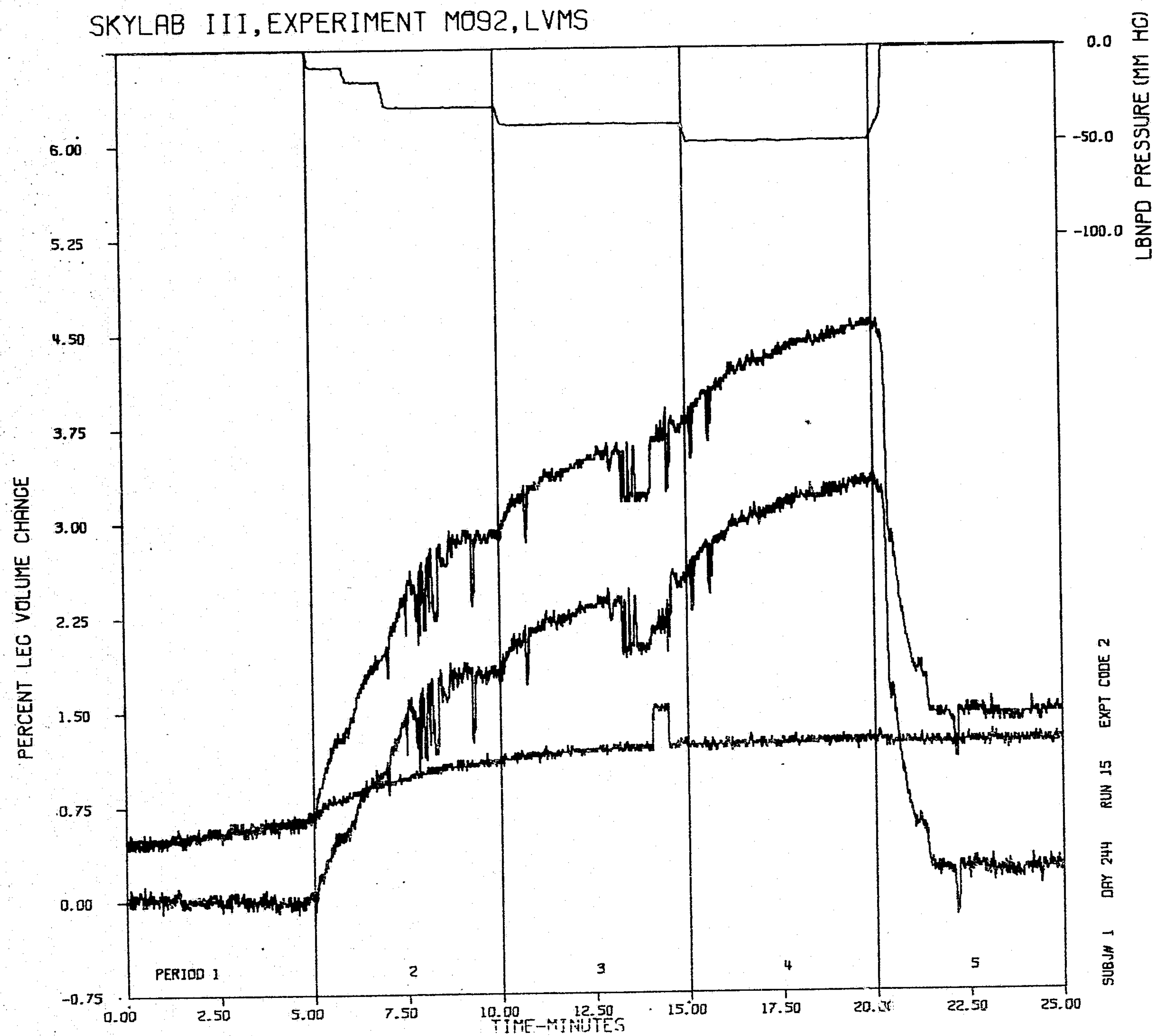
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 1 DAY 232 RUN 11 EXPT CODE 2



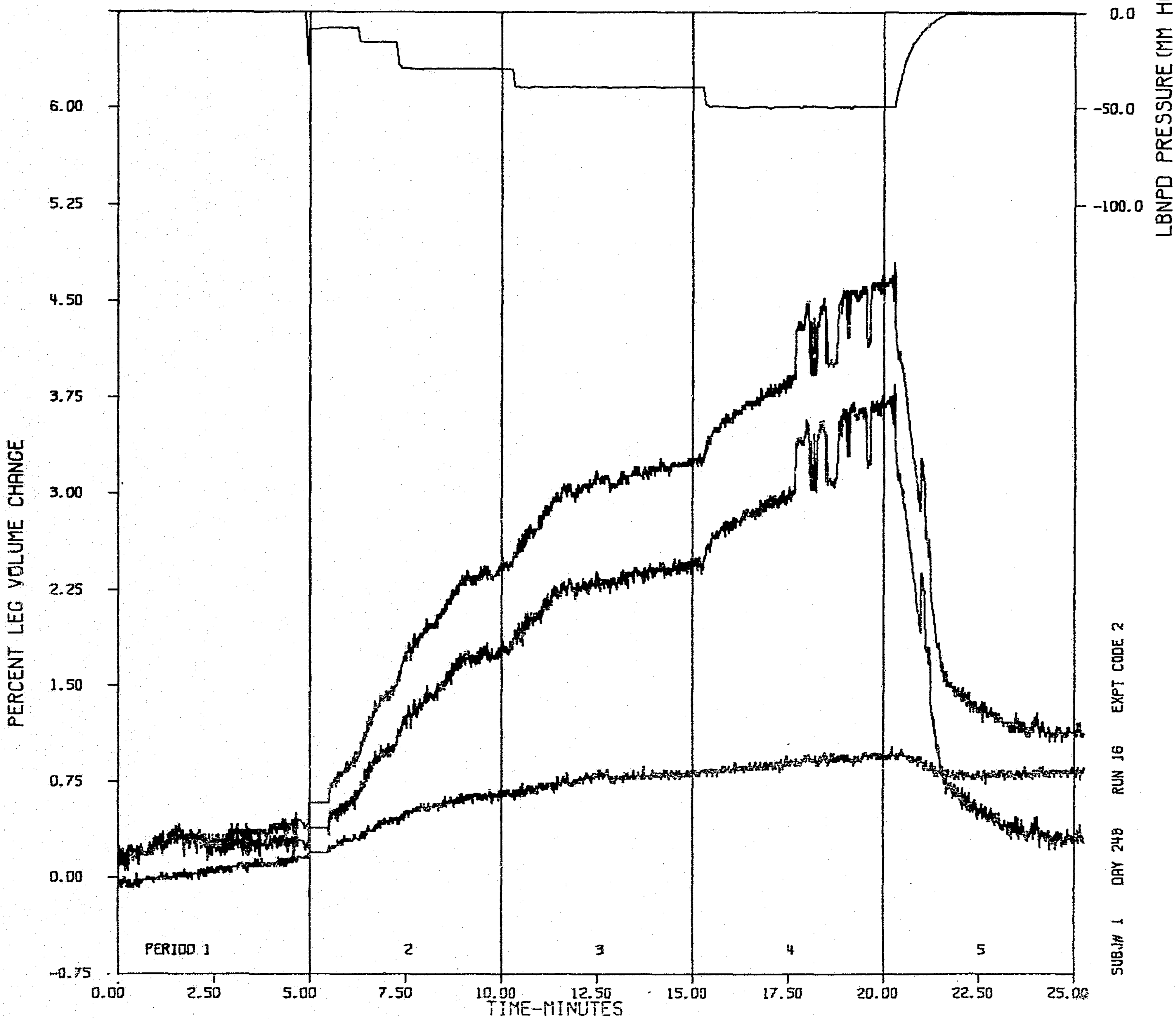
SKYLAB III,EXPERIMENT M092,LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 235 RUN 12 EXPT CODE 2


SKYLAB III,EXPERIMENT M092,LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
EXPT CODE 2
RUN 13
DAY 239
SUBJ# 1

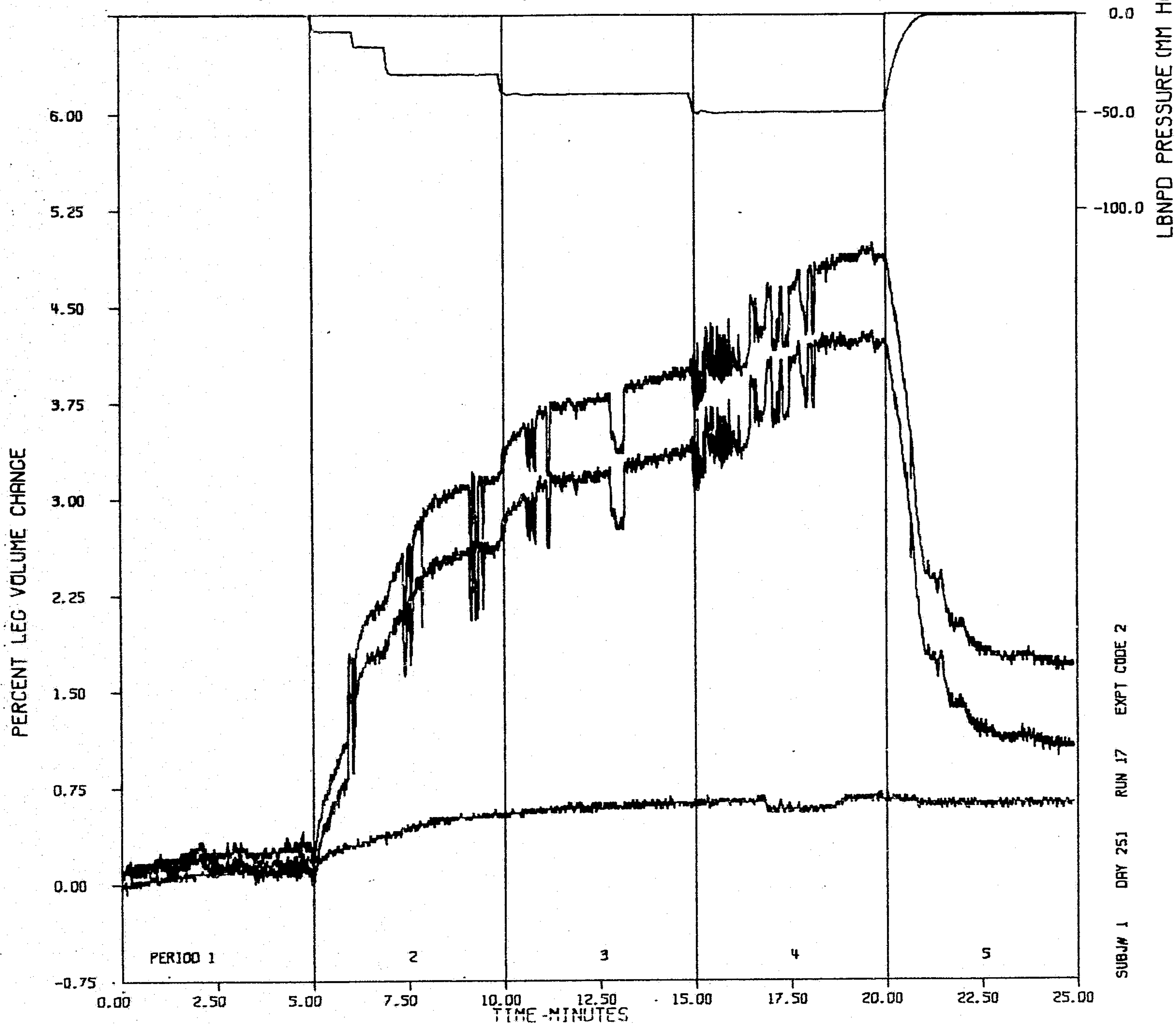

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1
DAY 242
RUN 14
EXPT CODE 2

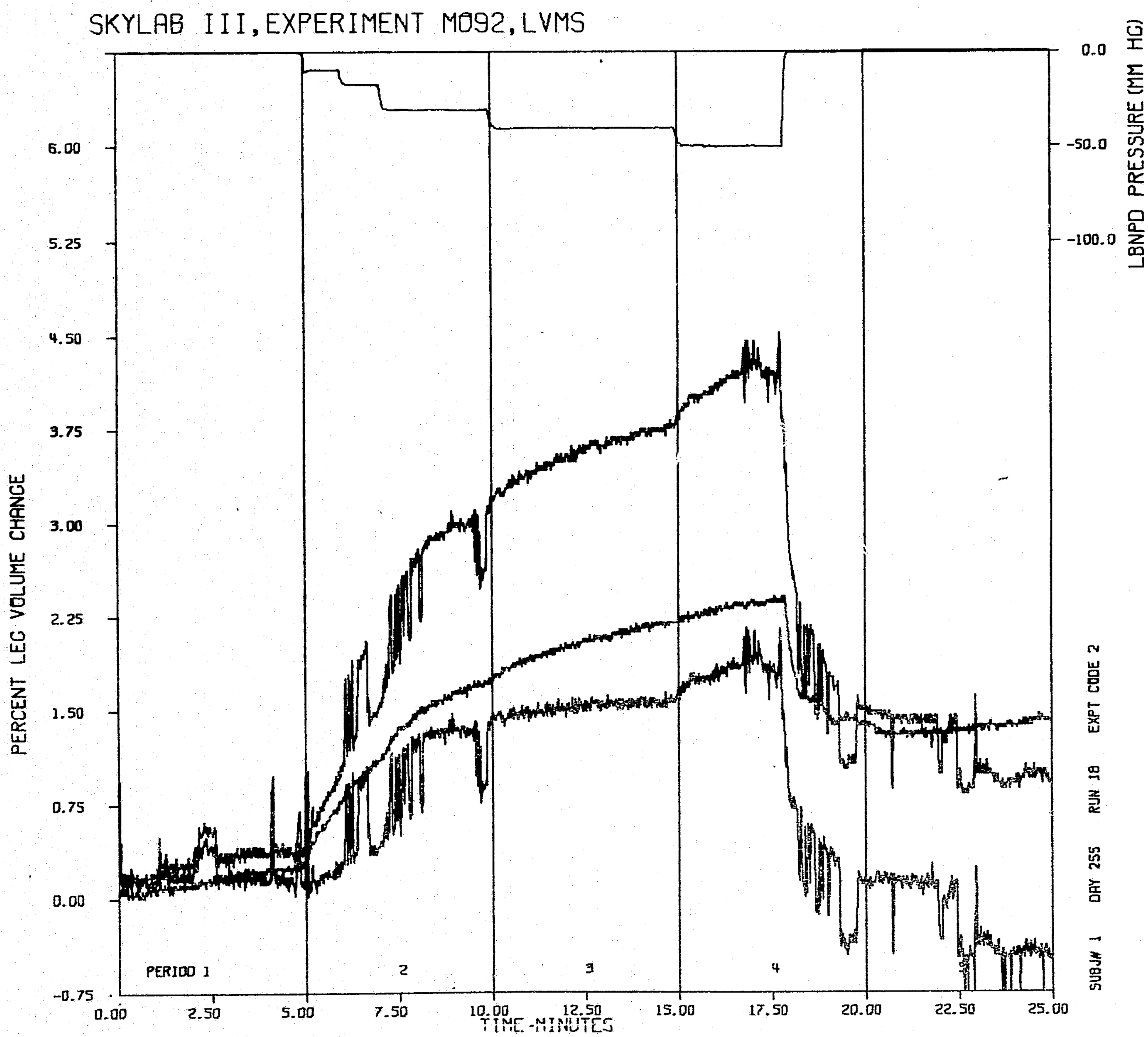

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 244 RUN 15 EXPT CODE 2

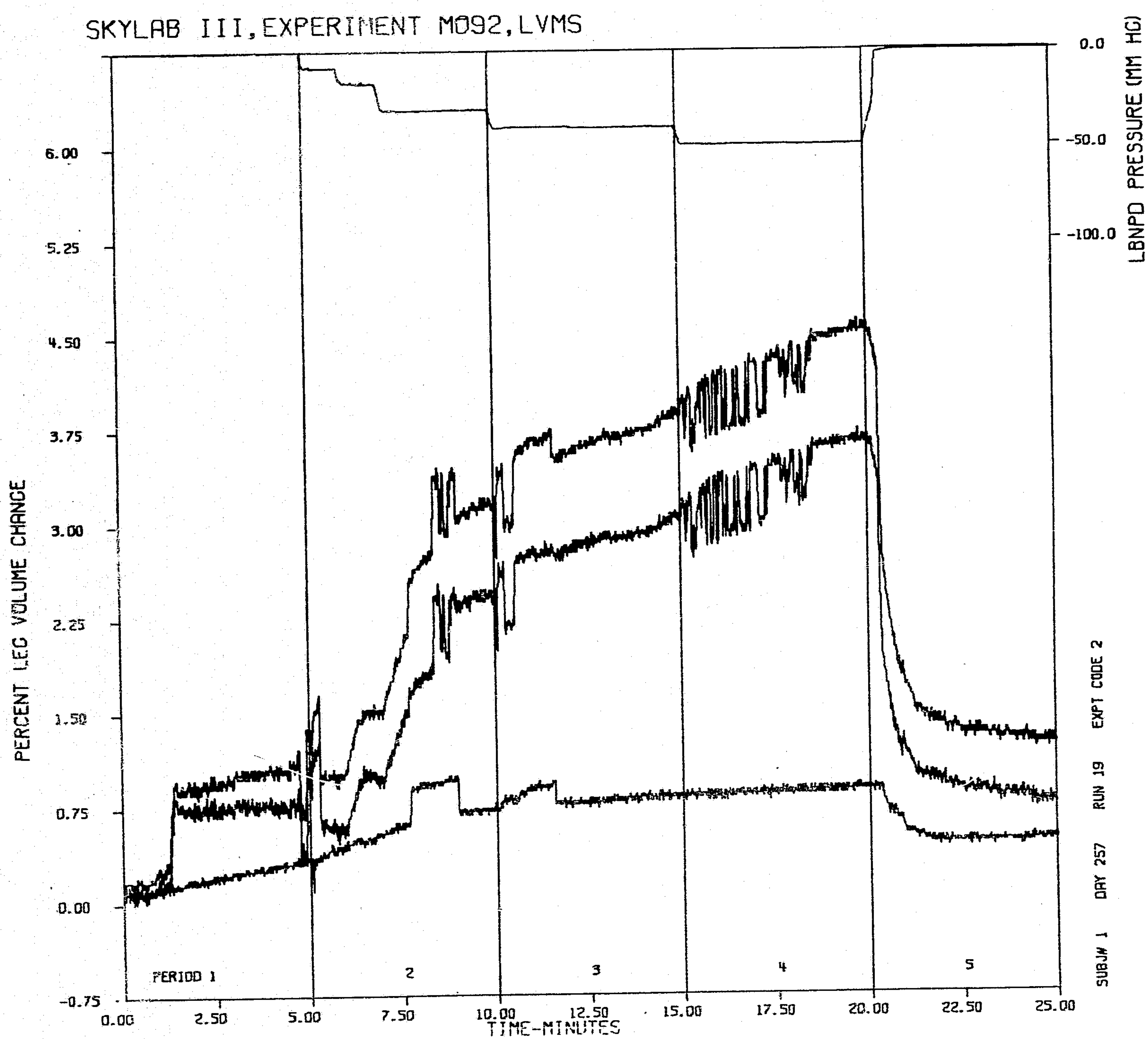
SKYLAB III, EXPERIMENT M092, LVMS



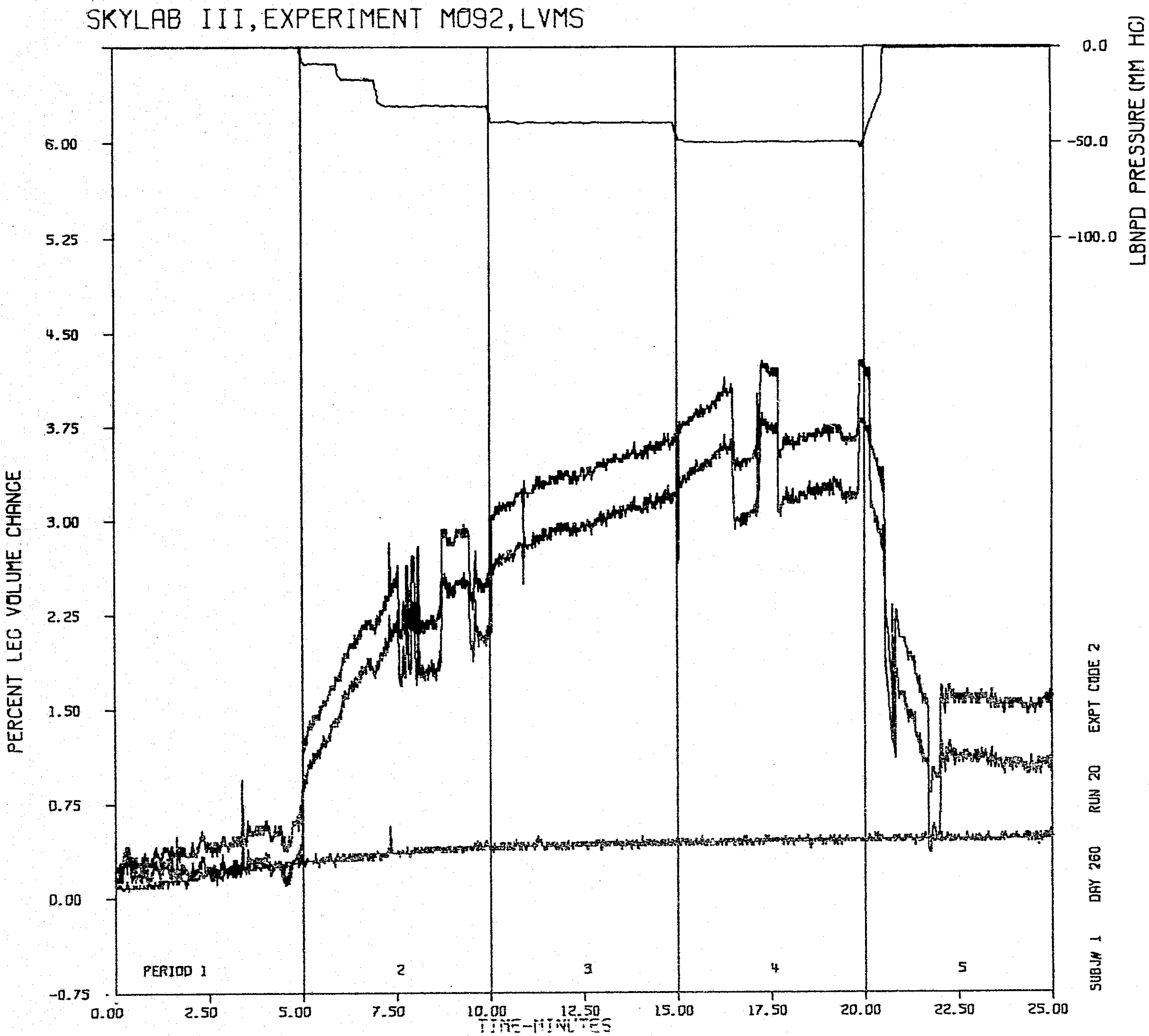
SKYLAB III, EXPERIMENT M092, LVMS

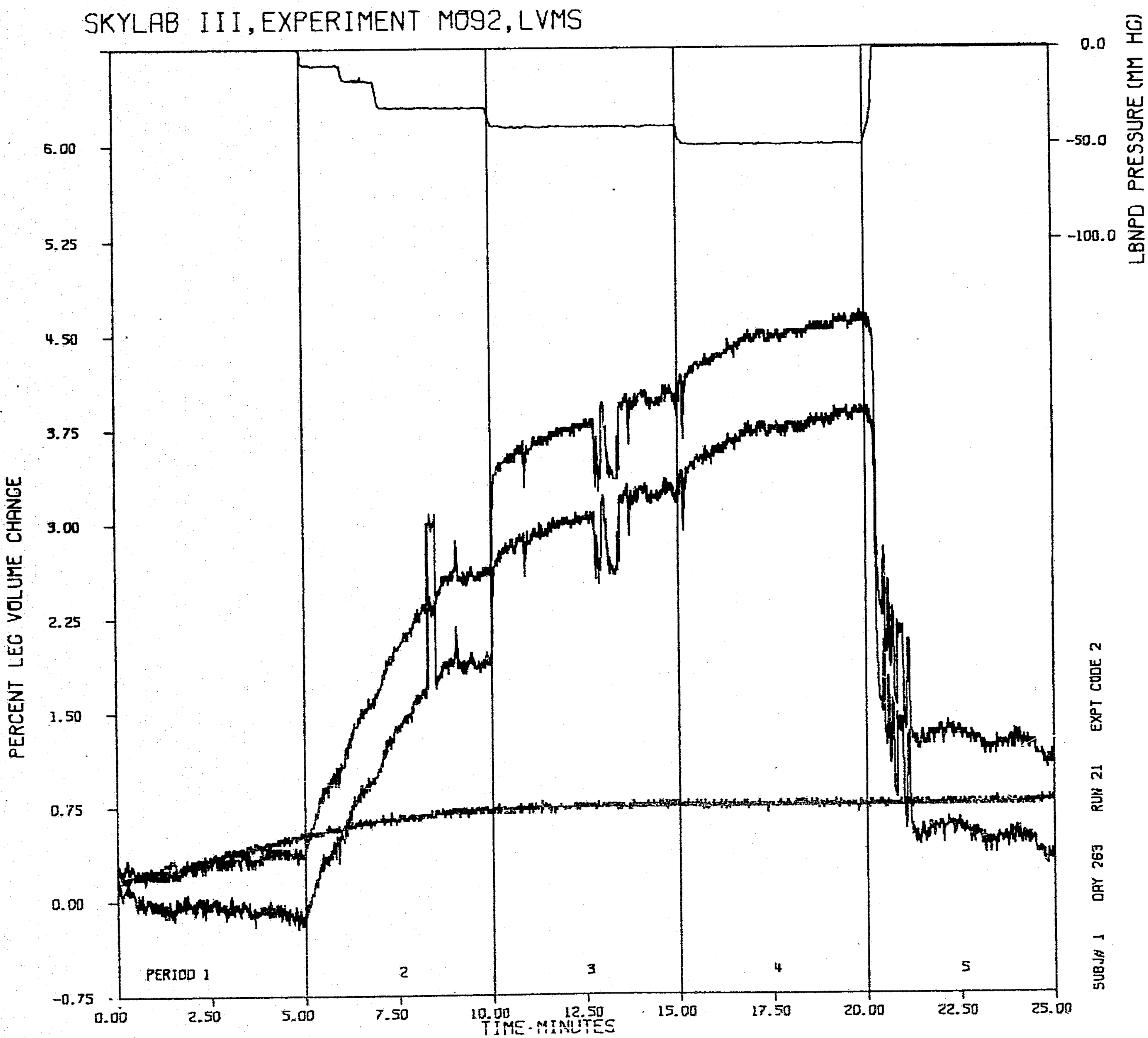



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
SUBJ# 1 DAY 255 RUN 18 EXPT CODE 2

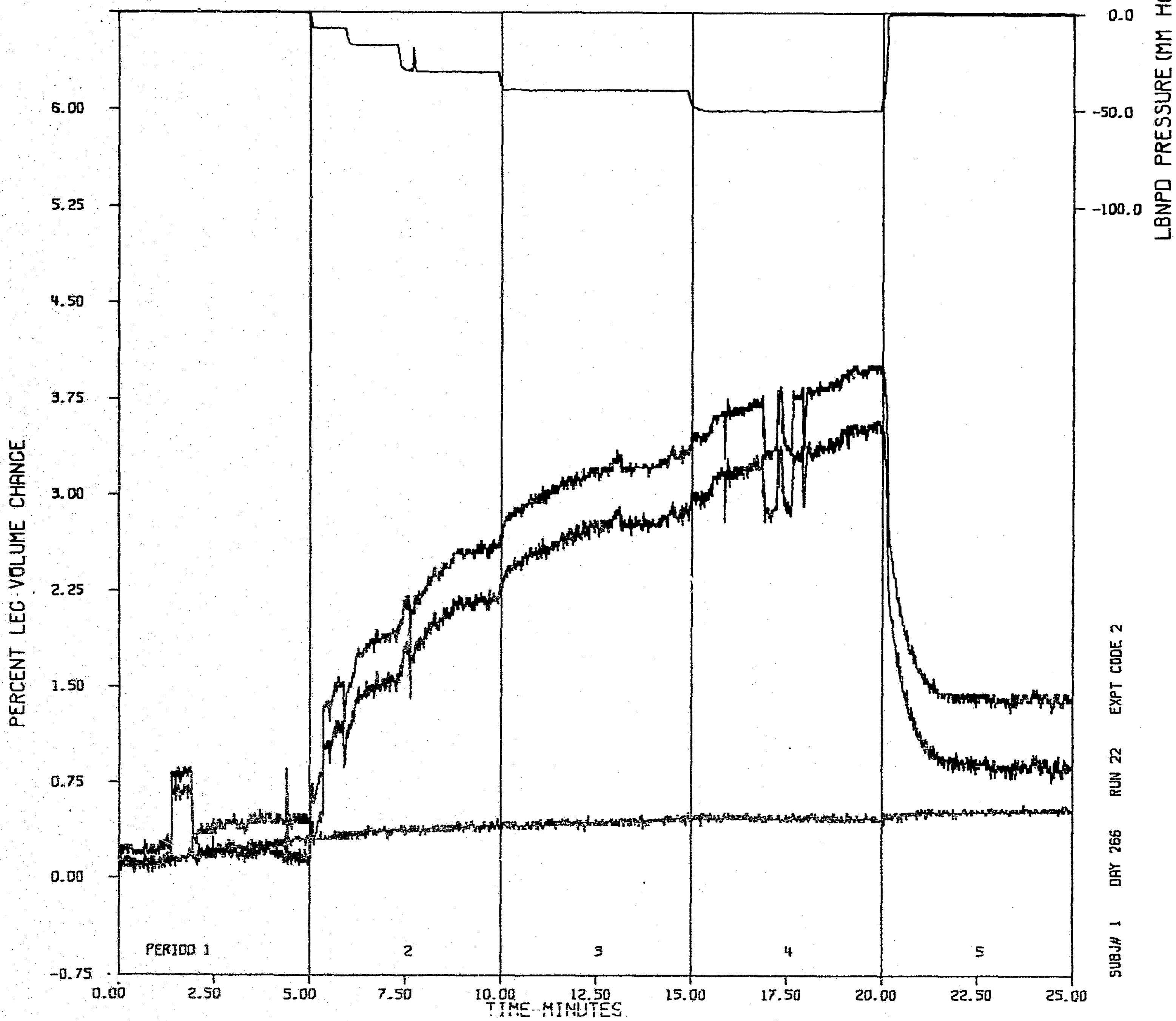


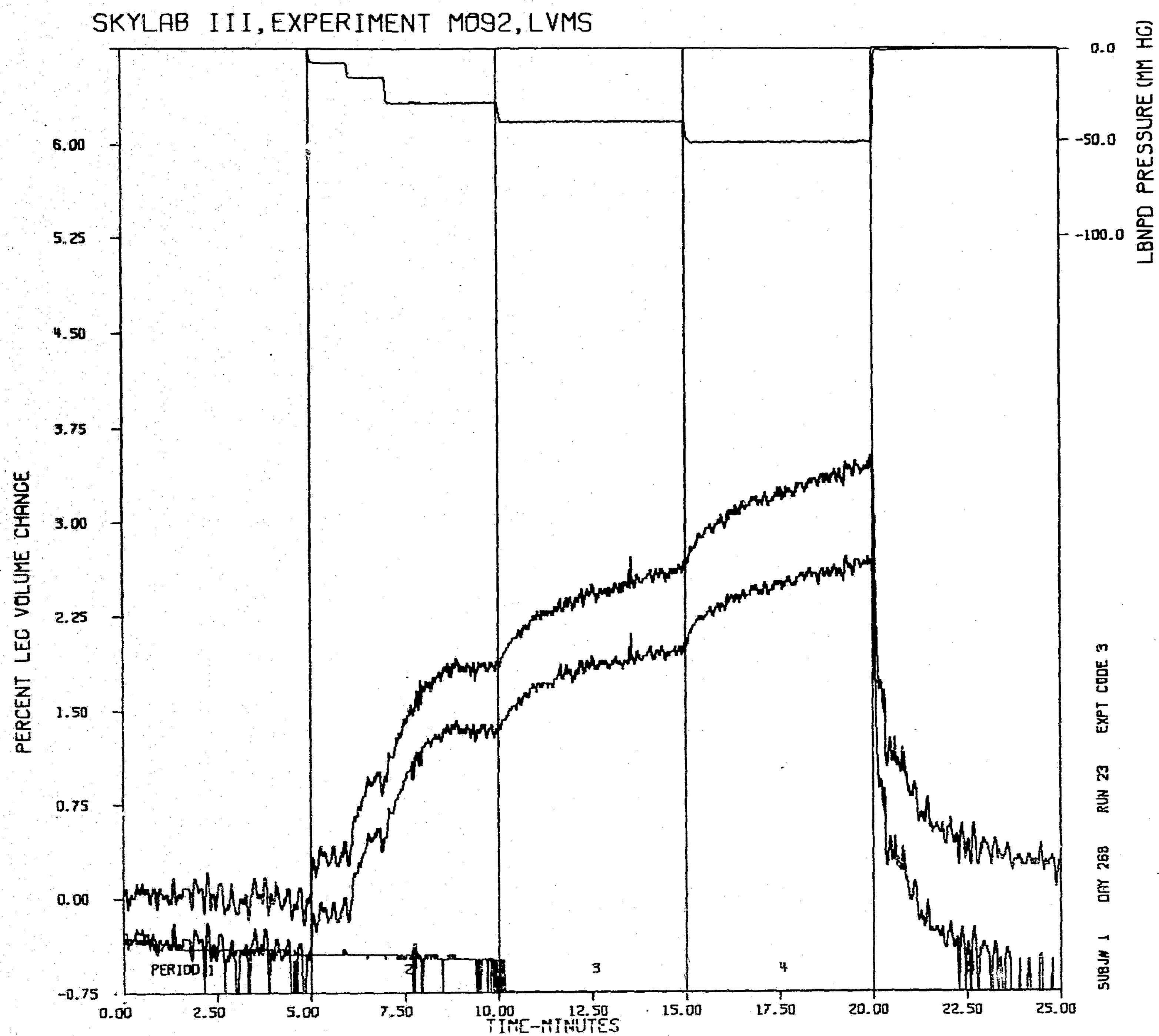
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJW 1
DAY 257
RUN 19
EXPT CODE 2

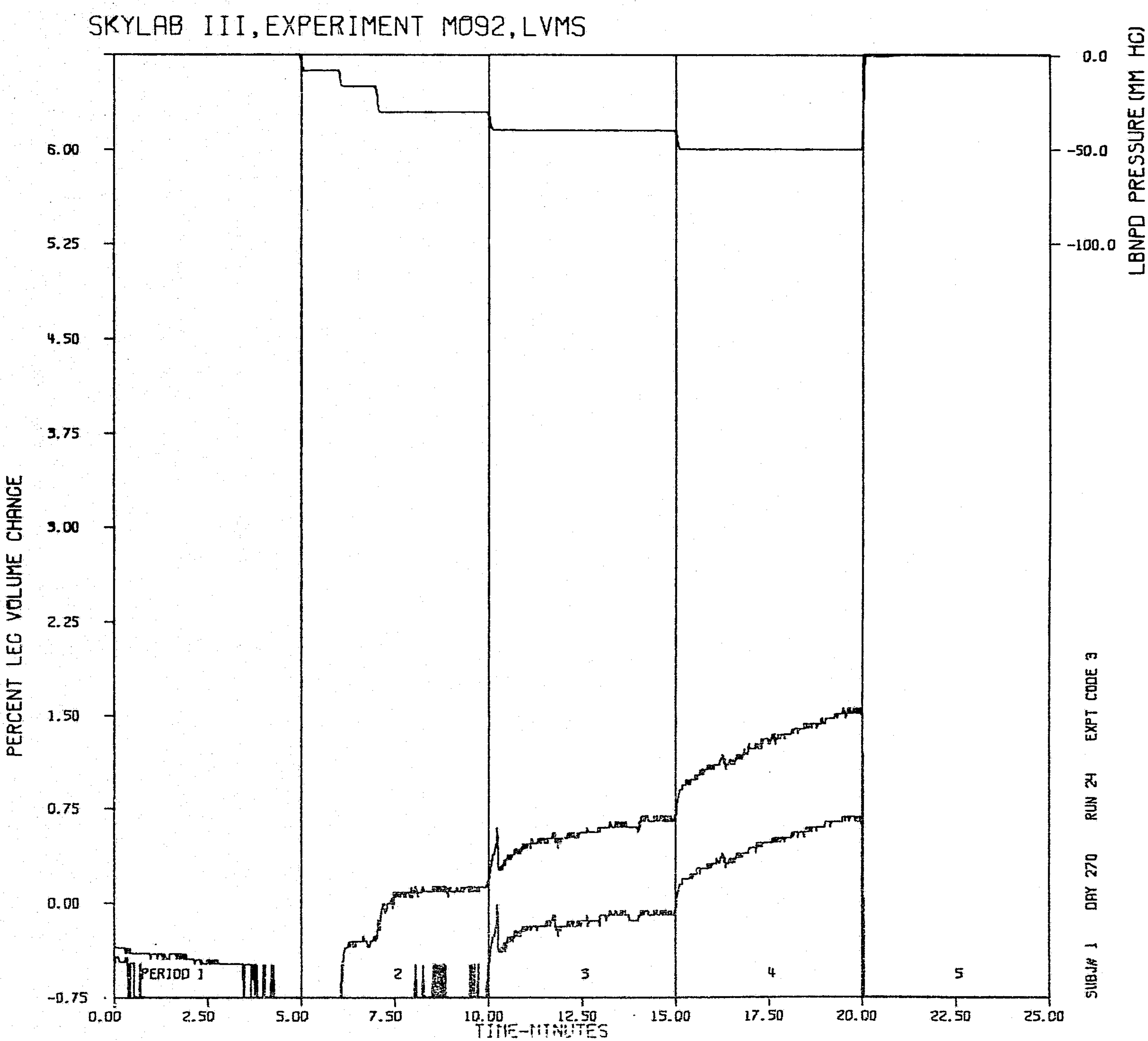

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 1 DAY 260 RUN 20 EXPT CODE 2

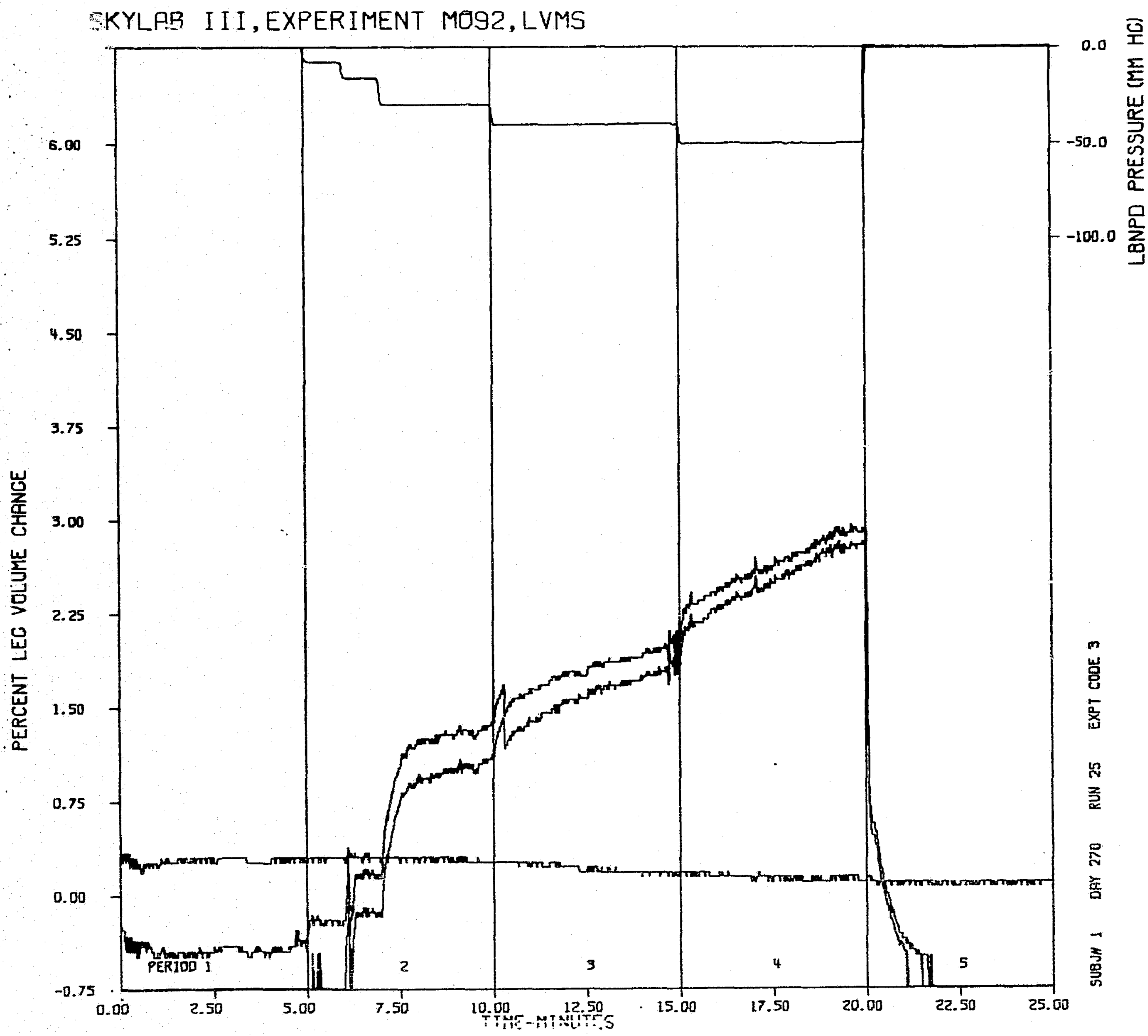

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
TIME-MINUTES
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
SUBJ# 1
DAY 263
RUN 21
EXPT CODE 2

SKYLAB III, EXPERIMENT M092, LVMS

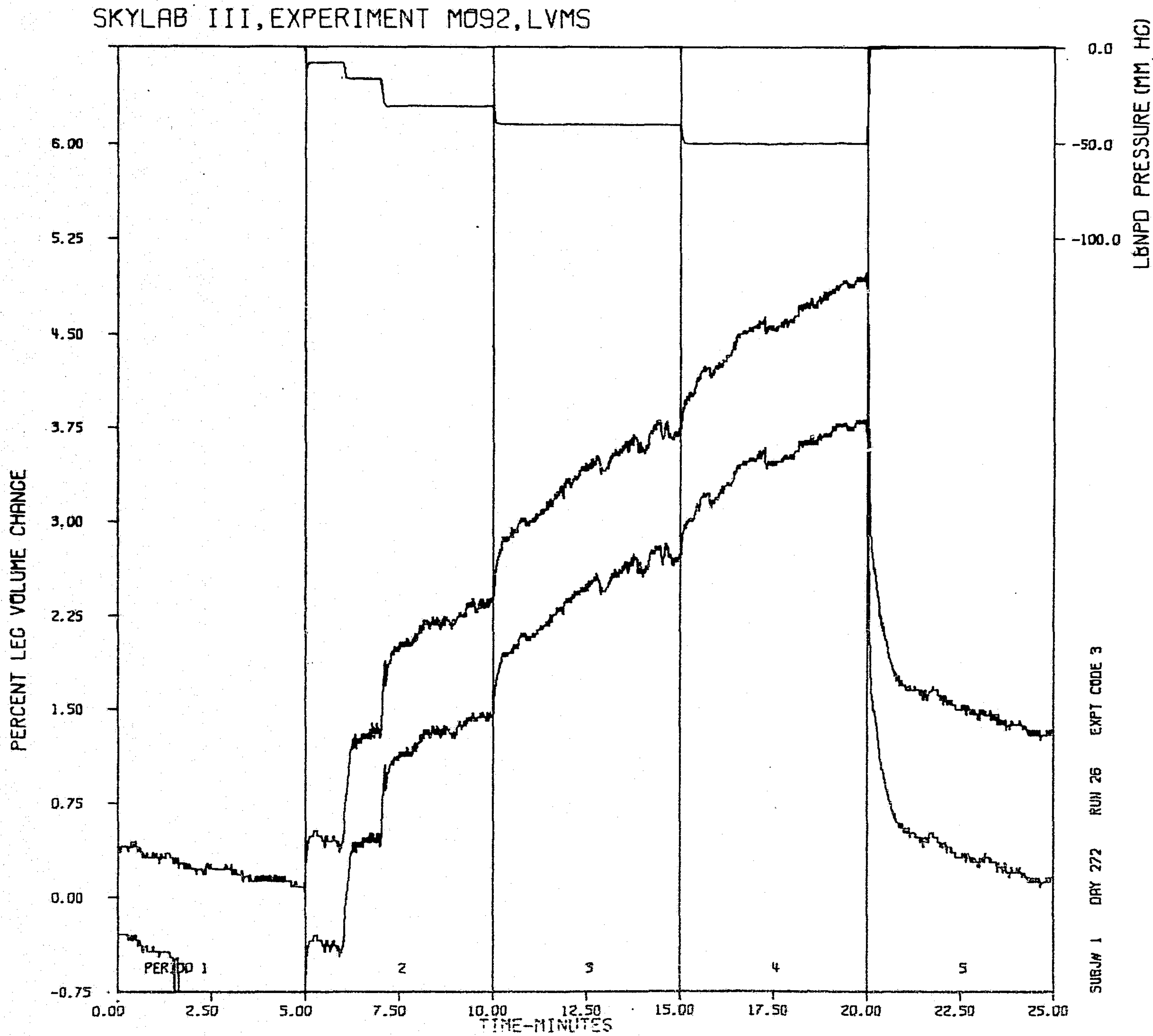



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJW 1 DAY 269 RUN 23 EXPT CODE 3

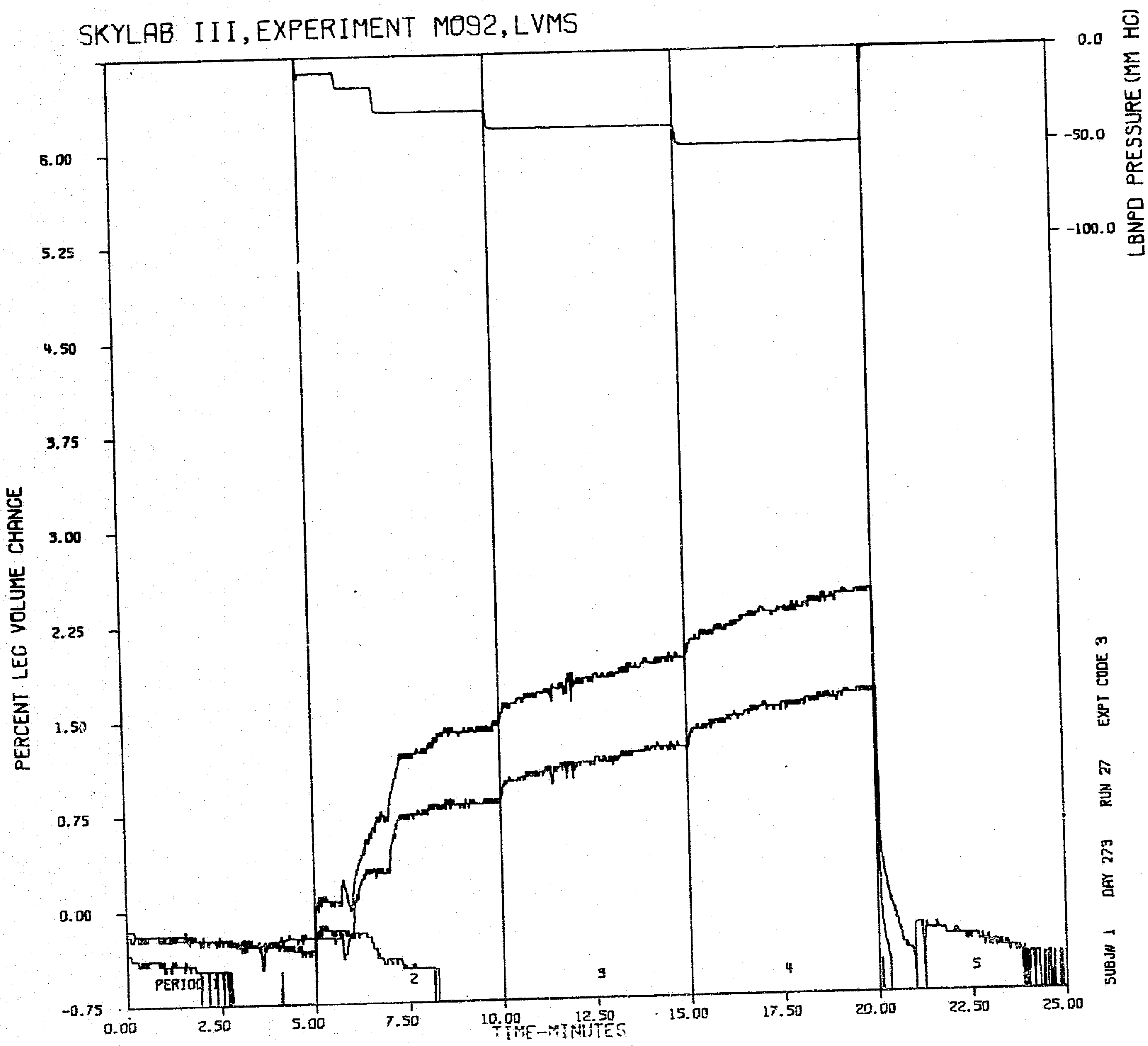

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 270 RUN 24 EXPT CODE 3



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
LBNPD PRESSURE (MM HG)
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 1 DAY 270 RUN 25 EXPT CODE 3

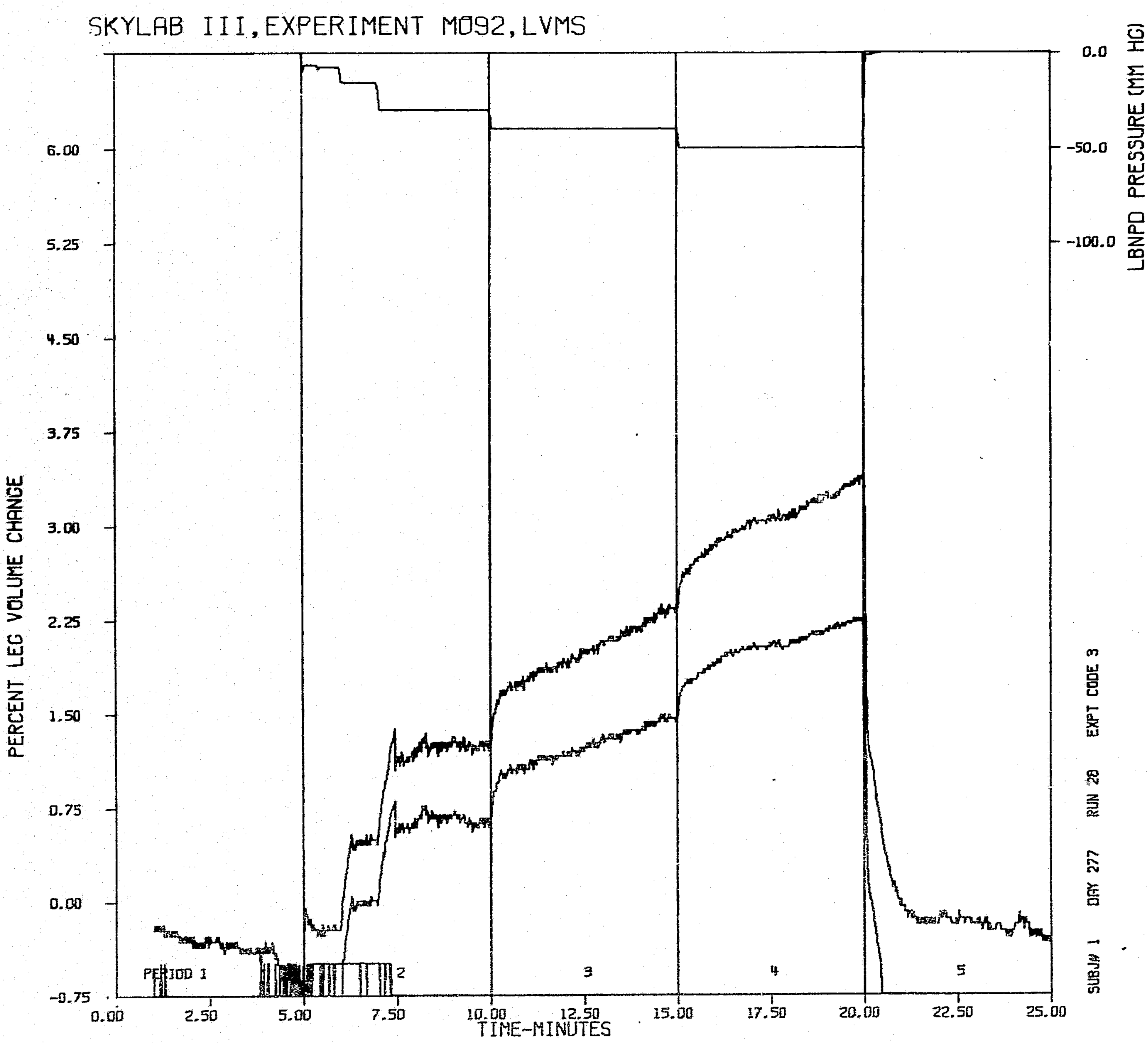


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 272 RUN 26 EXPT CODE 3

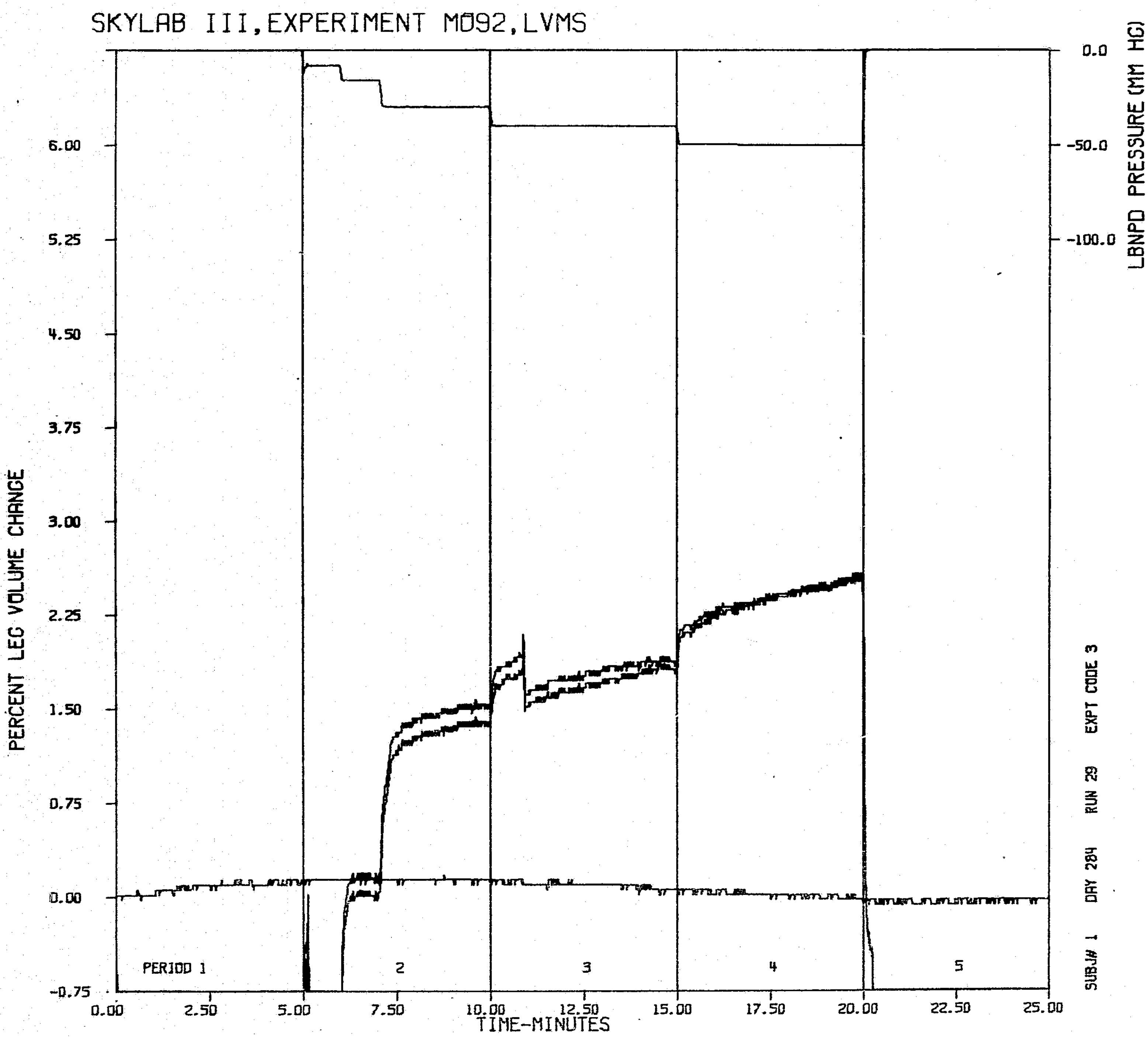


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1
DAY 273
RUN 27
EXPT CODE 3

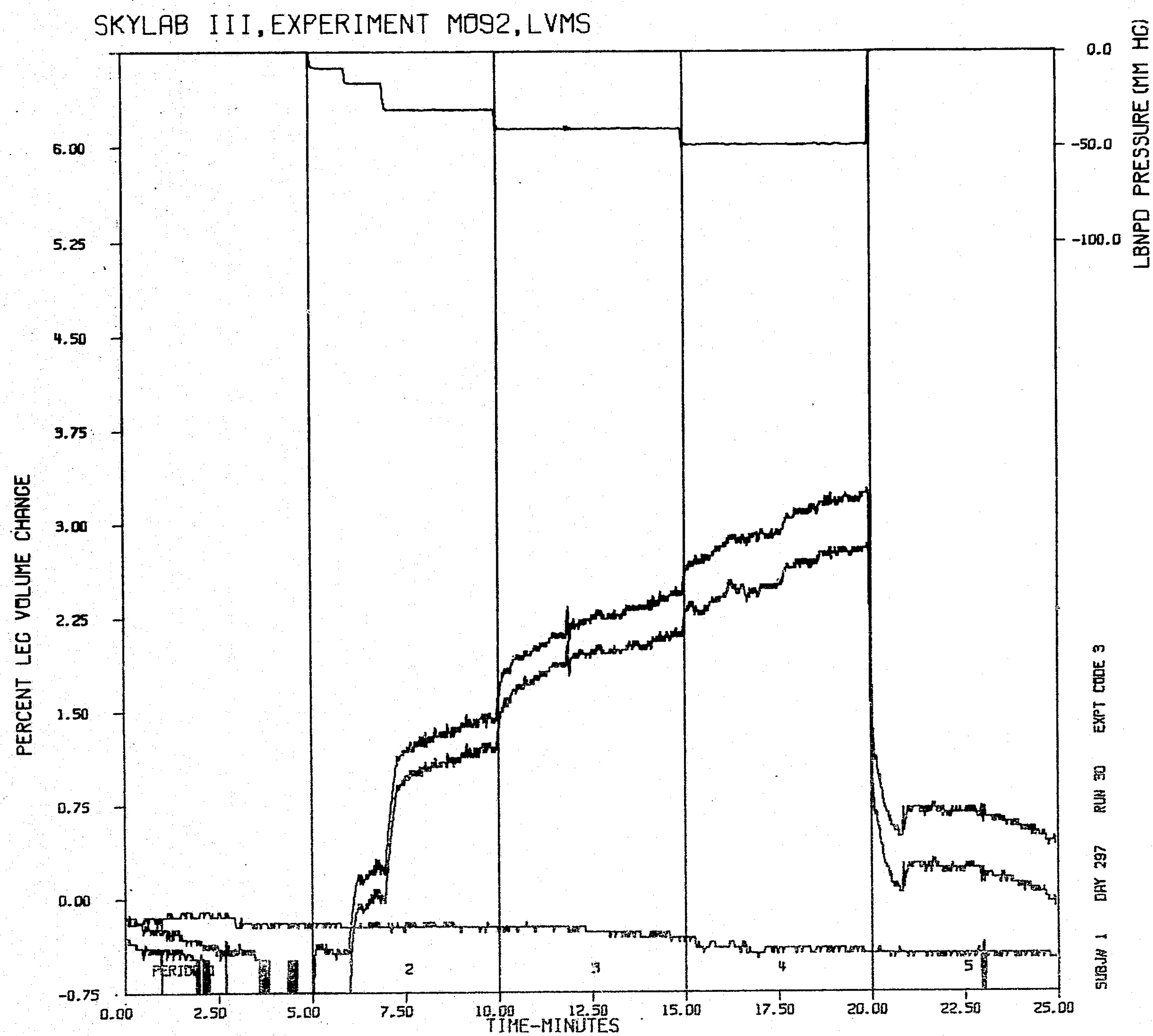
B-26

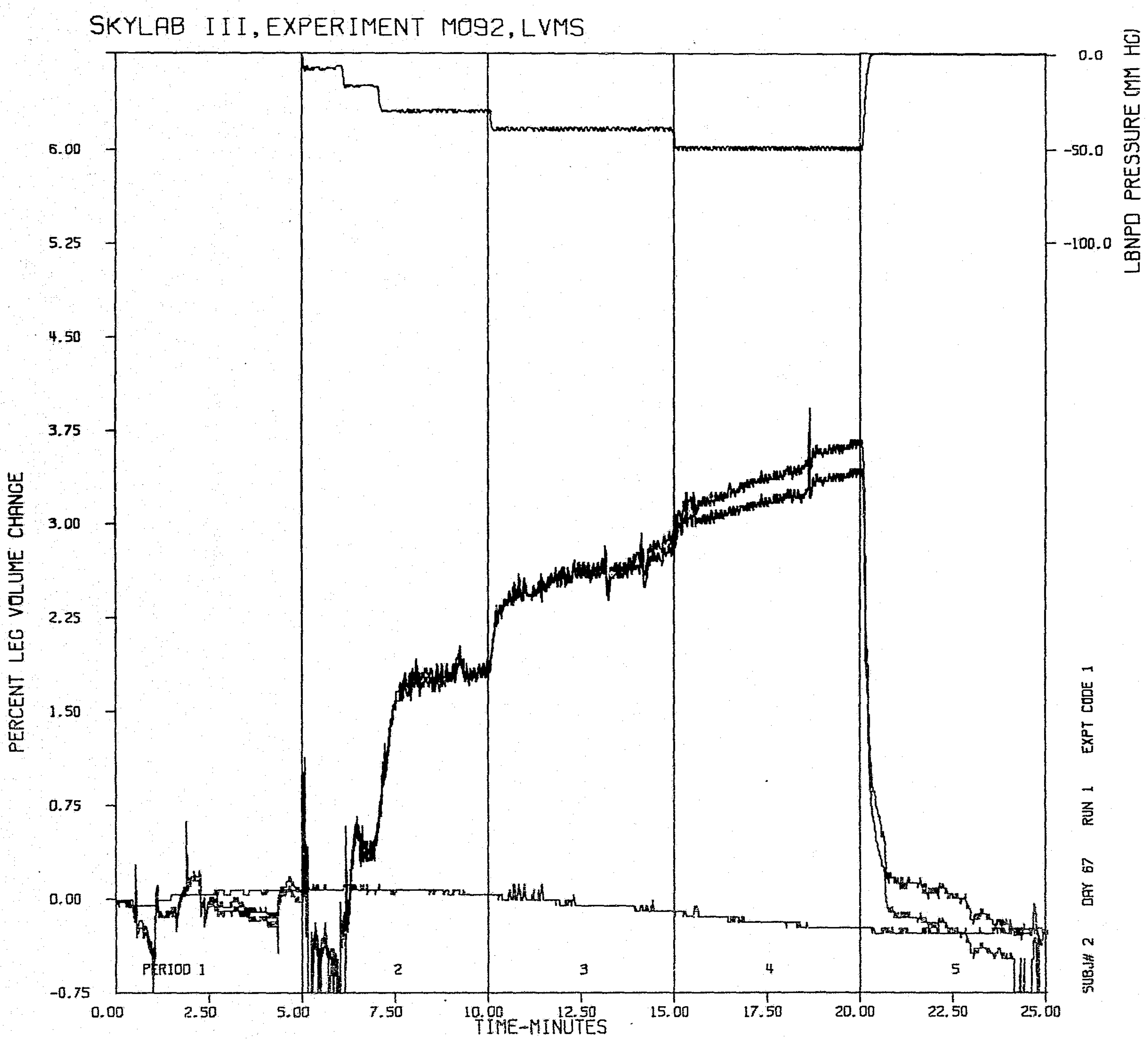


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 277 RUN 28 EXPT CODE 3

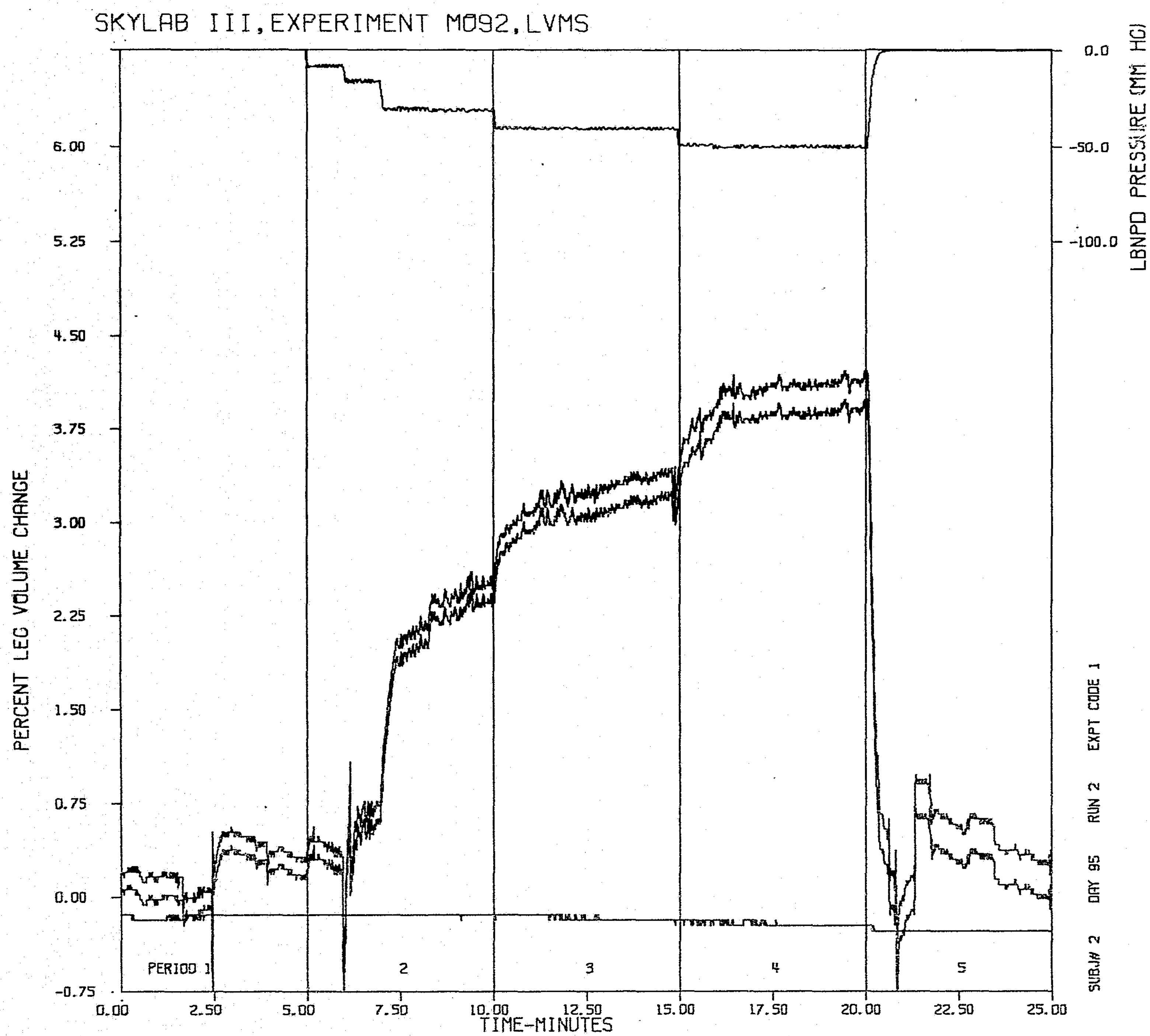

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 284 RUN 29 EXPT CODE 3
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00

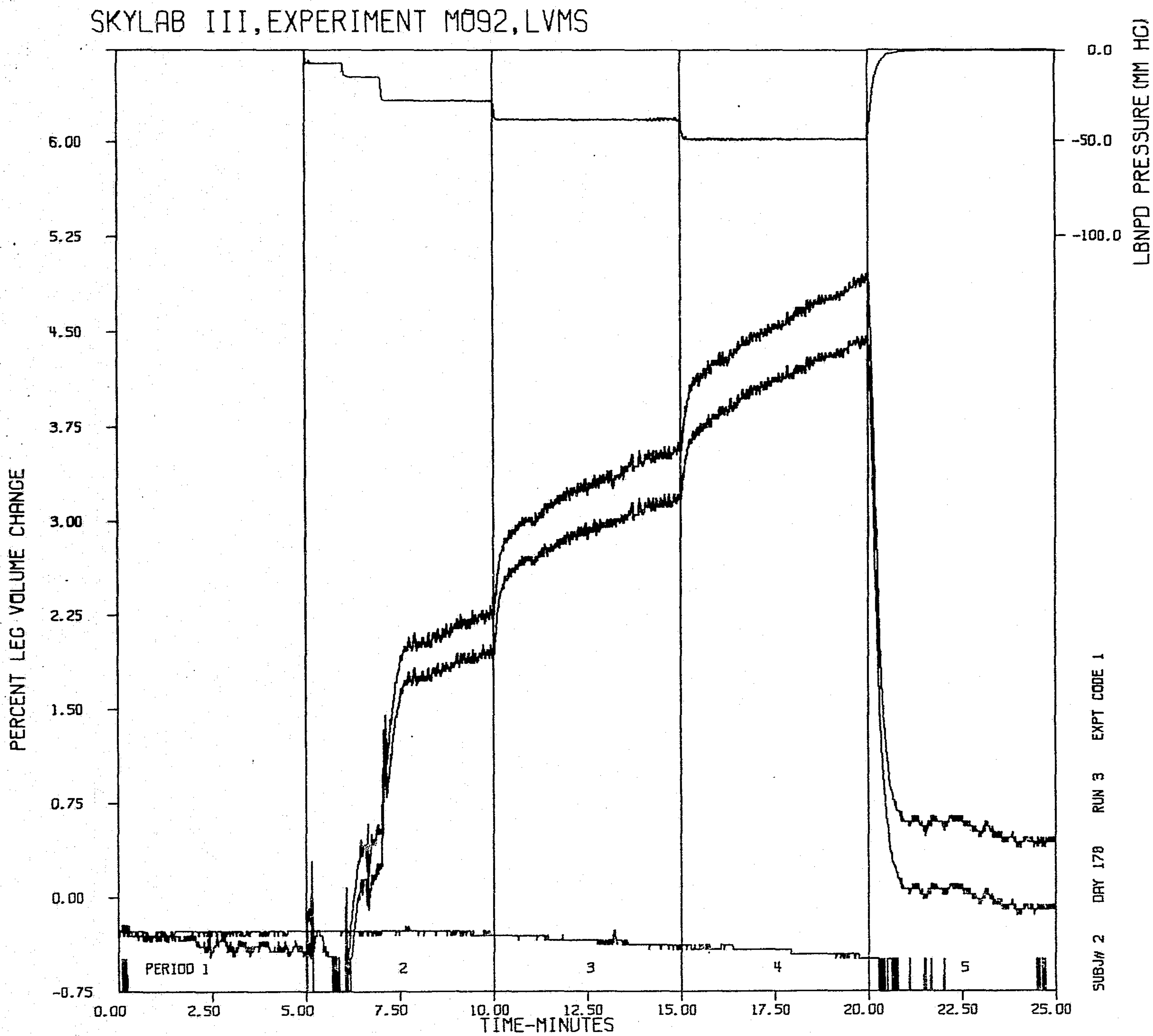
B-28

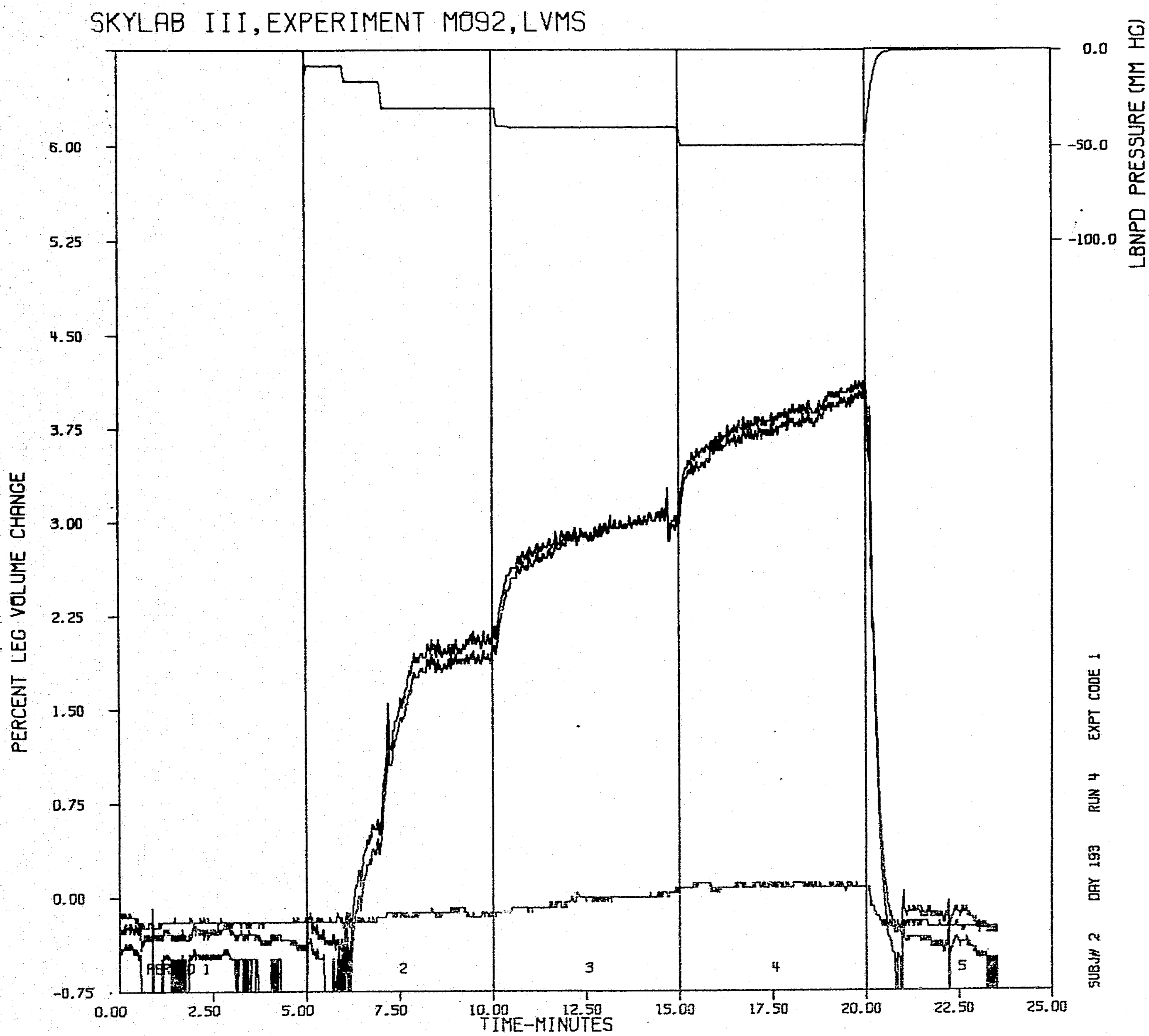

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1
DAY 297
RUN 30
EXPT CODE 3



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
EXPT CODE 1
RUN 1
DAY 67
SUBJ# 2

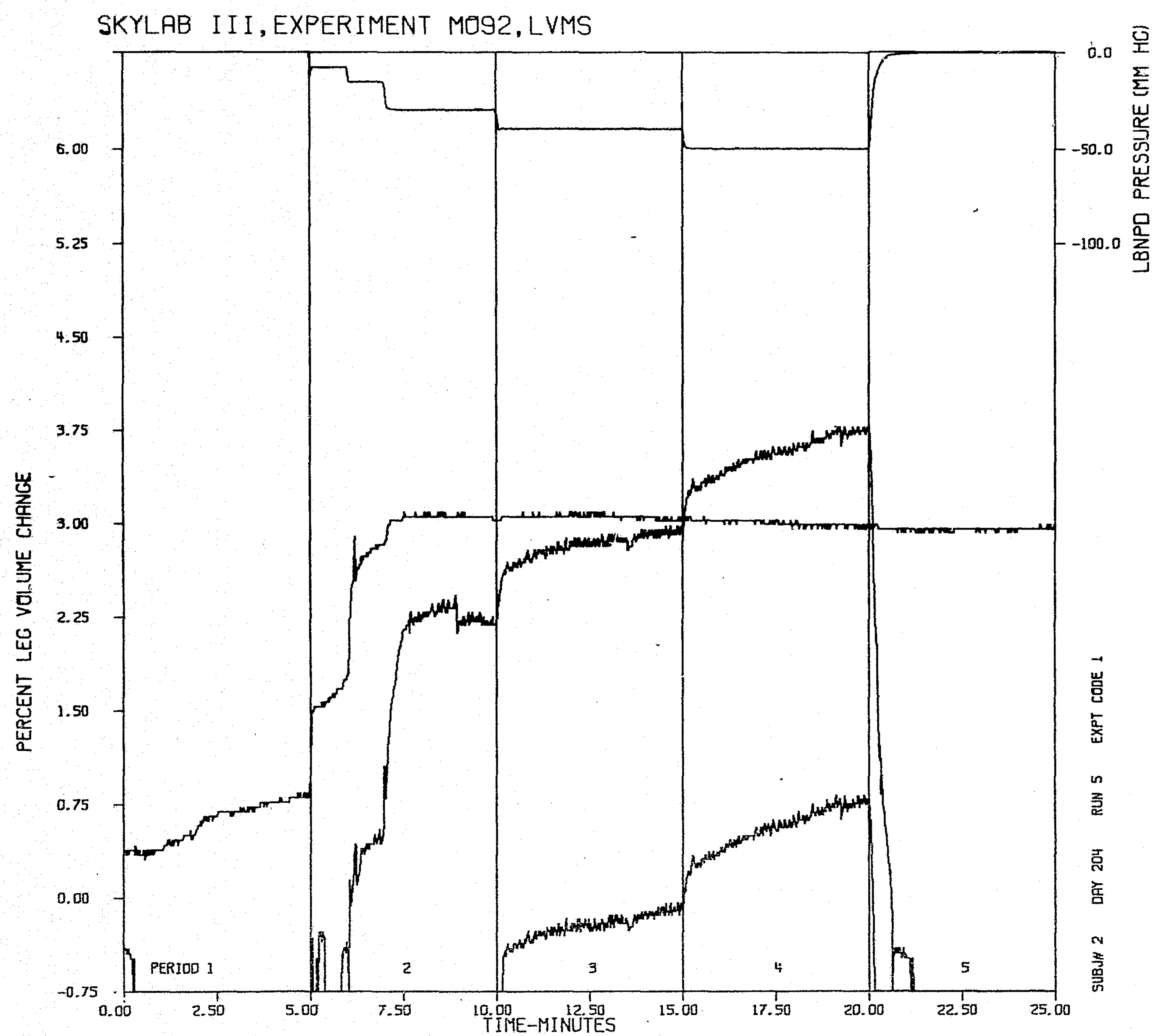

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 95 RUN 2 EXPT CODE 1


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
EXPT CODE 1
RUN 3
DAY 178
SUBJ# 2



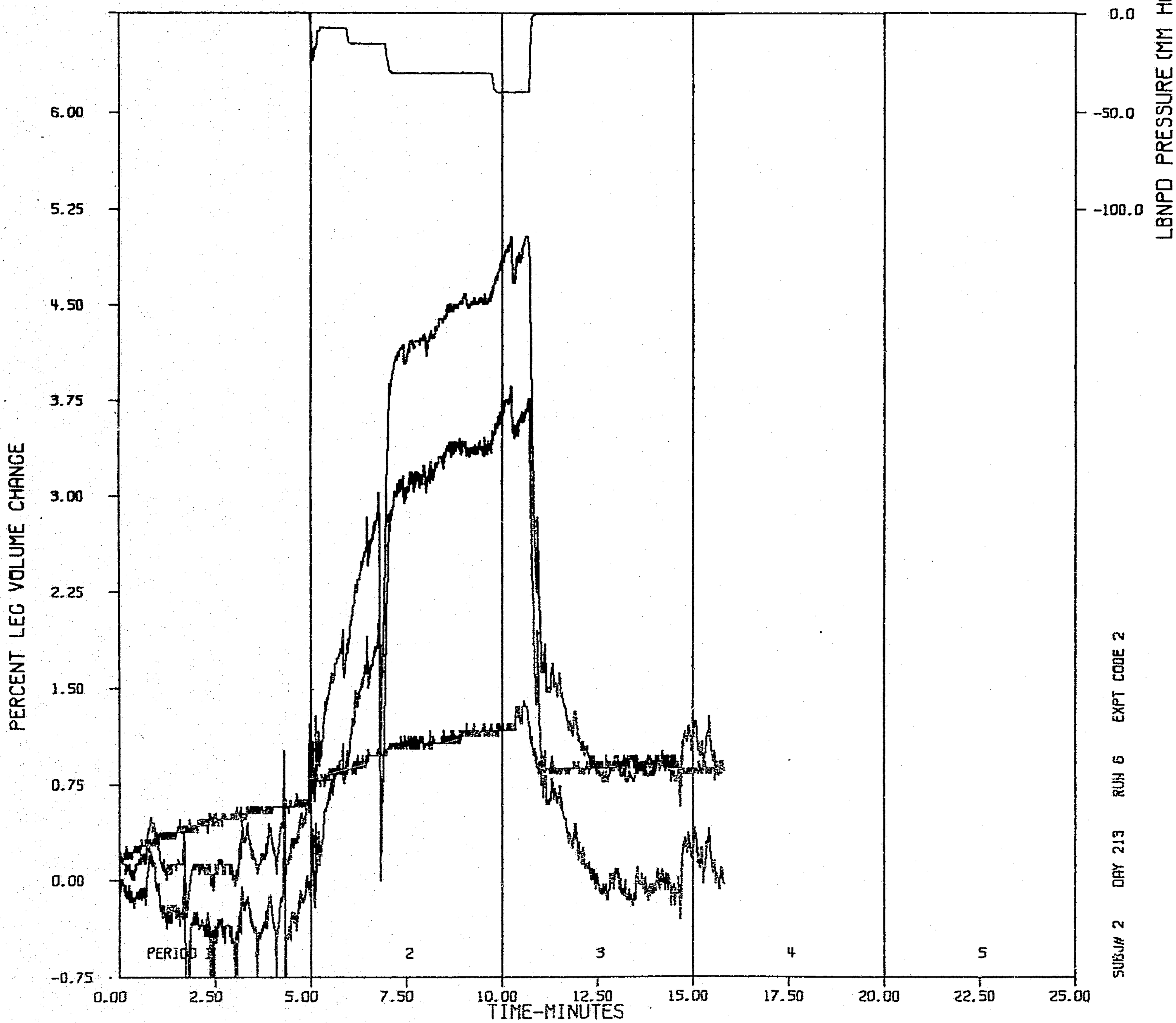
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 193 RUN 4 EXPT CODE 1

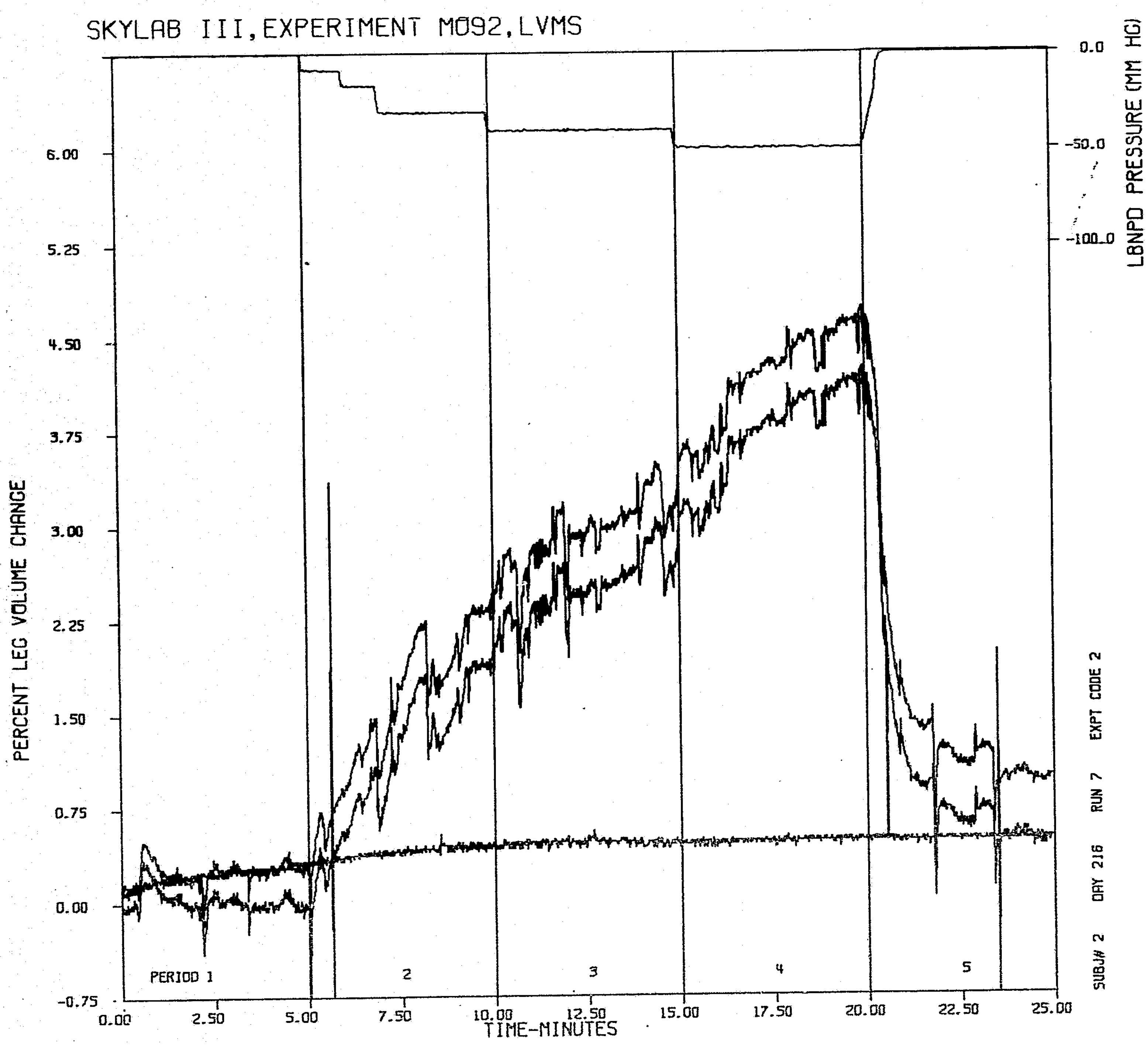
B-33

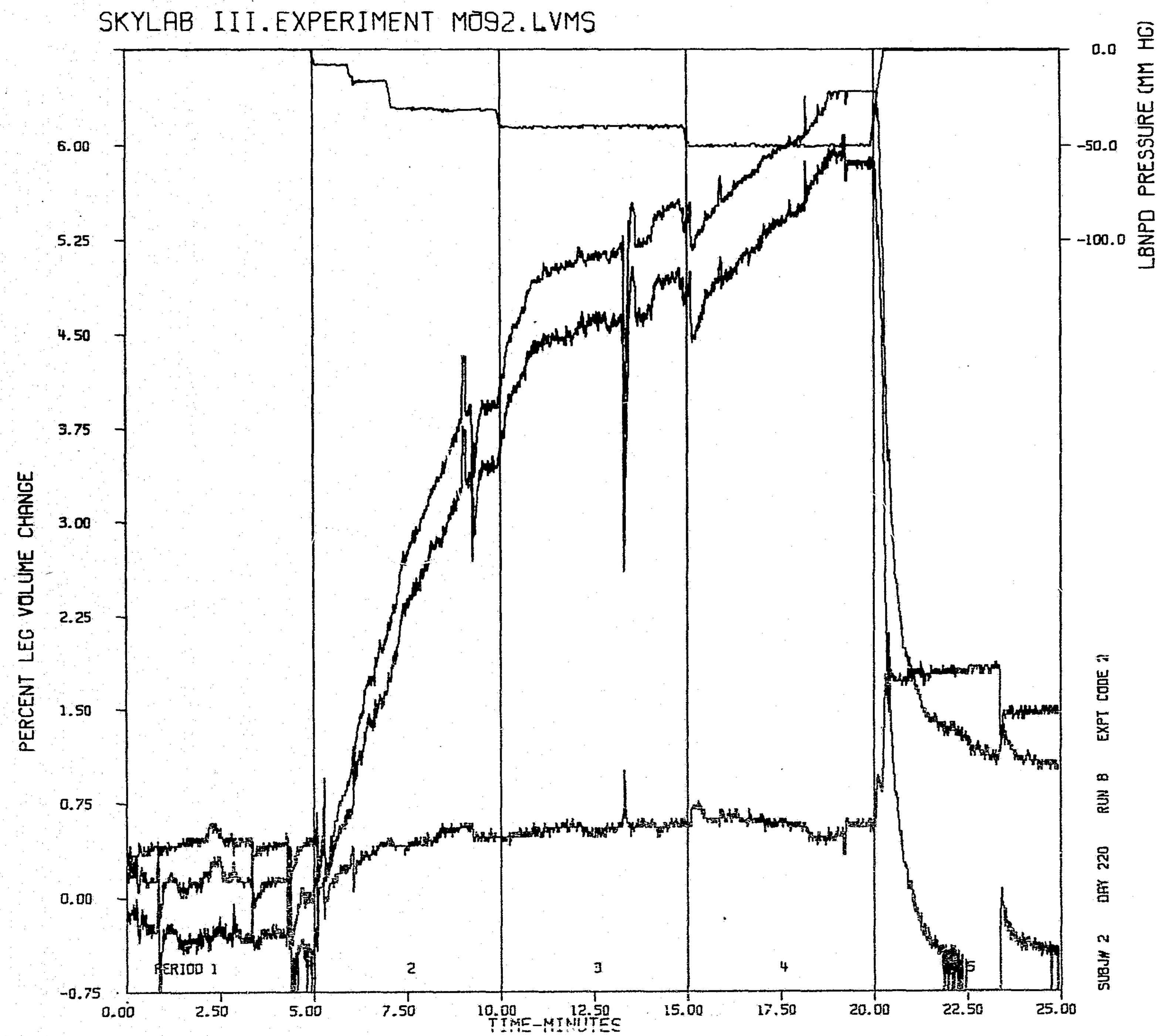


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 204 RUN 5 EXPT CODE 1
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00

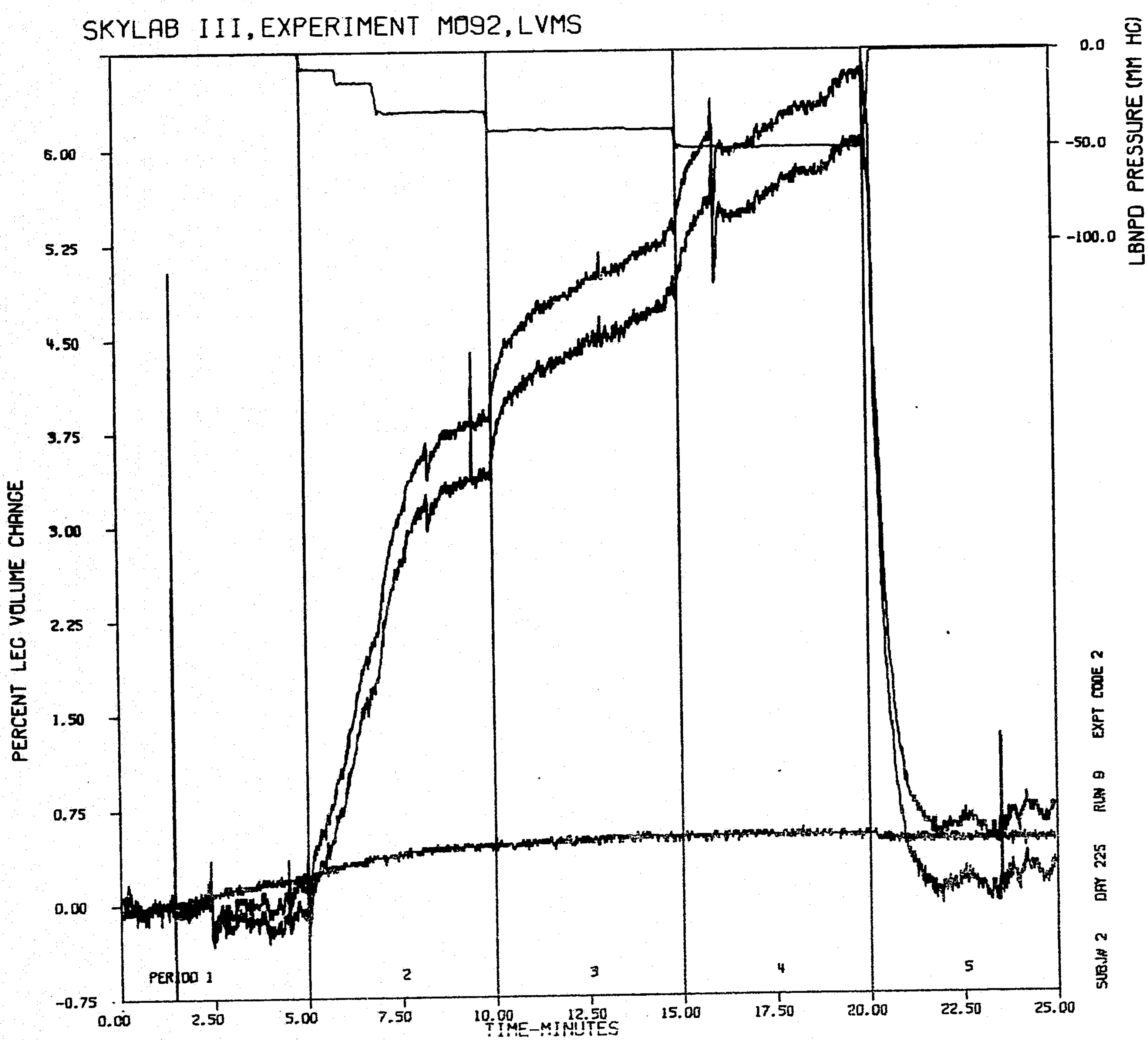
SKYLAB III, EXPERIMENT M092, LVMS



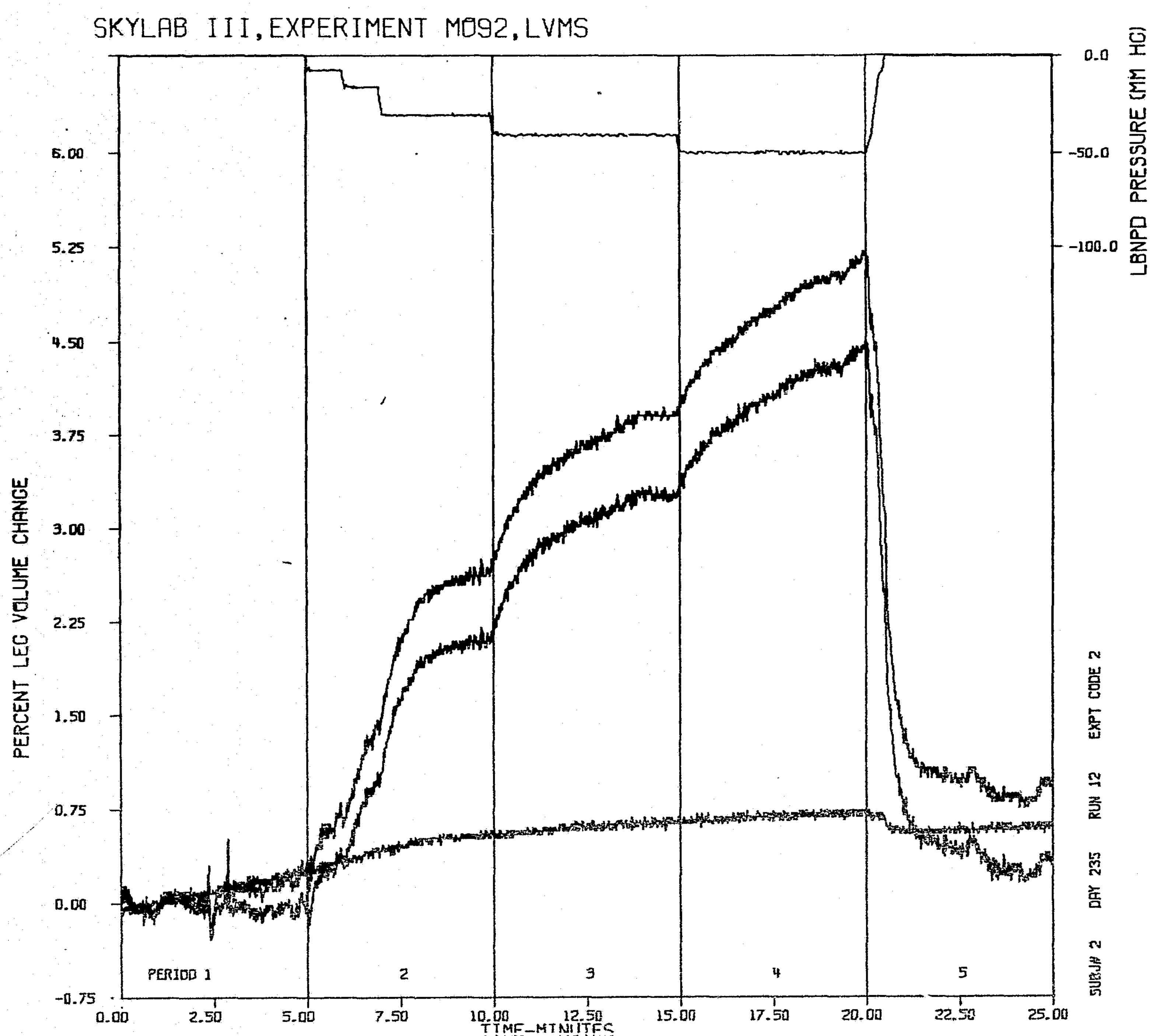

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2
DAY 216
RUN 7
EXPT CODE 2



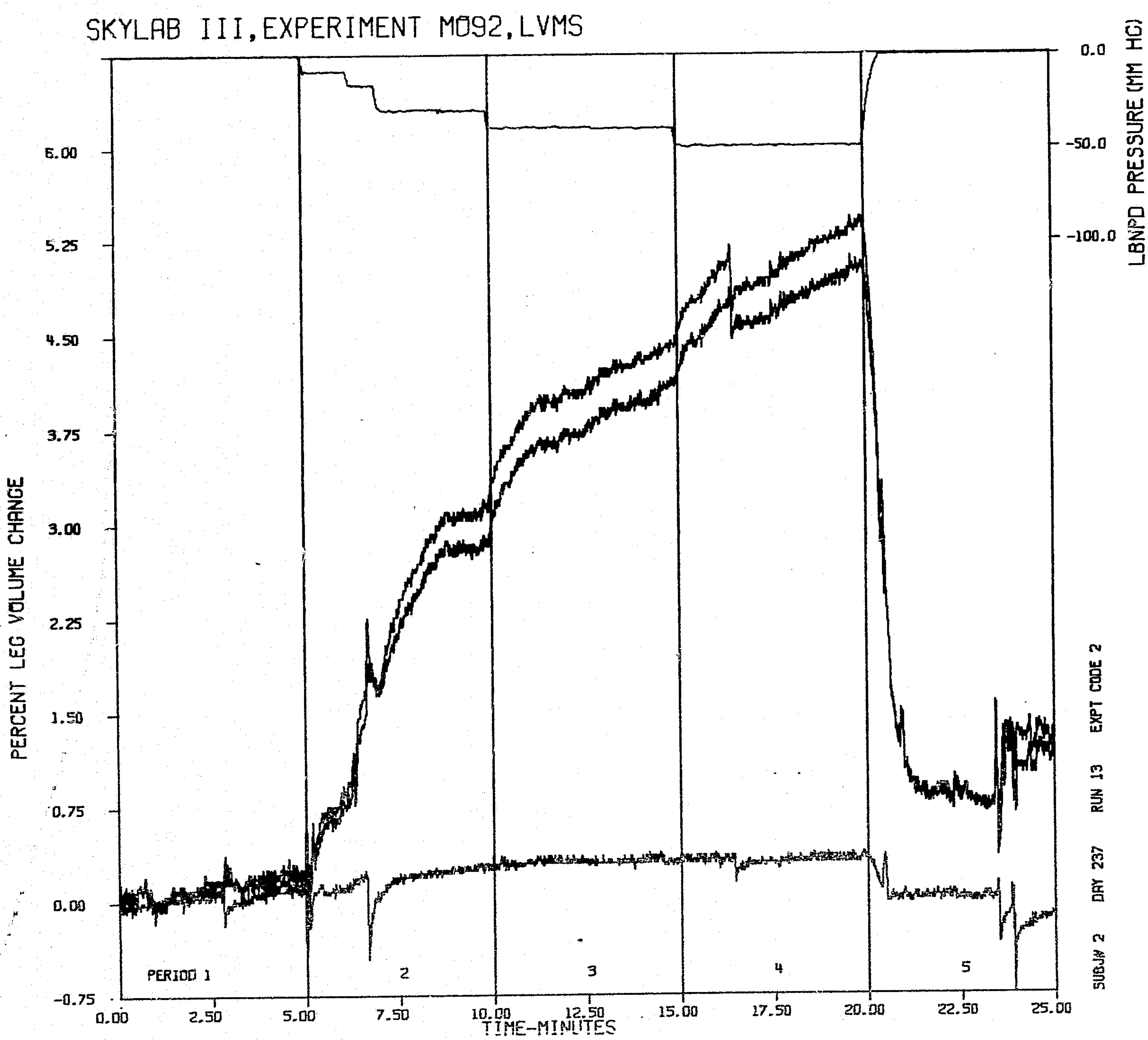
SKYLAB III.EXPERIMENT M092.LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 2
DAY 220
RUN 8
EXPT CODE 2



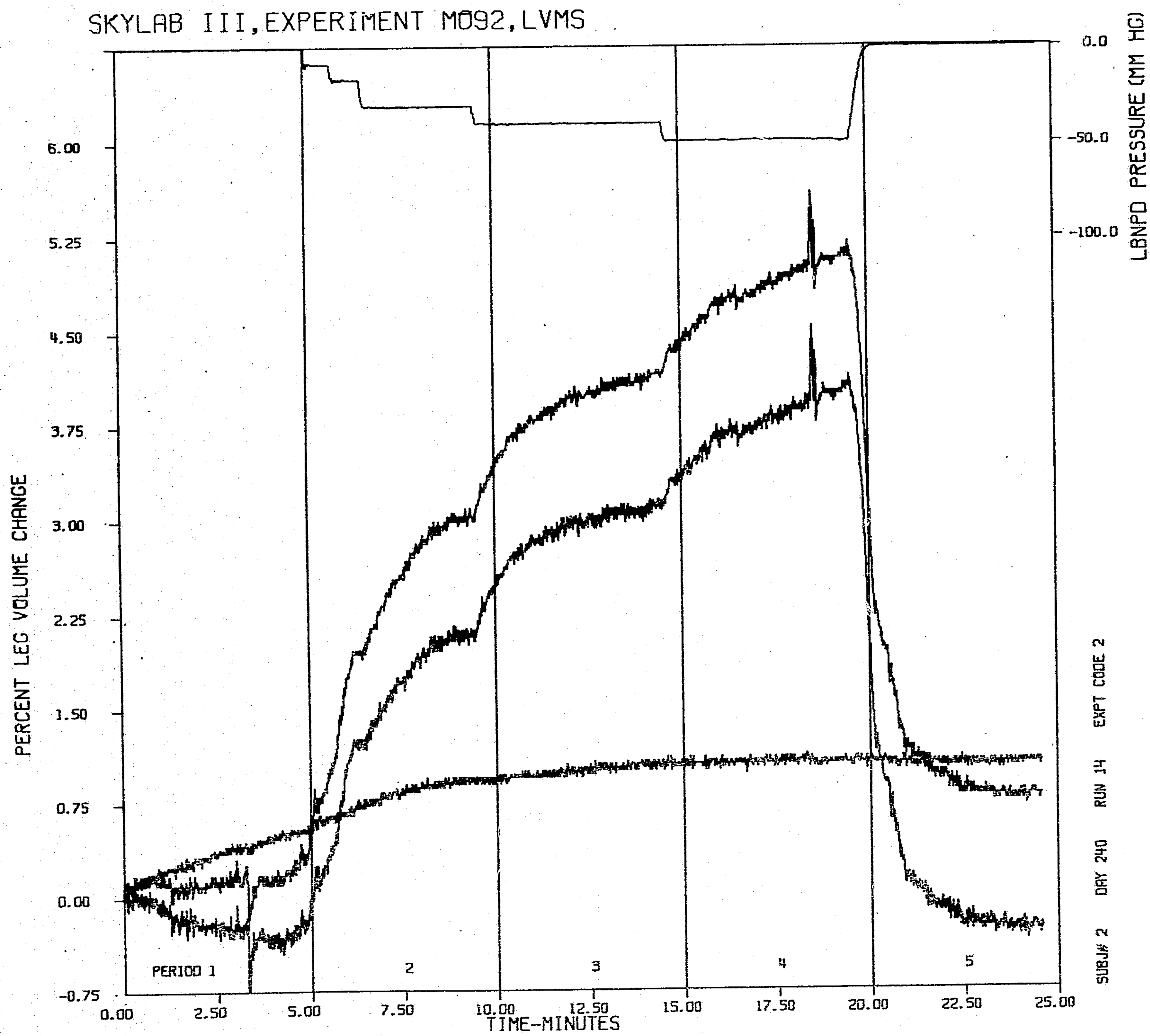
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2
DAY 225
RUN 9
EXPT CODE 2



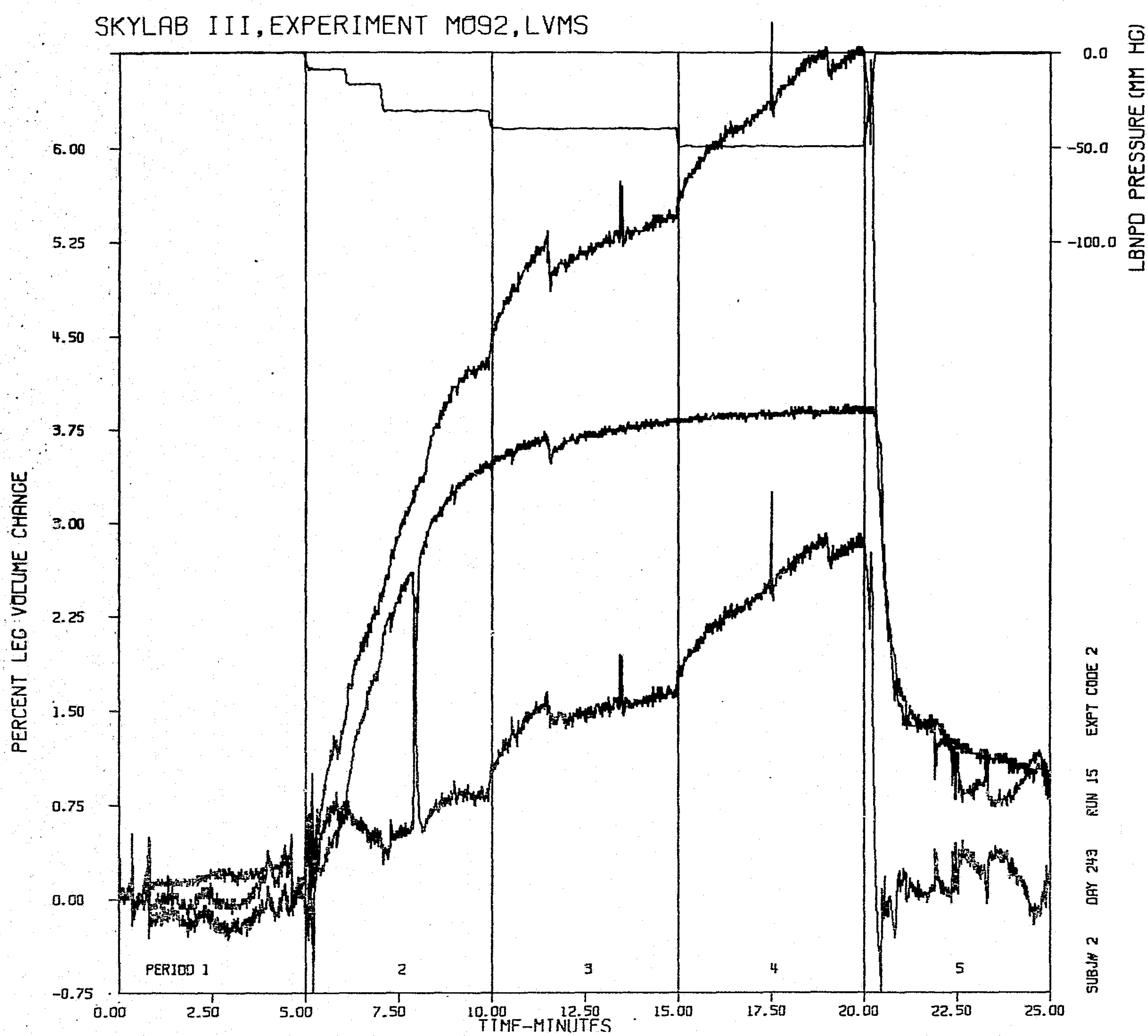
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
EXPT CODE 2
RUN 12
DAY 235
SUBJ# 2


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
PERIOD 1
2
3
4
5
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
EXPT CODE 2
RUN 13
DAY 237
SUBJ# 2

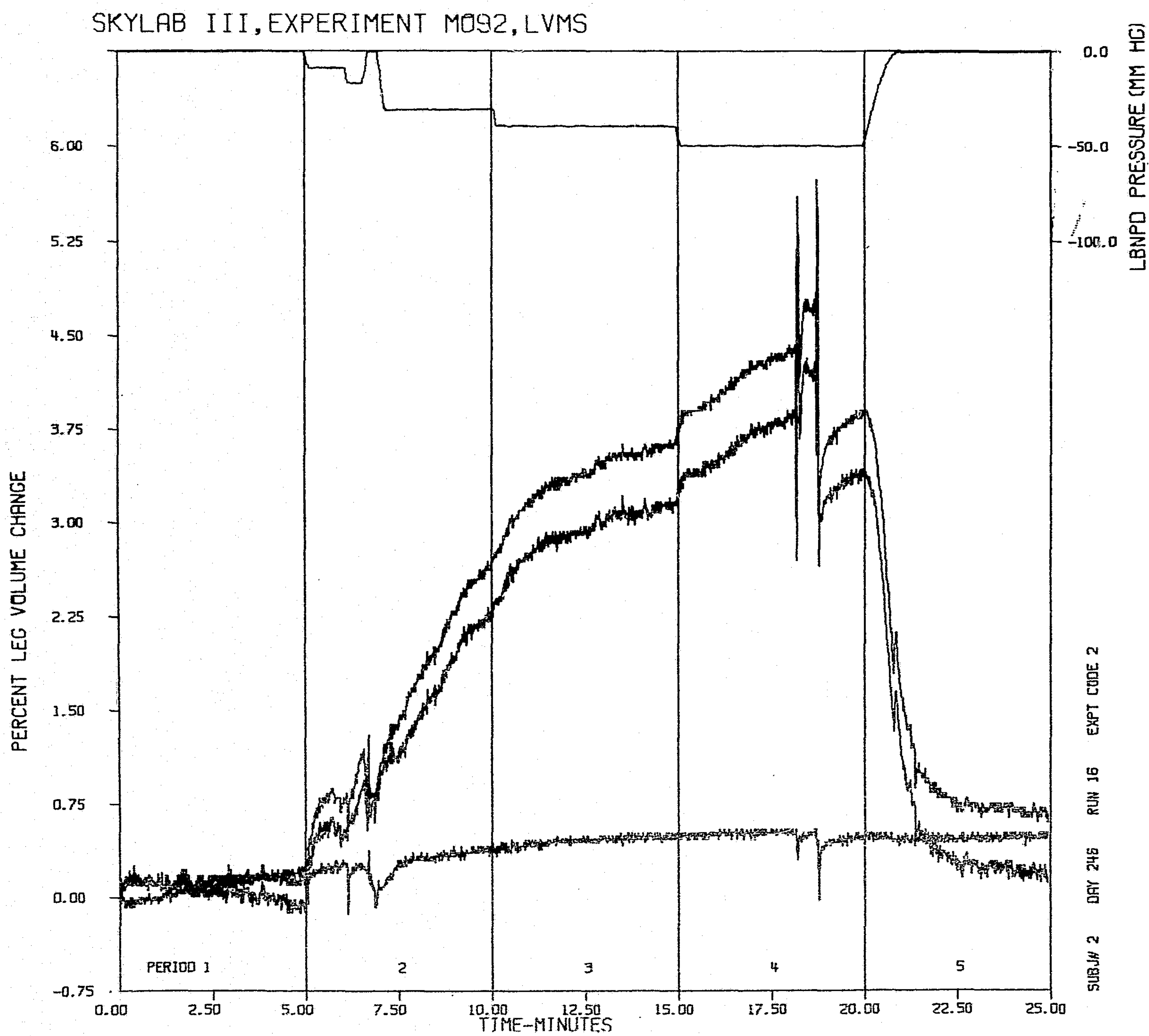
B-40



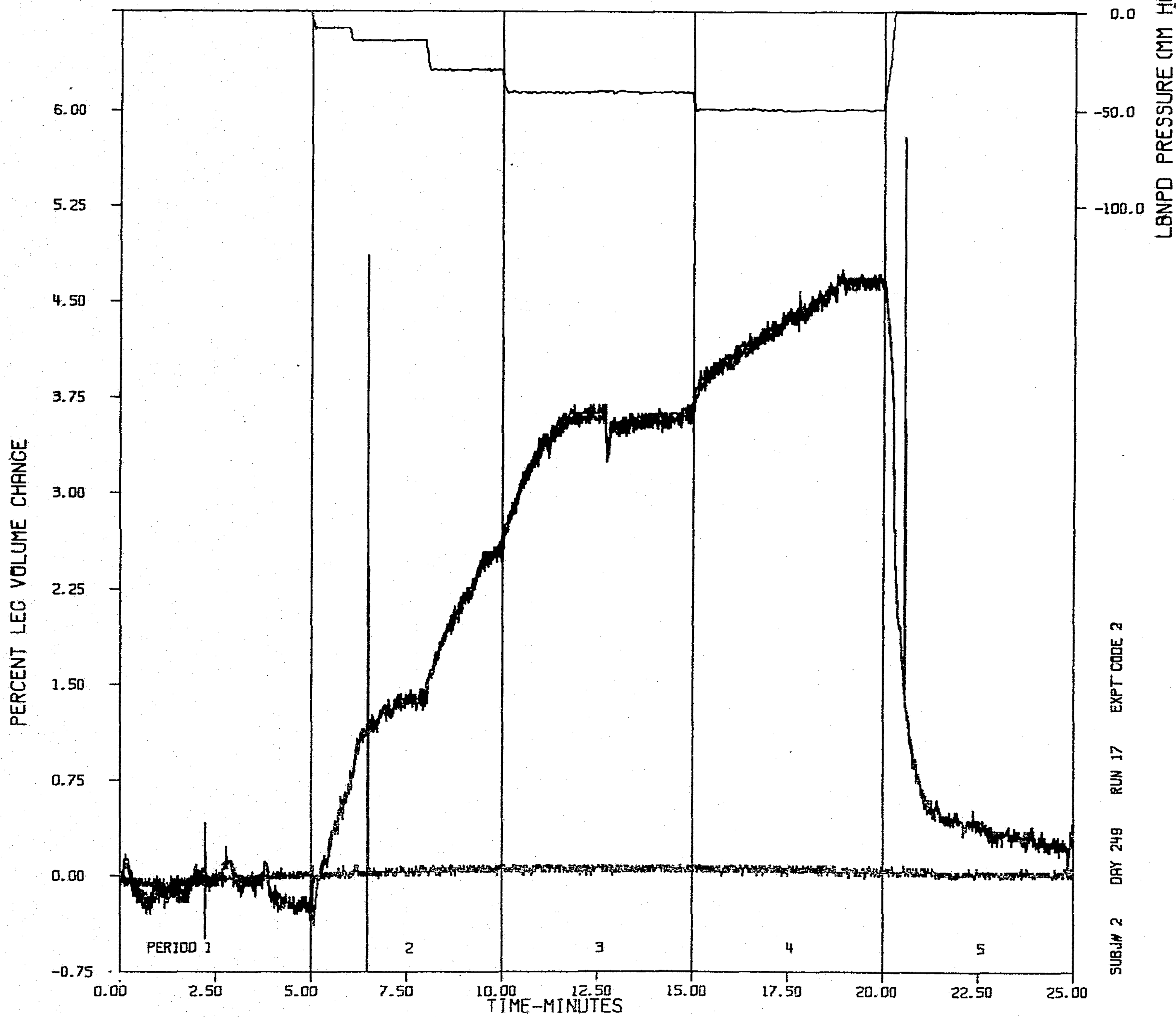
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
EXPT CODE 2
RUN 14
DAY 240
SUBJ# 2

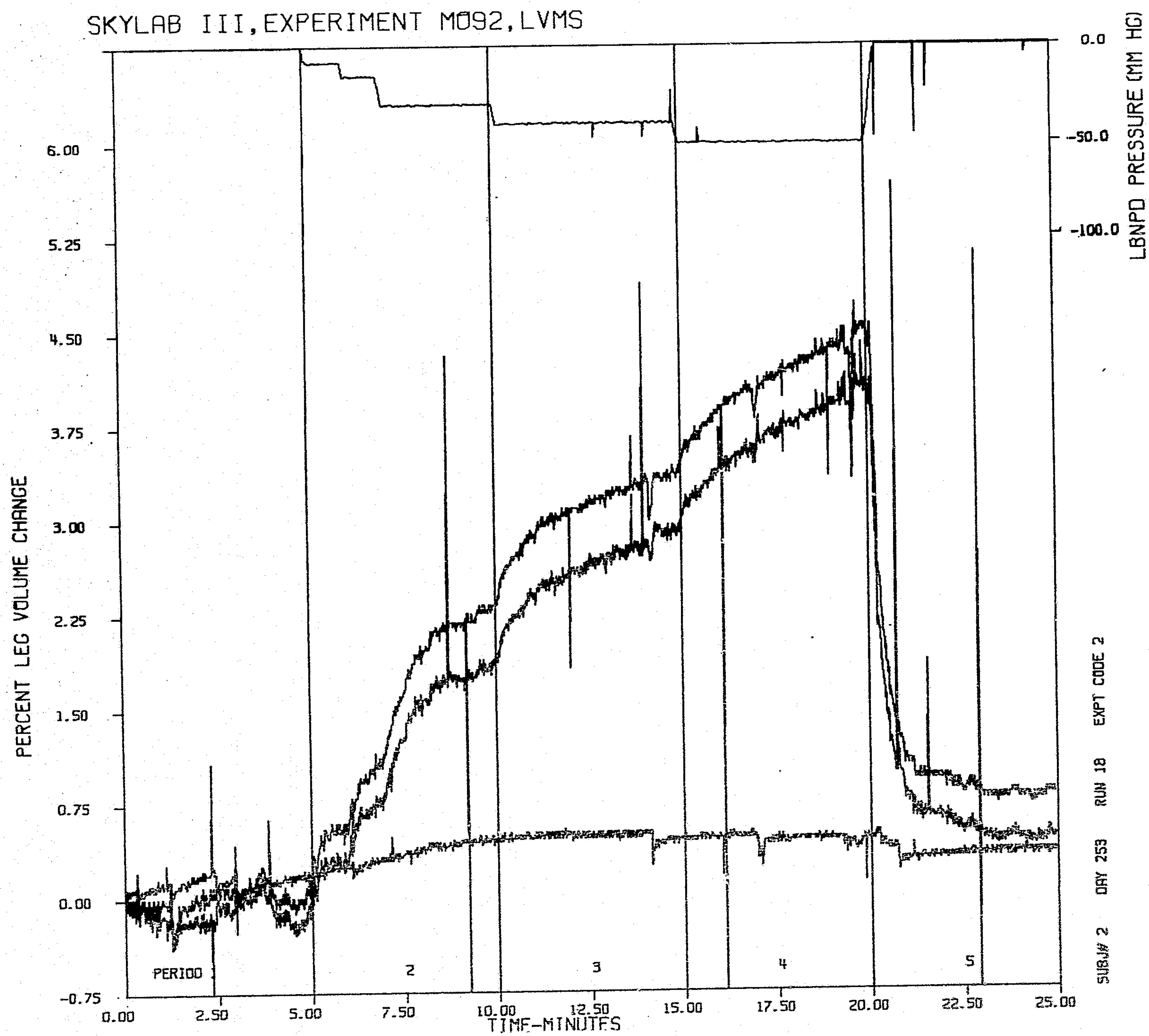


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 2 DAY 243 RUN 15 EXPT CODE 2


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 246 RUN 16 EXPT CODE 2

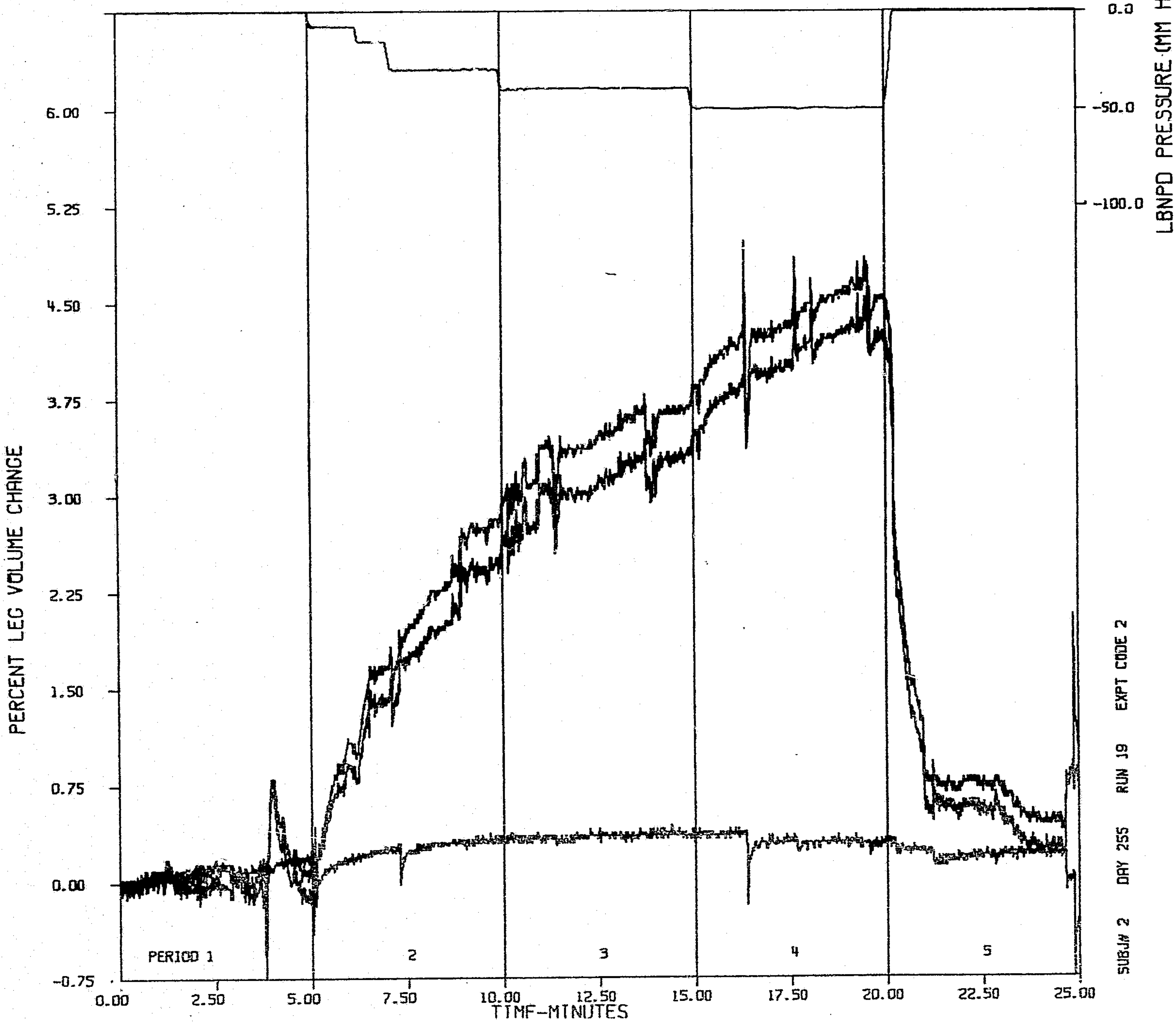
SKYLAB III, EXPERIMENT M092, LVMS



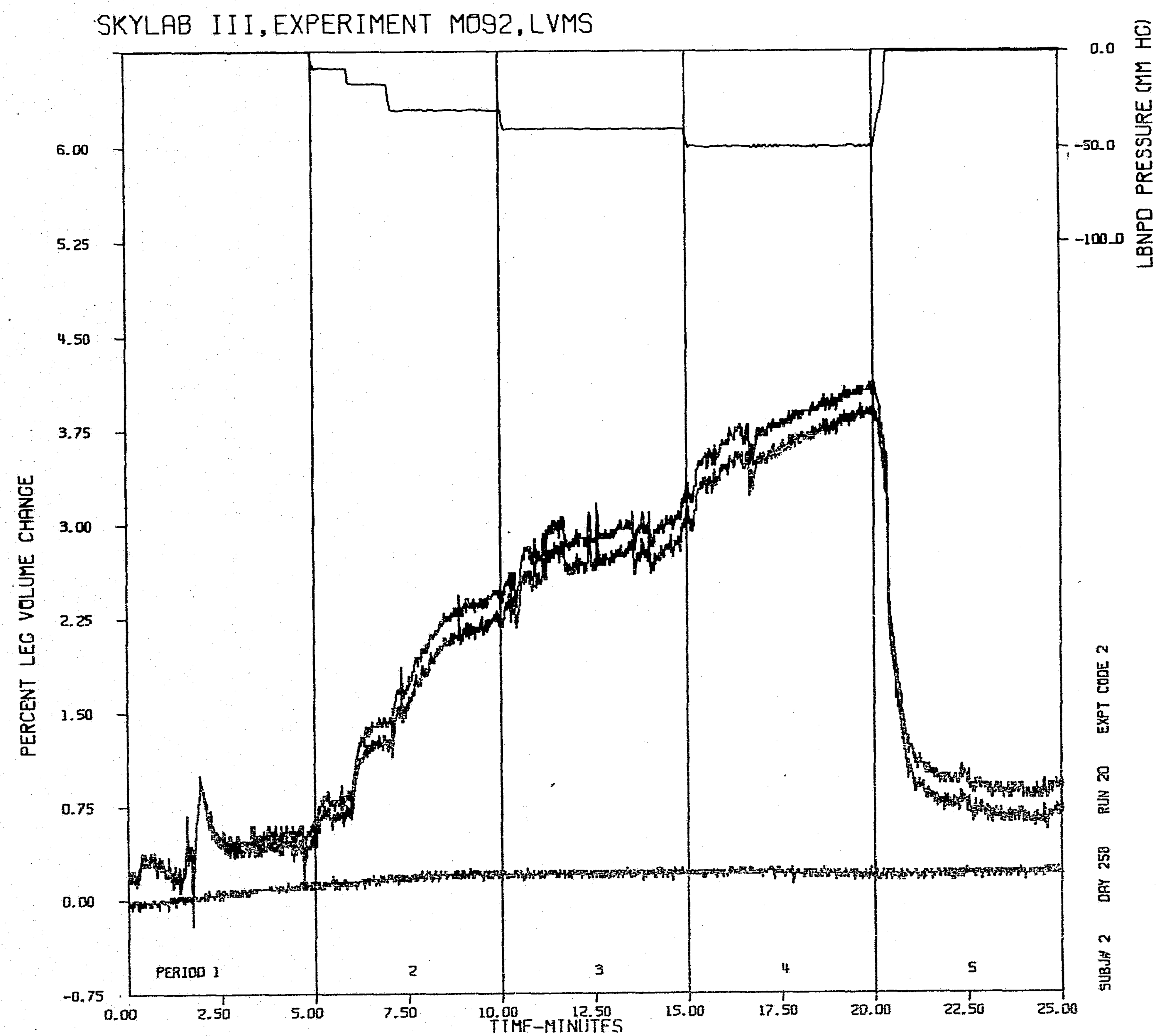

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
PERIOD
2
3
4
5
0.0
-50.0
-100.0
LBNPD PRESSURE (MM HG)
SUBJ# 2 DAY 253 RUN 18 EXPT CODE 2

B-45

SKYLAB III, EXPERIMENT M092, LVMS

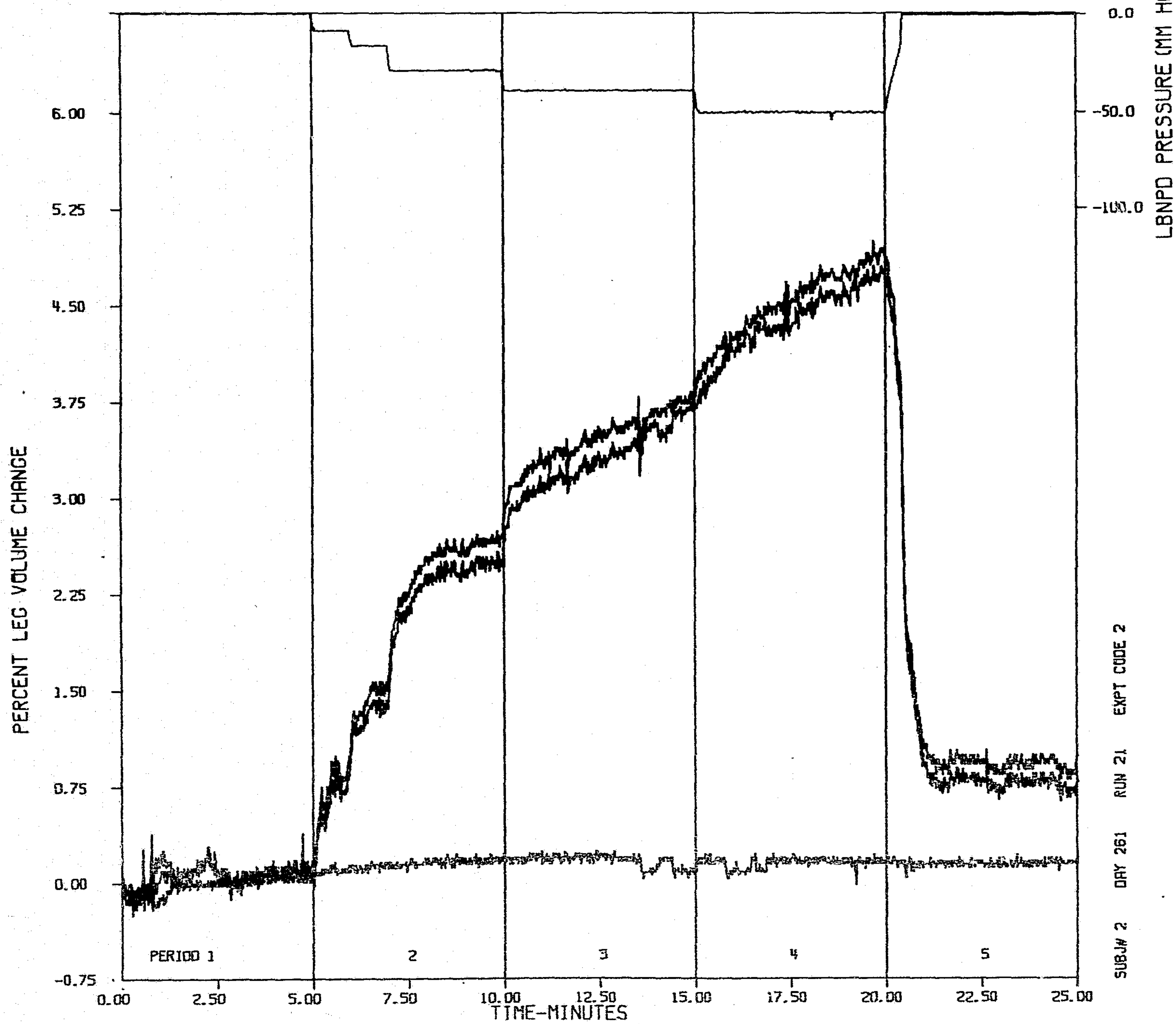


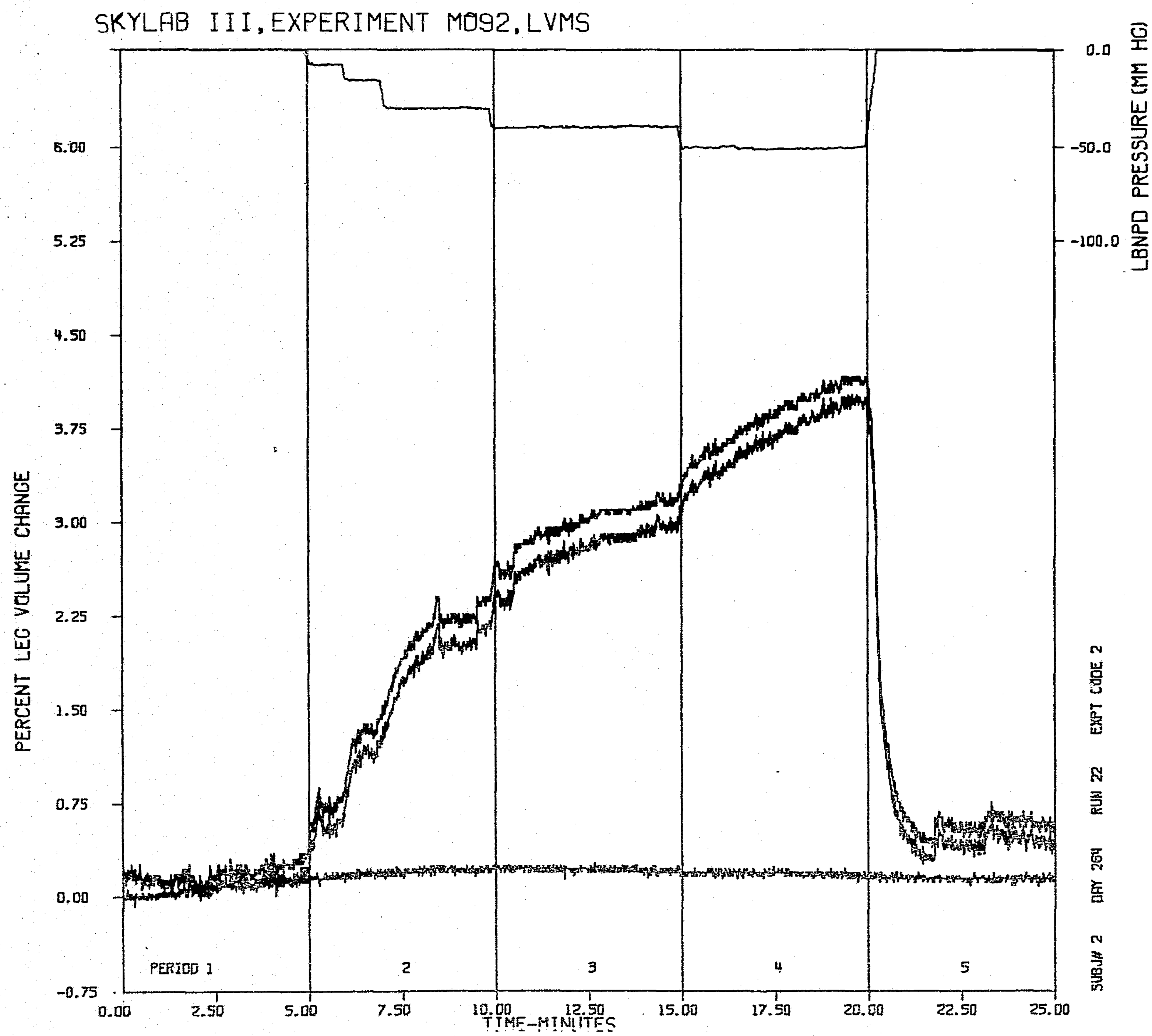
B-46

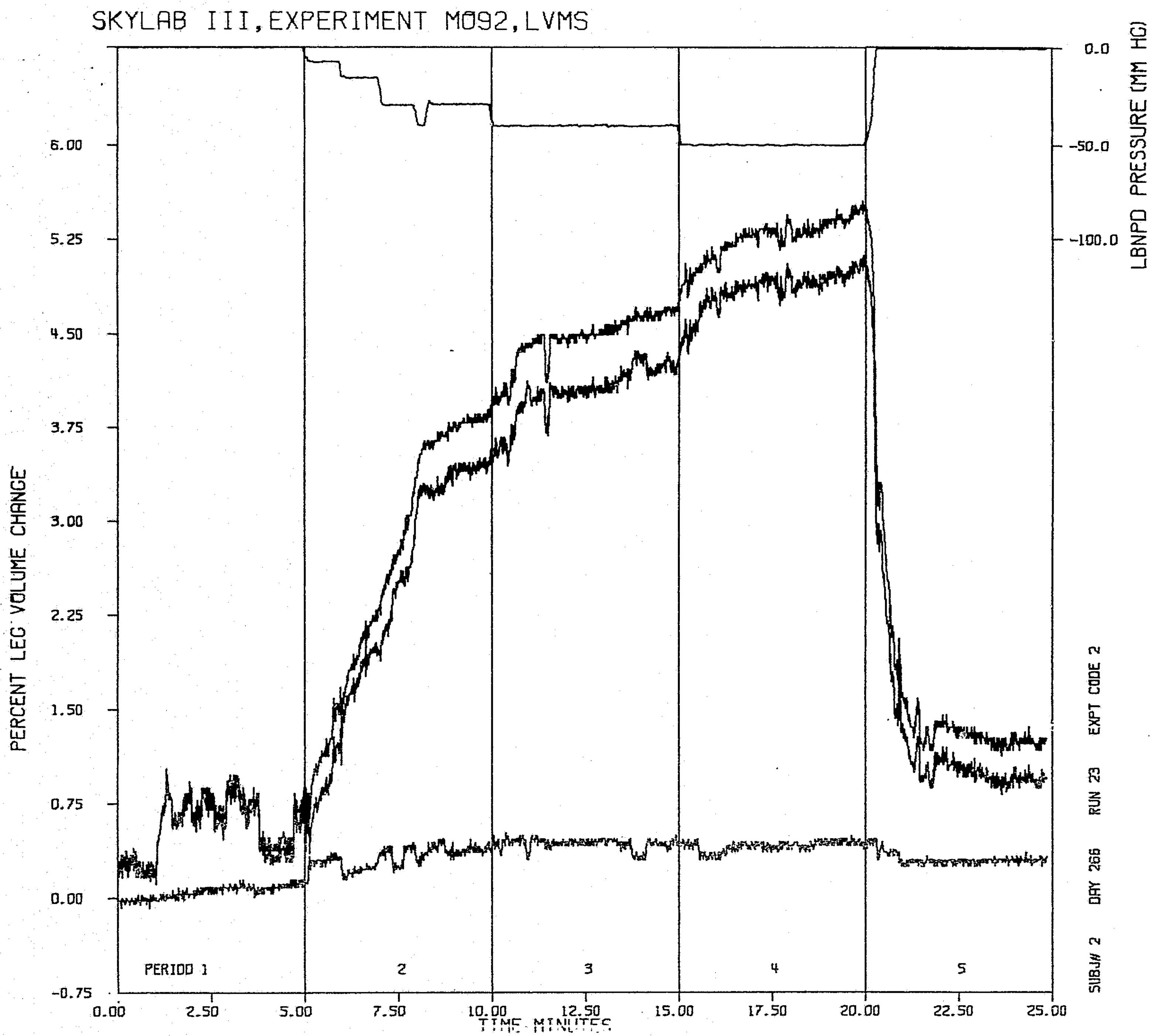


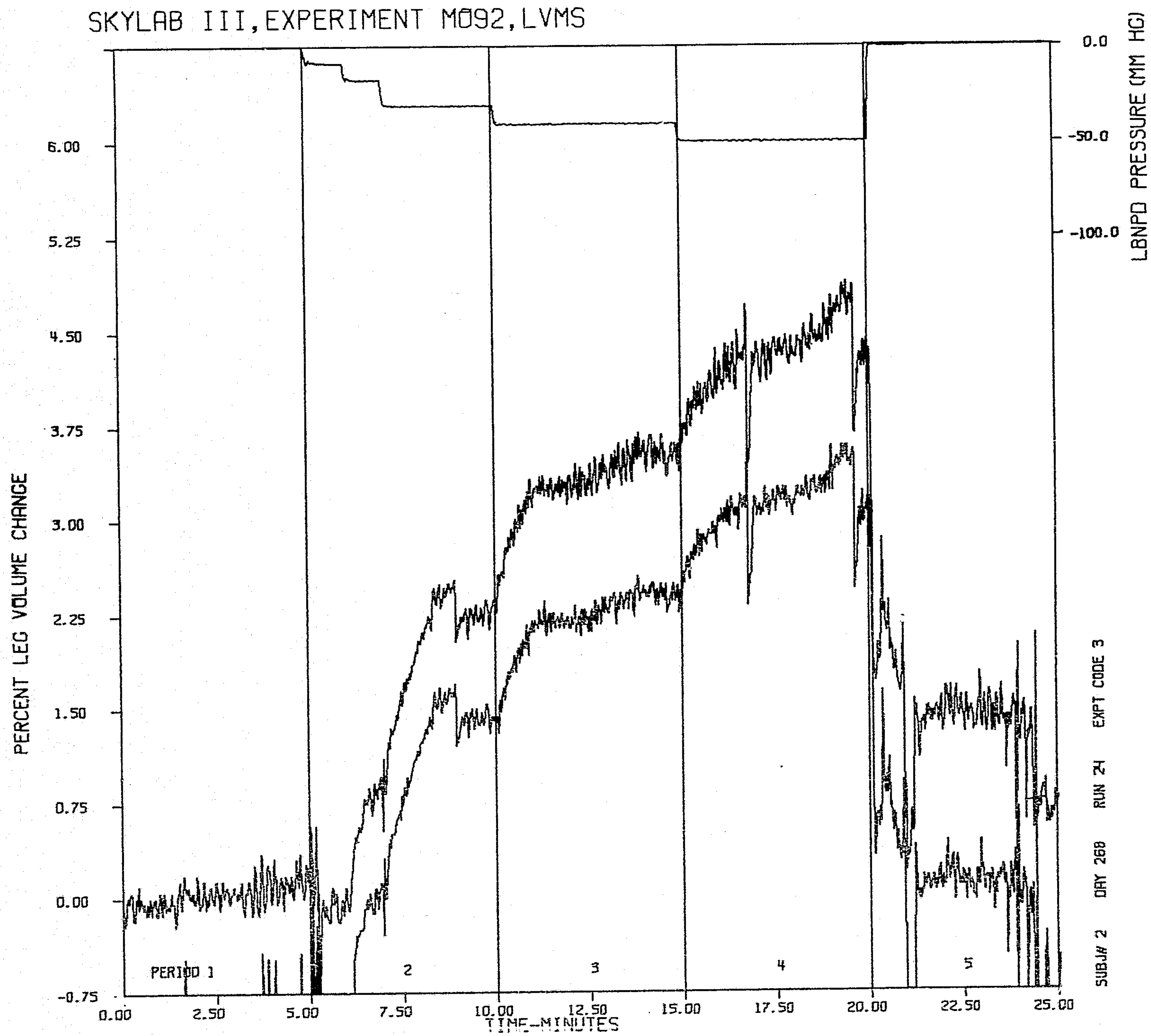
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2
DAY 250
RUN 20
EXPT CODE 2

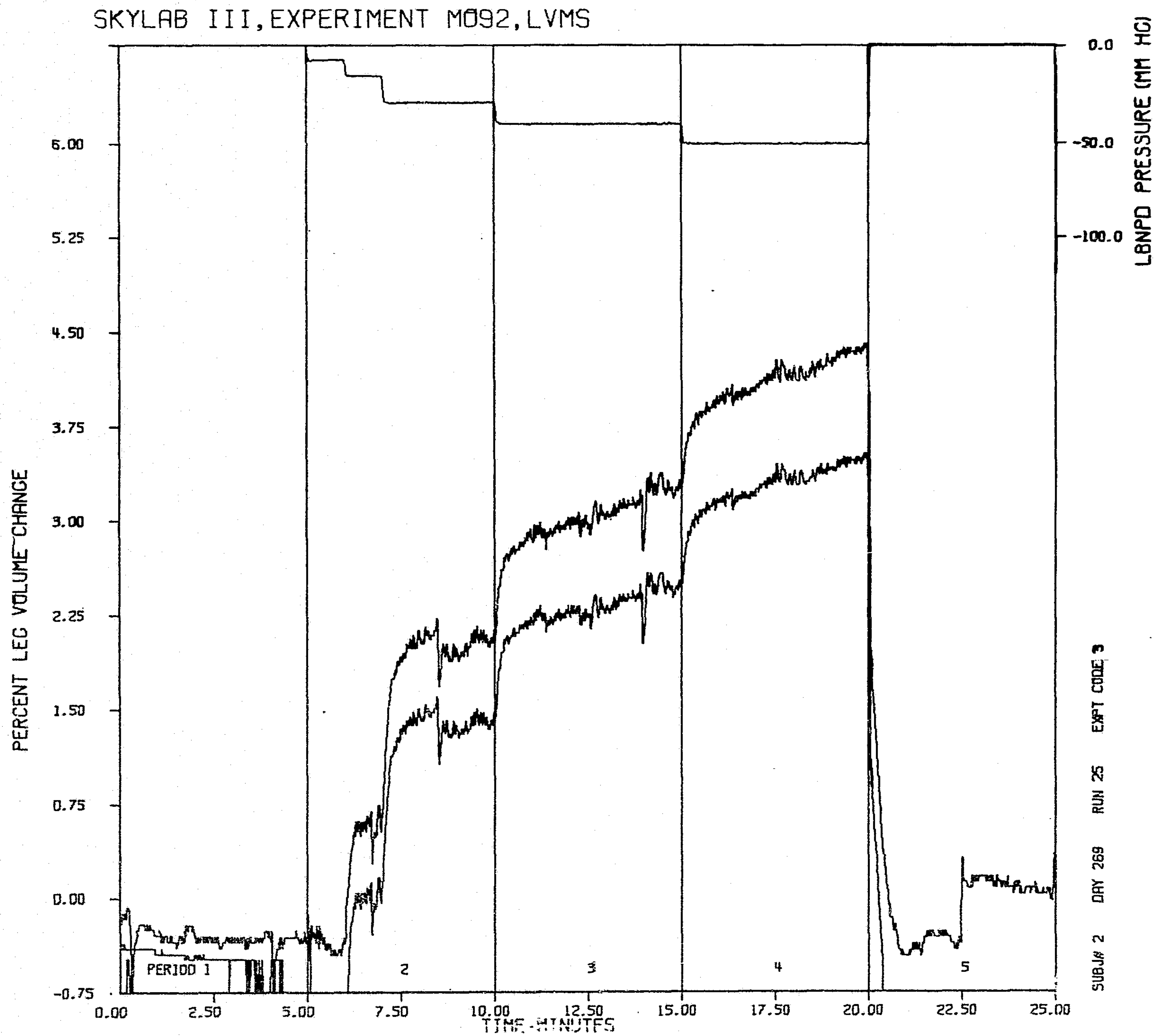
SKYLAB III, EXPERIMENT M092, LVMS

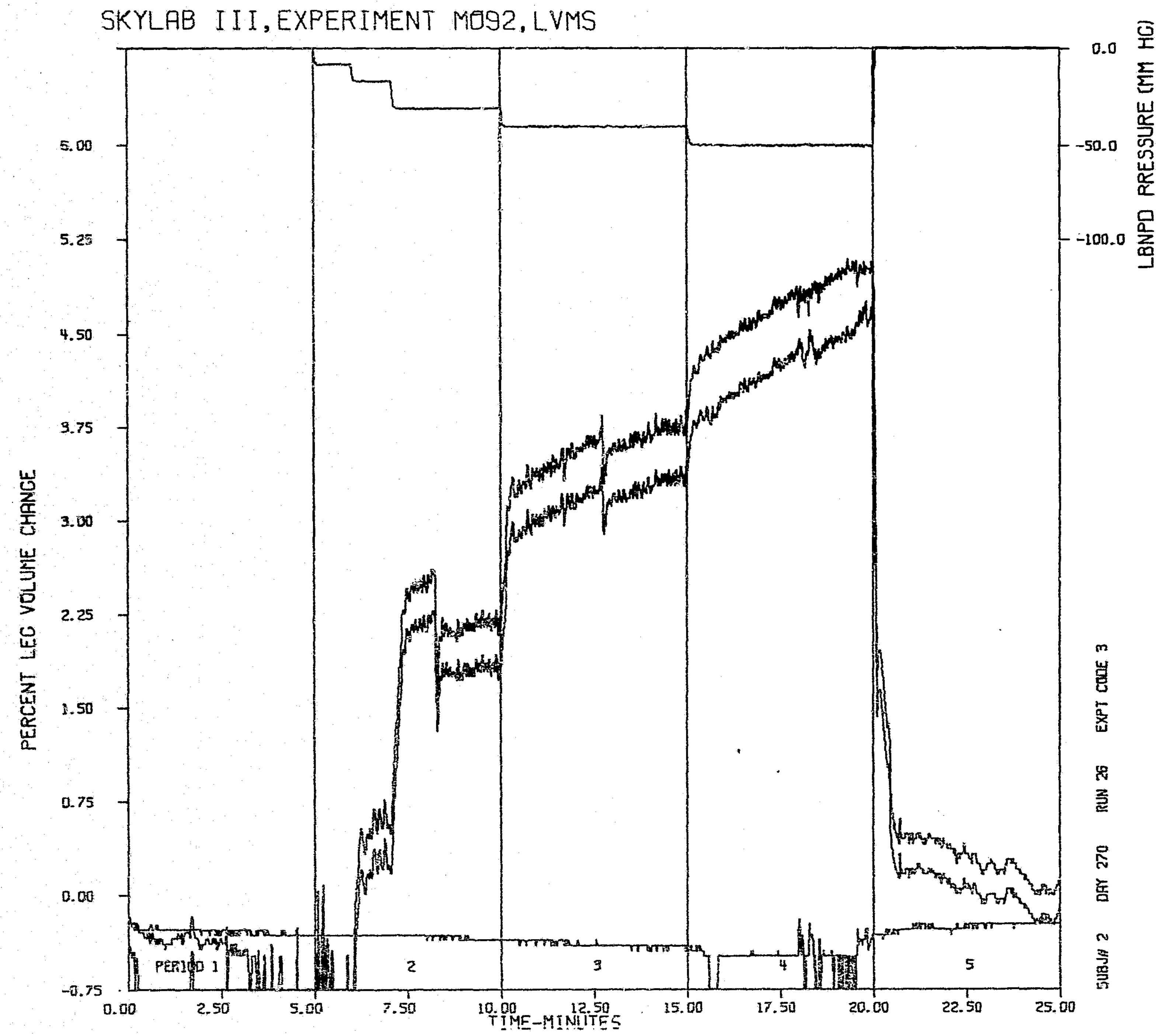


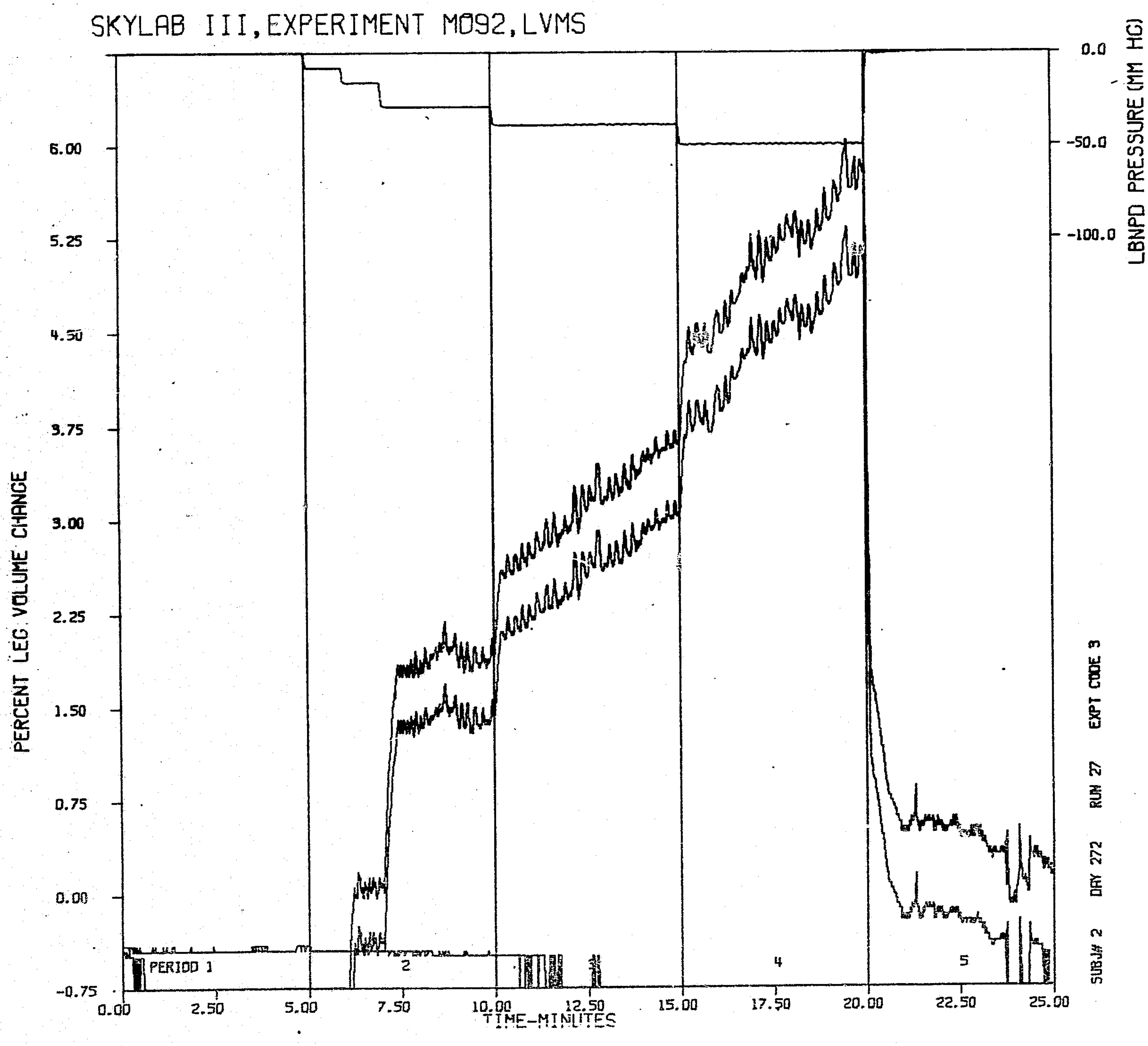

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2
DAY 264
RUN 22
EXPT CODE 2


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME MINUTES
PERIOD 1
2
3
4
5
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
EXPT CODE 2
RUN 23
DAY 266
SUBJ# 2

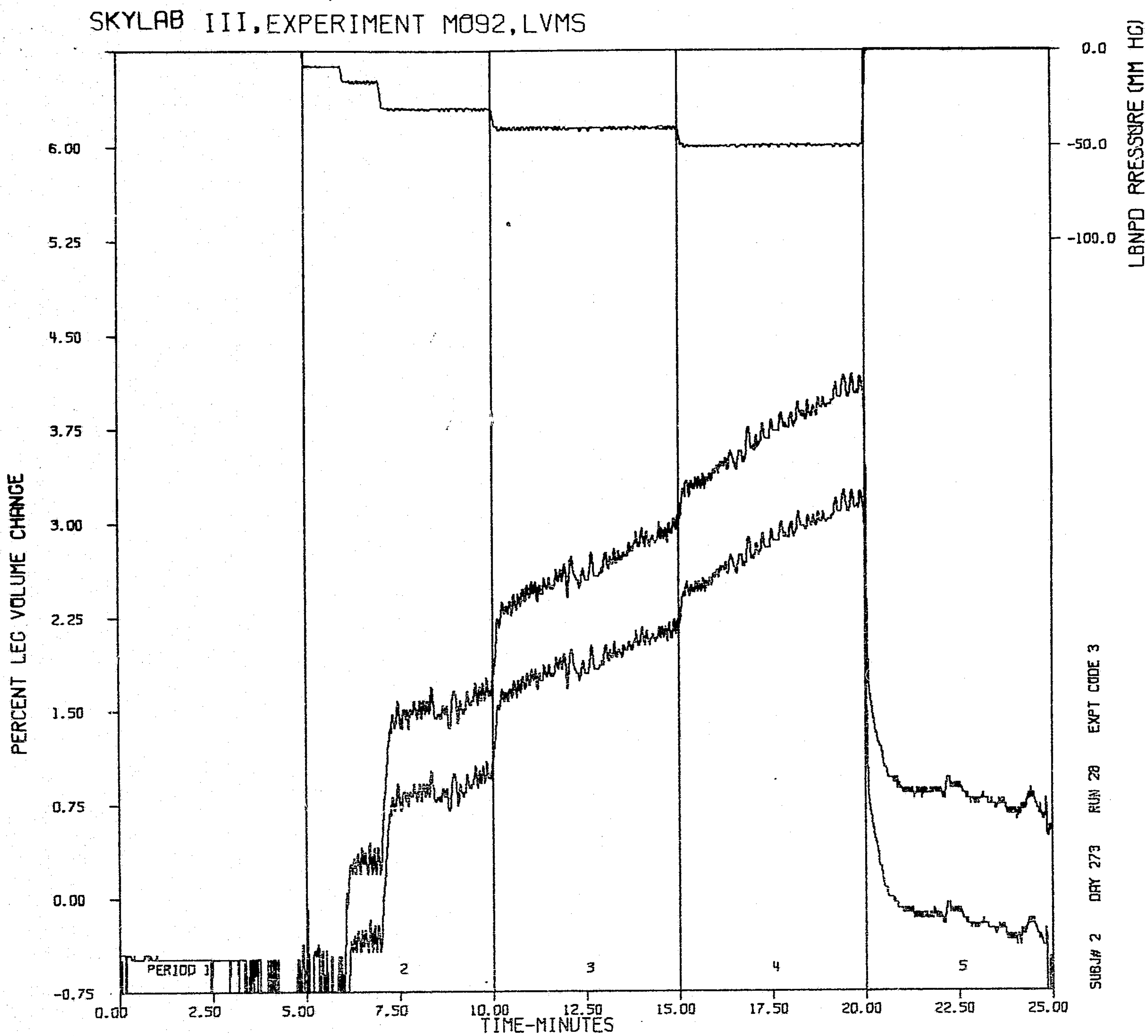

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 2
DAY 268
RUN 24
EXPT CODE 3


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 2 DAY 269 RUN 25 EXPT CODE 3

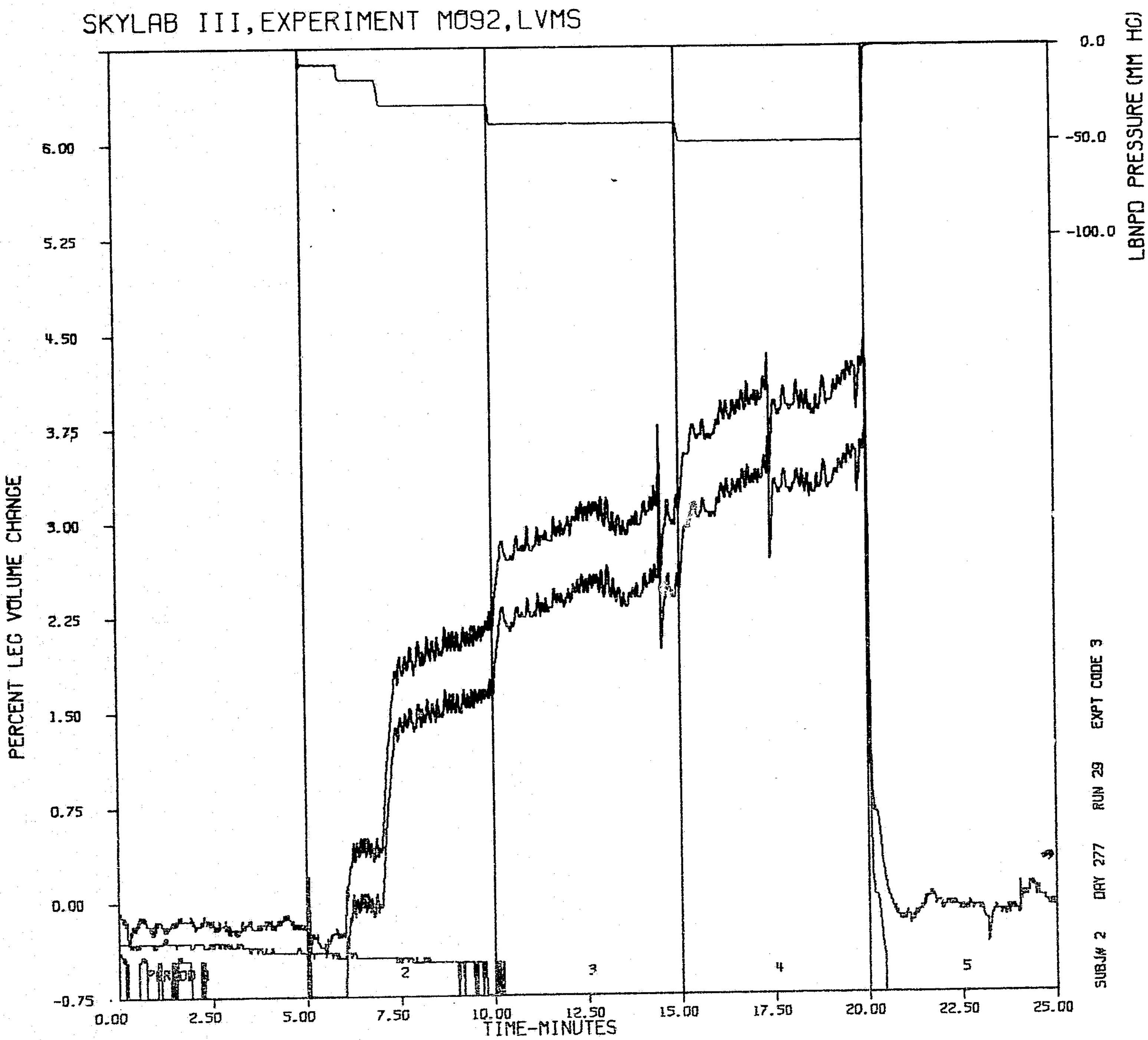

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
5.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
EXPT CODE 3
RUN 26
DAY 270
SUBJ# 2



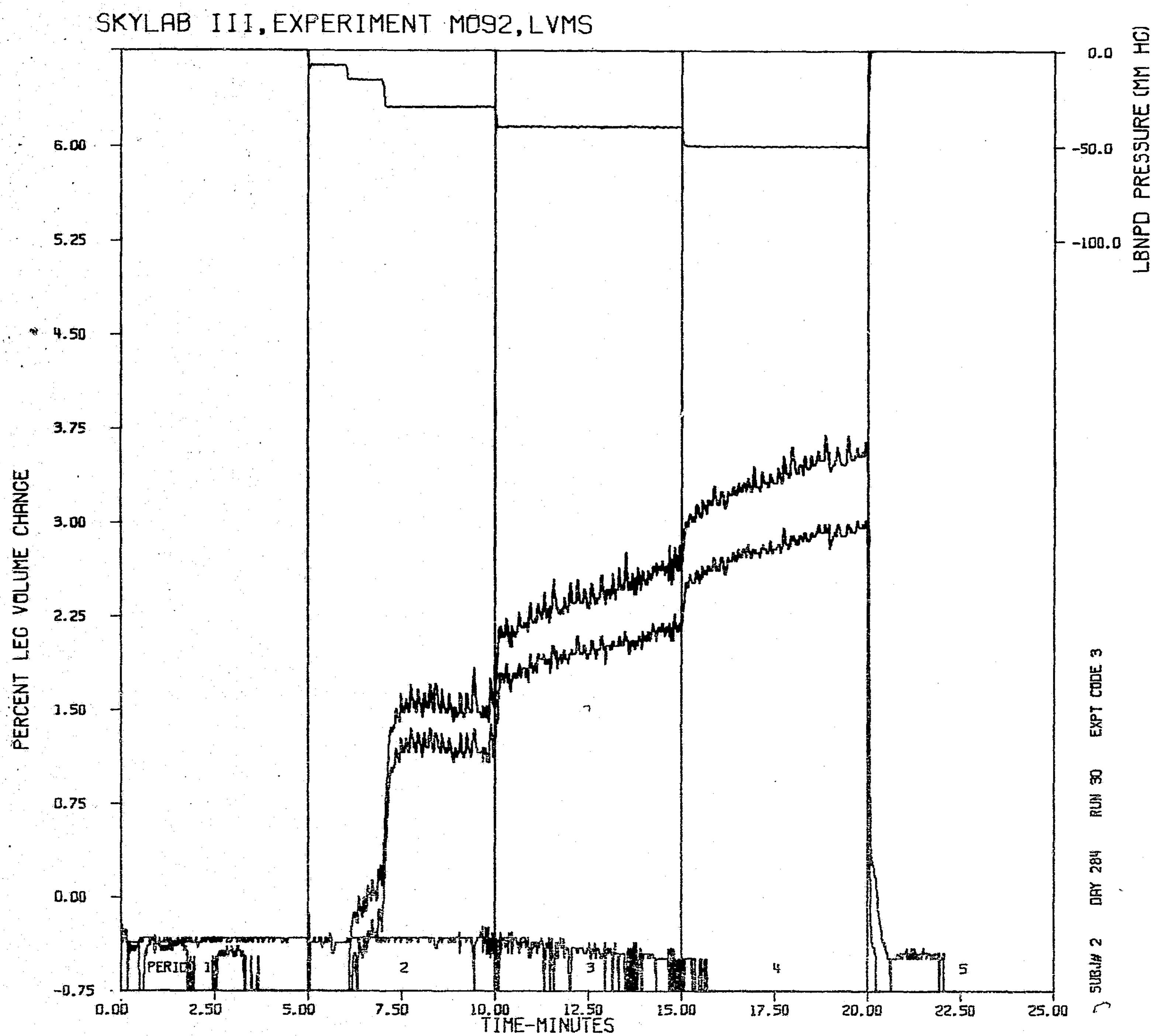
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
4
5
SUBJ# 2
DAY 272
RUN 27
EXPT CODE 3

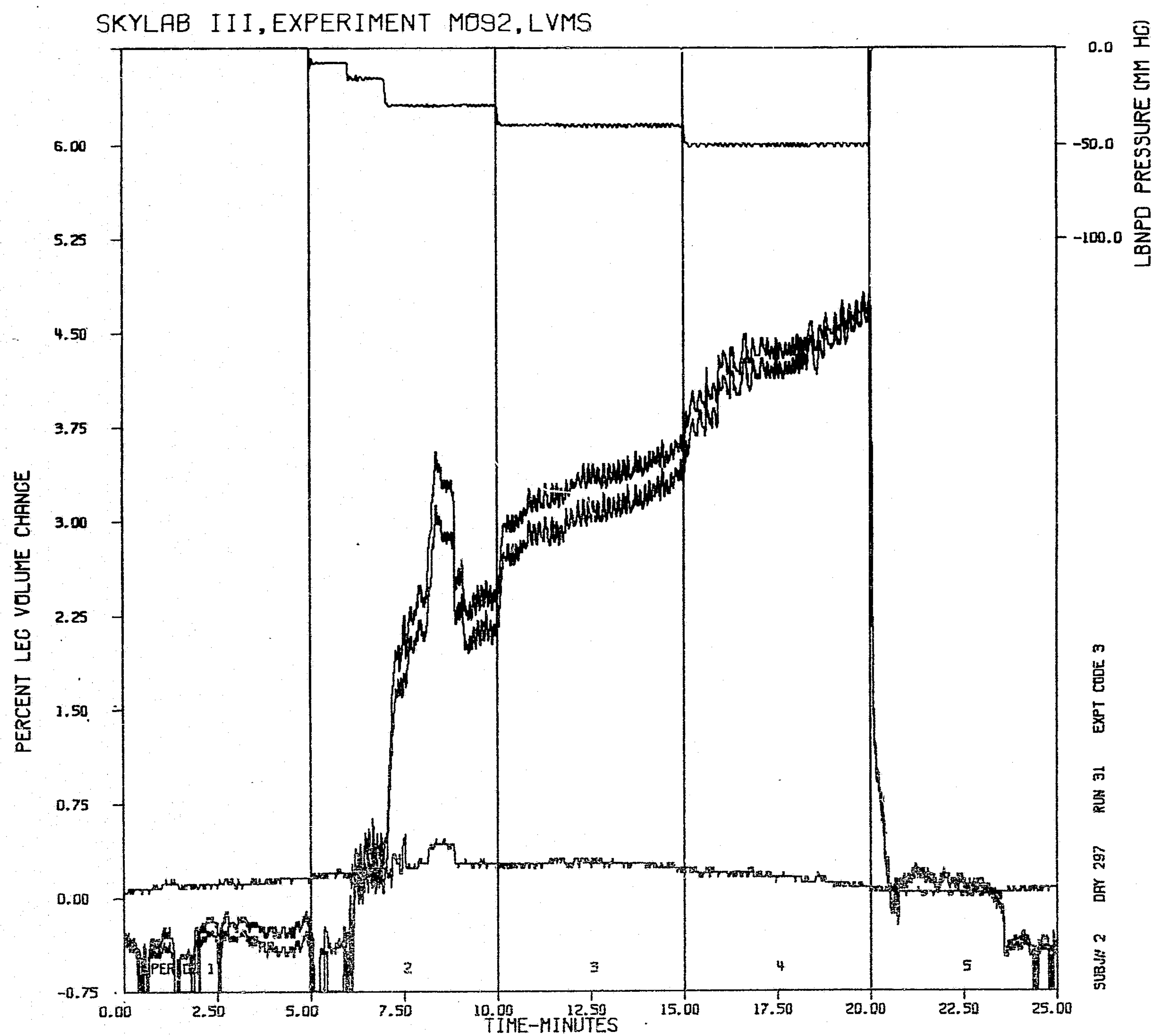


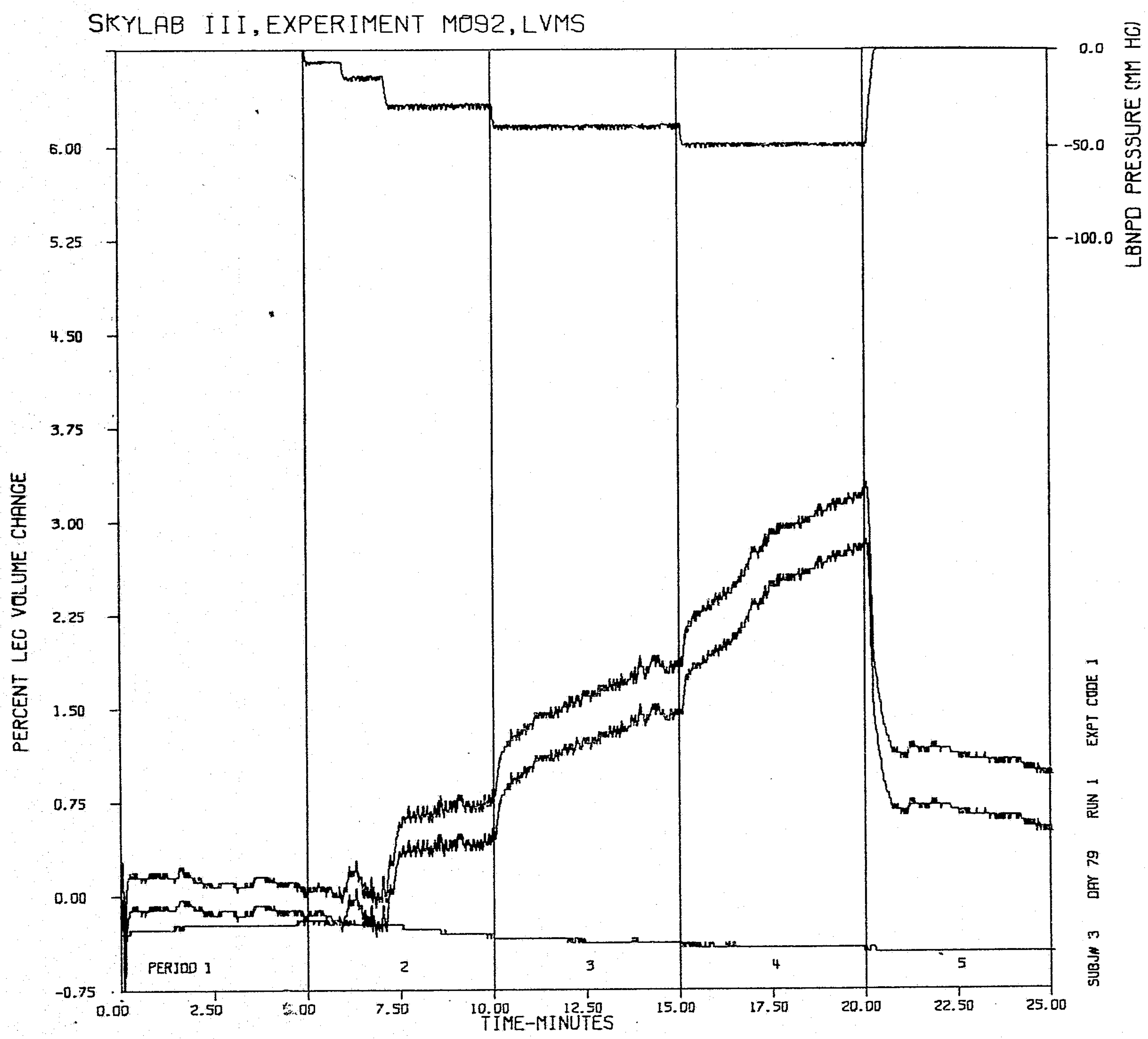
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 2
DAY 273
RUN 28
EXPT CODE 3

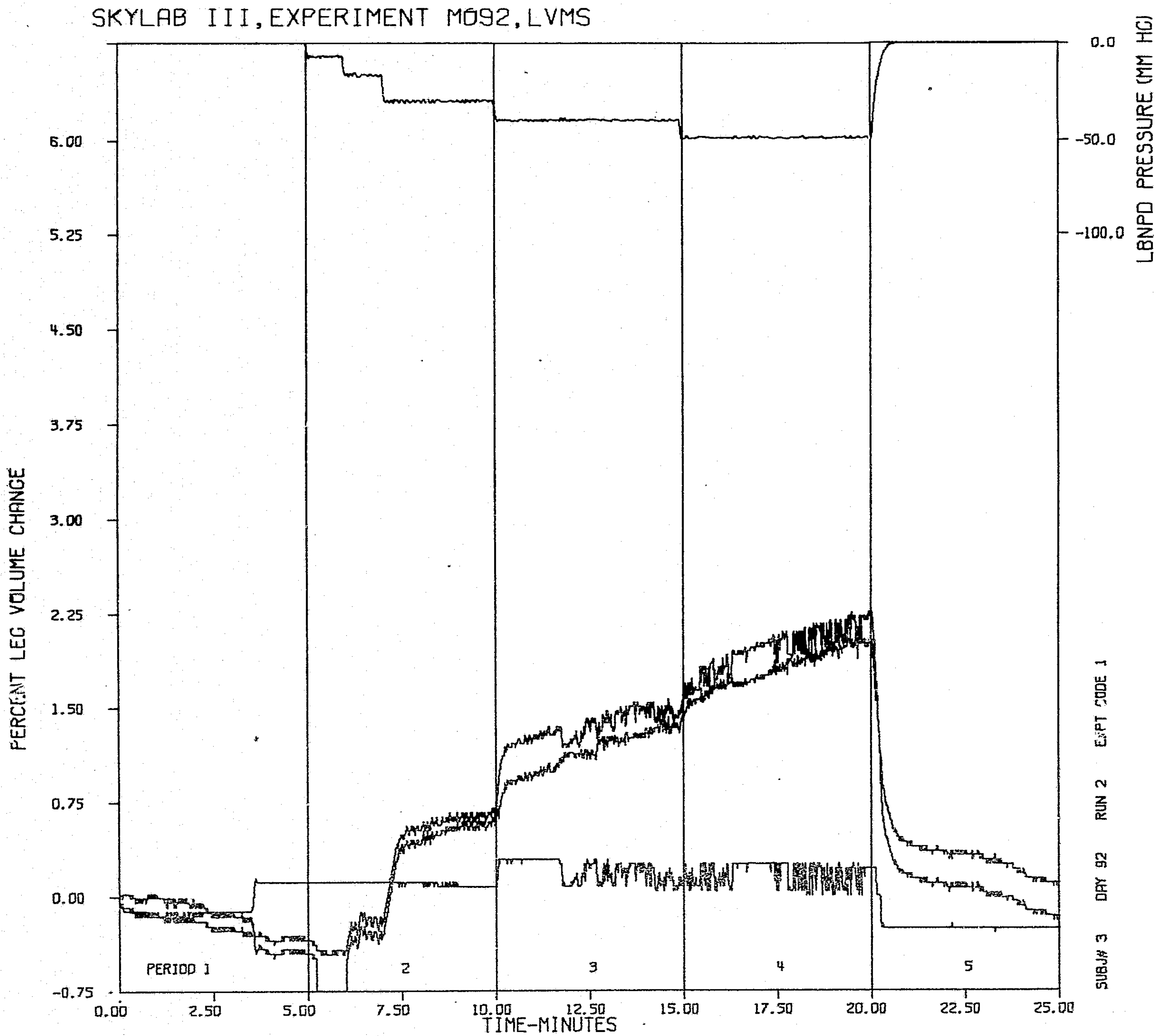


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
2
3
4
5
SUBJ# 2 DAY 277 RUN 29 EXPT CODE 3

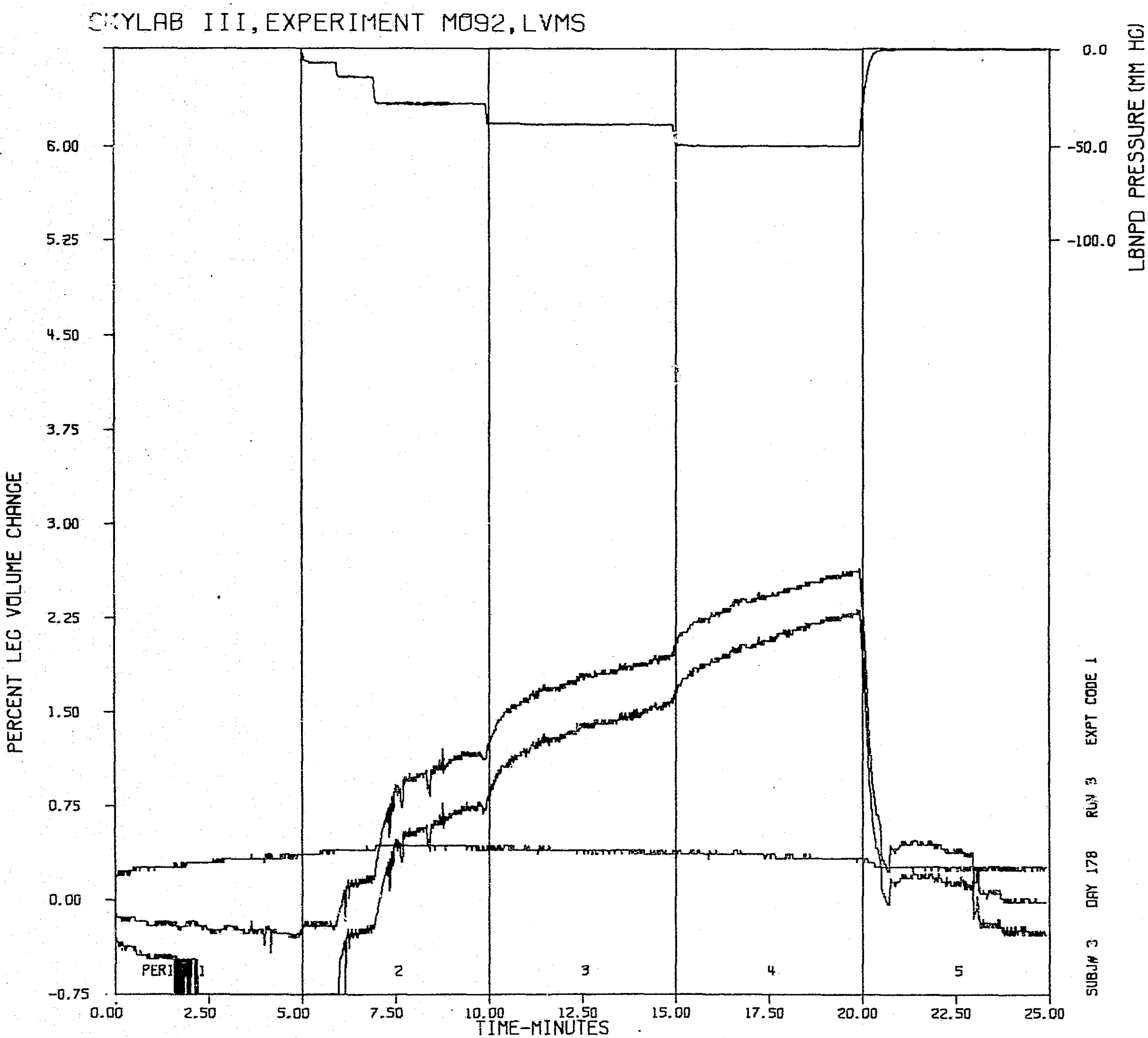

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
LBNPD PRESSURE (MM HG)
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 2
DAY 284
RUN 30
EXPT CODE 3

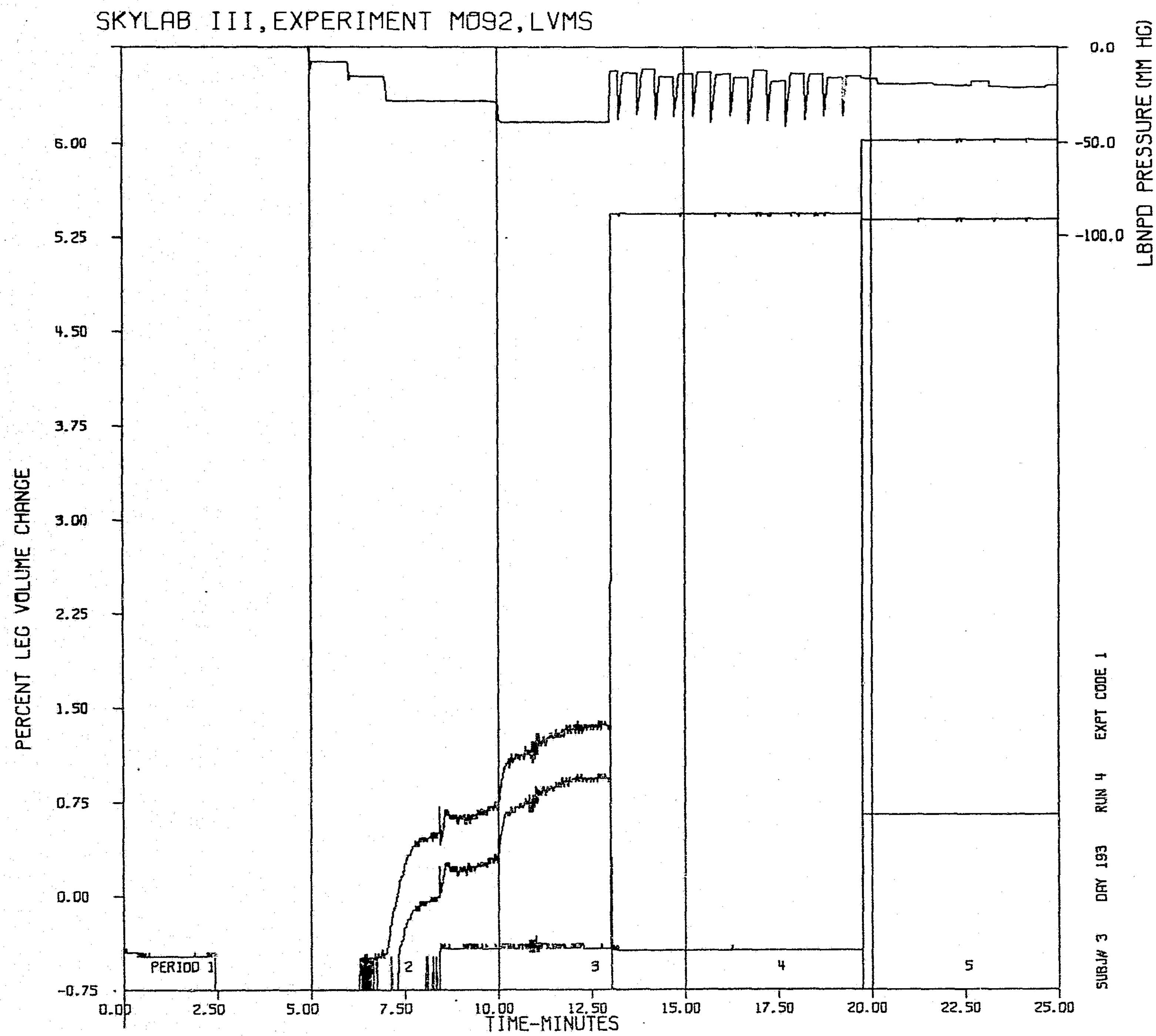

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
EXPT CODE 3
RUN 31
DAY 297
SUBJ# 2

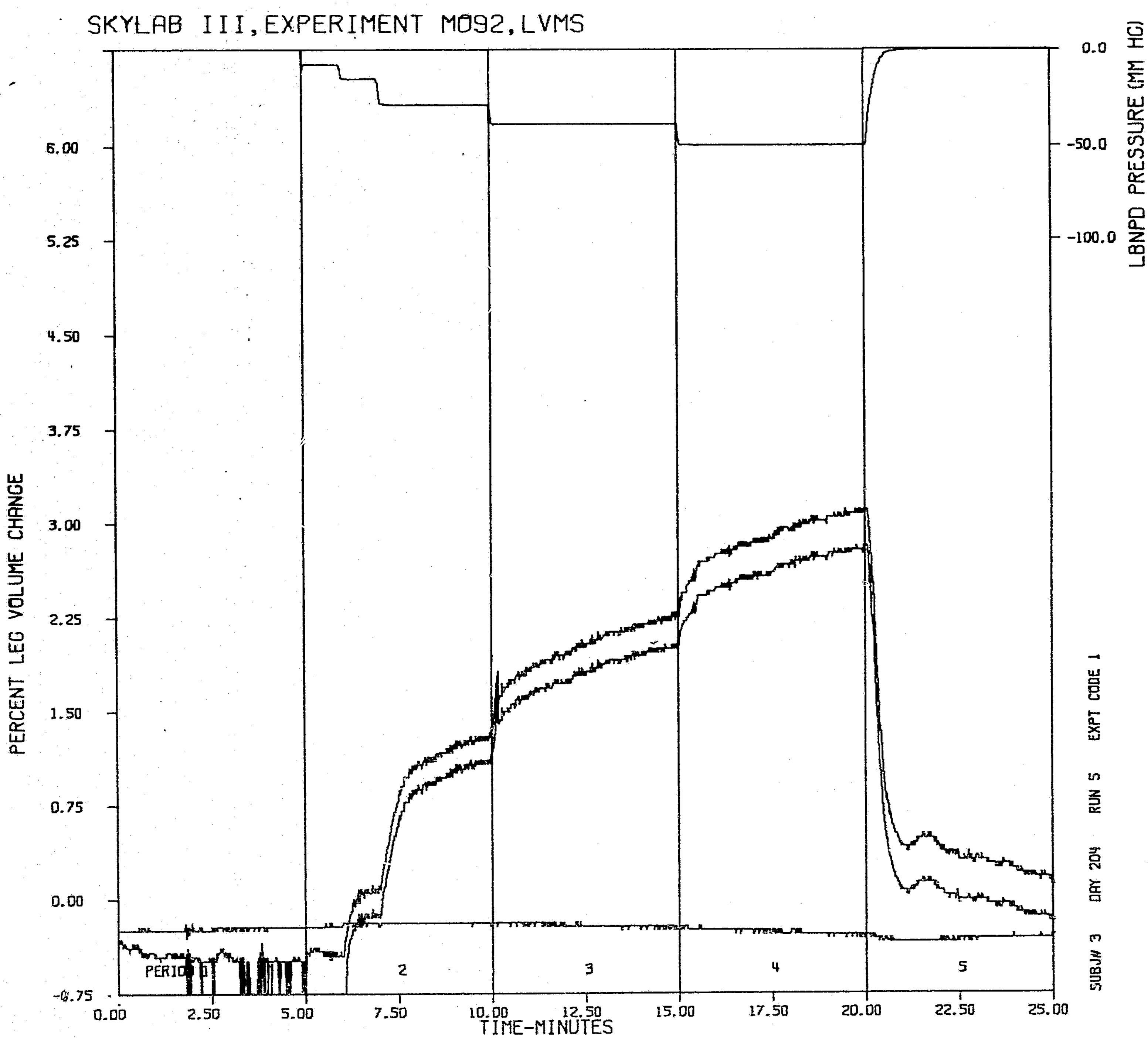

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
EXPT CODE 1
RUN 1
DAY 79
SUBJ# 3



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
EXPT CODE 1
RUN 2
DAY 92
SUBJ# 3

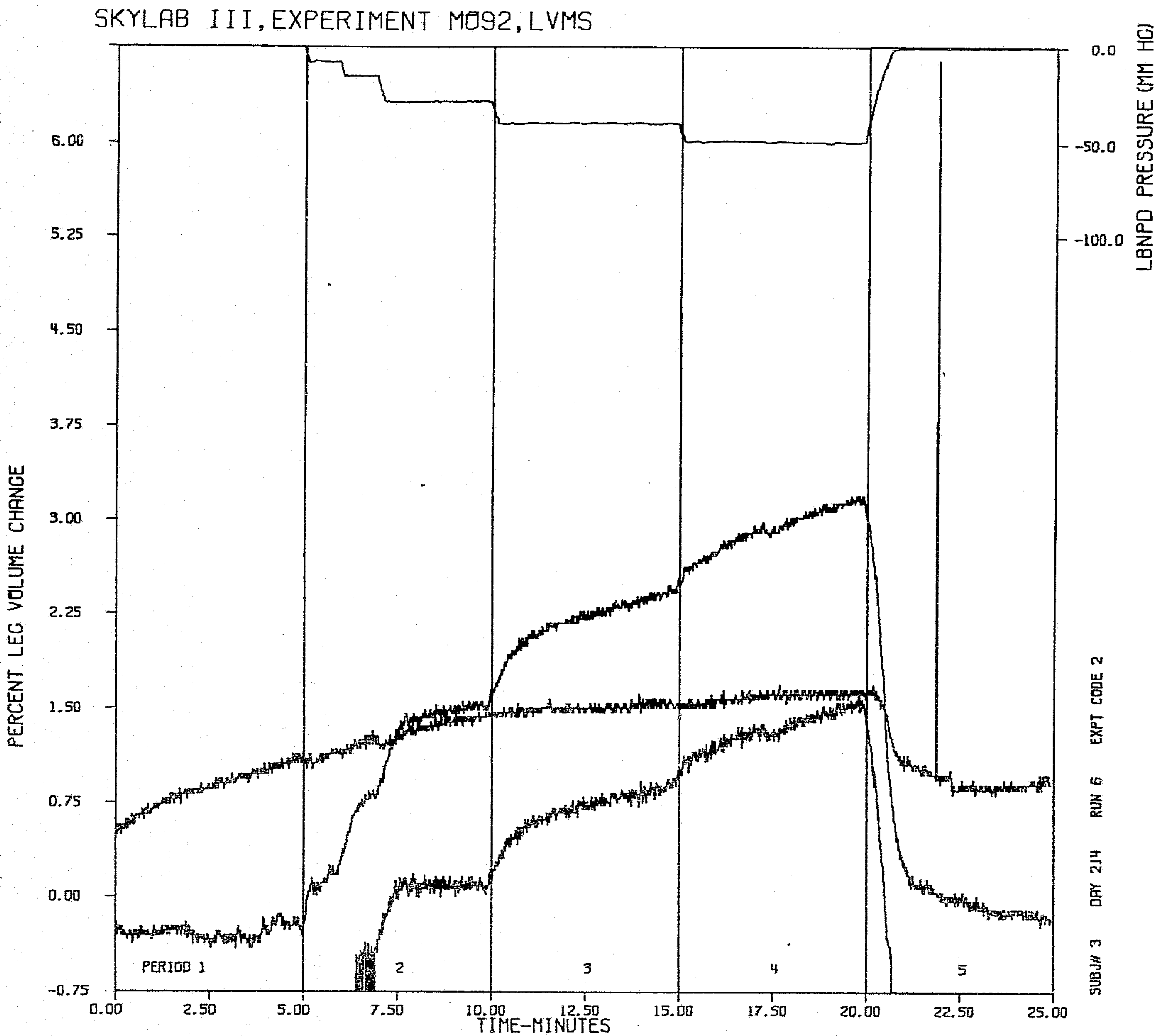

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3
DAY 178
RUN 3
EXPT CODE 1


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3
DAY 193
RUN 4
EXPT CODE 1

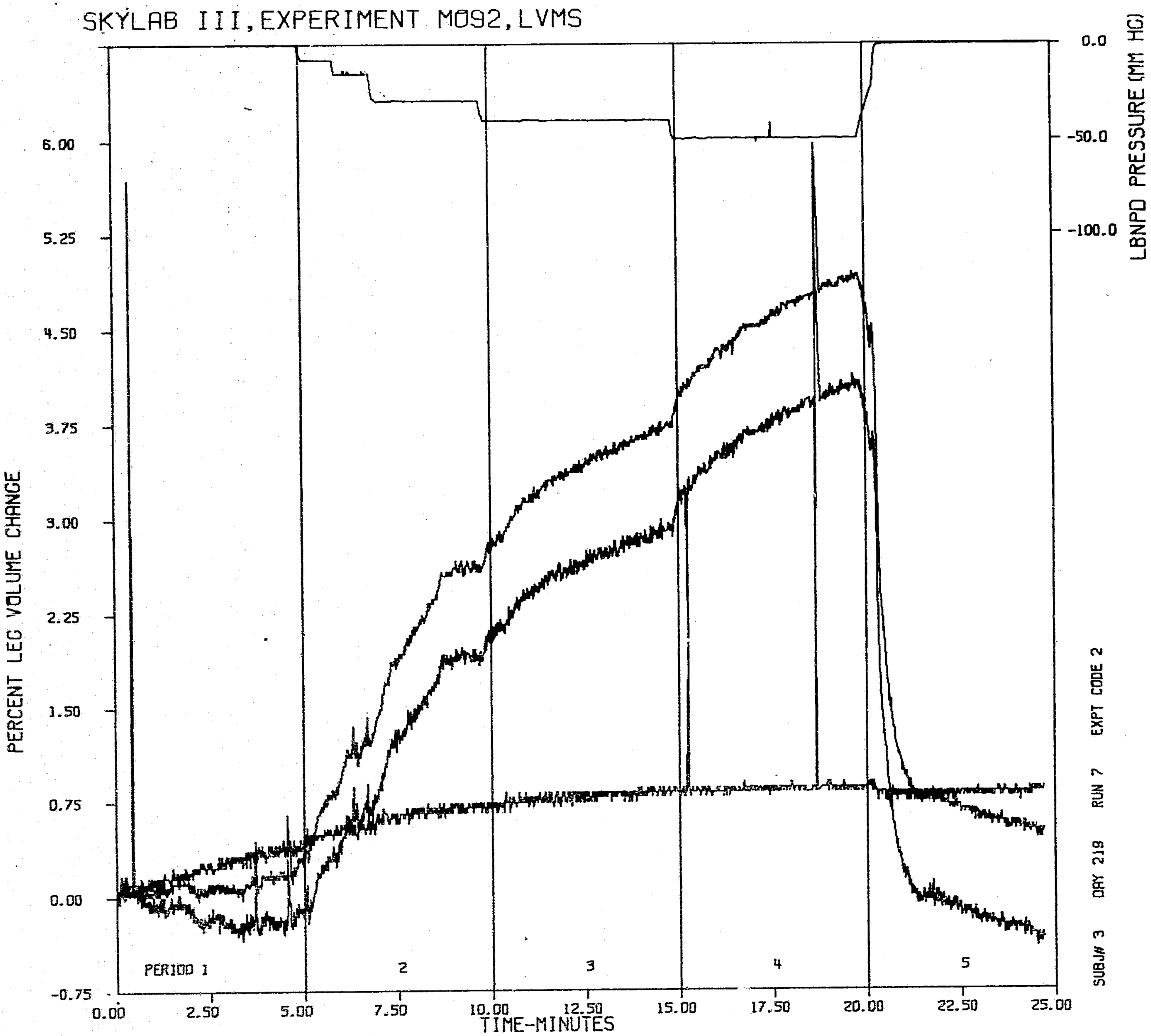


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 204 RUN 5 EXPT CODE 1

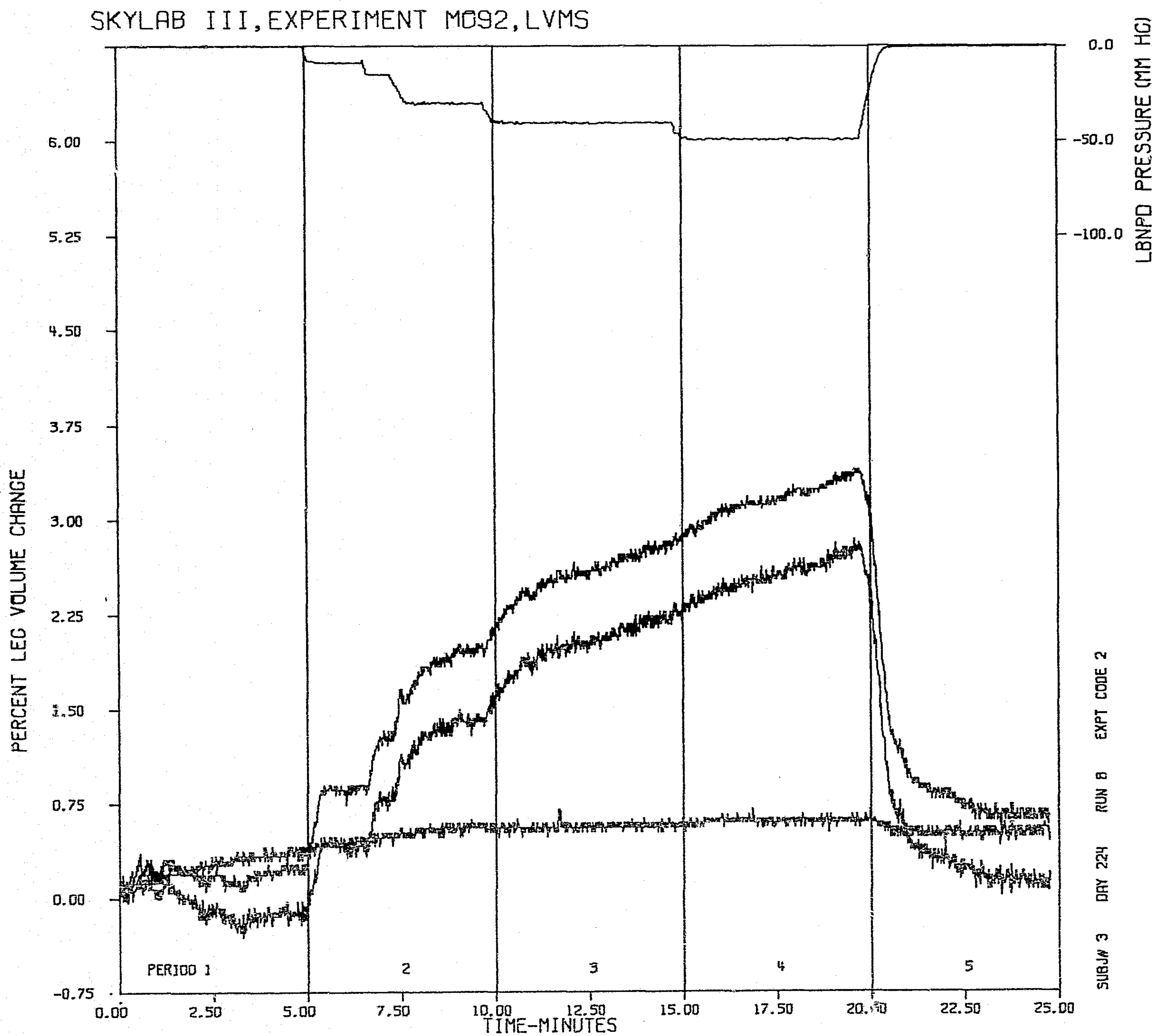
B-63


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 214 RUN 6 EXPT CODE 2

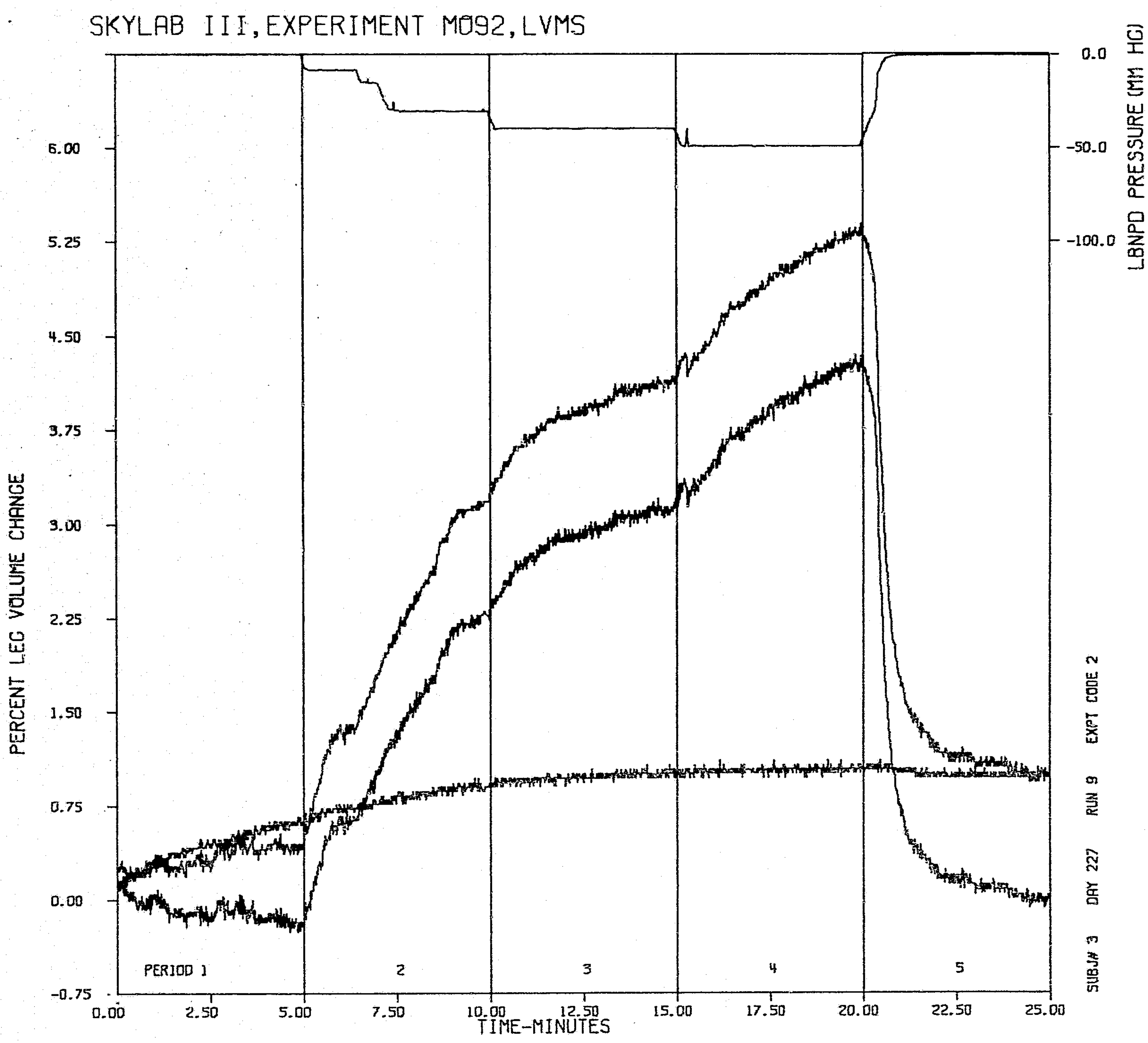
SKYLAB III, EXPERIMENT M092, LVMS



B-65

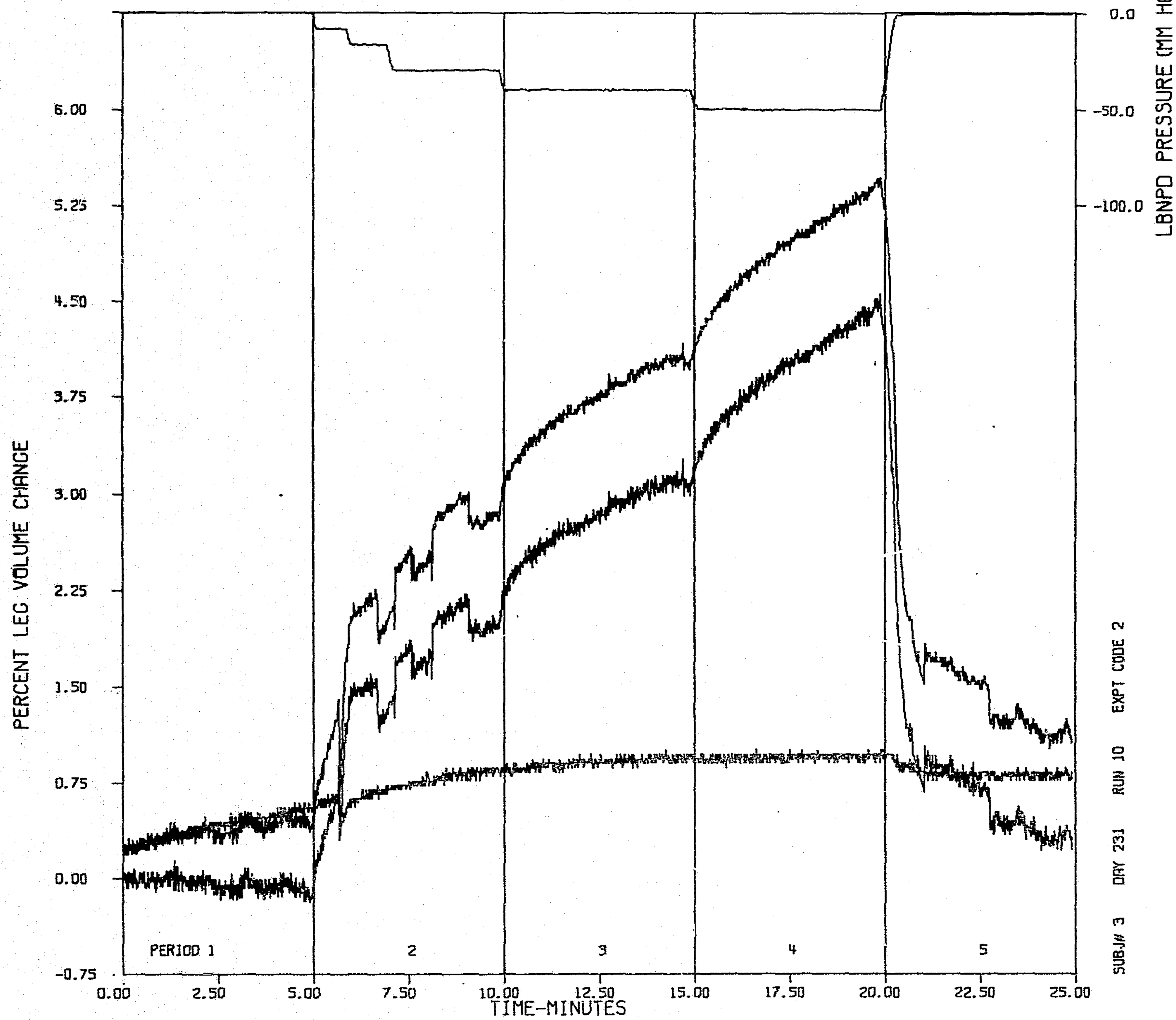


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3
DAY 224
RUN 8
EXPT CODE 2

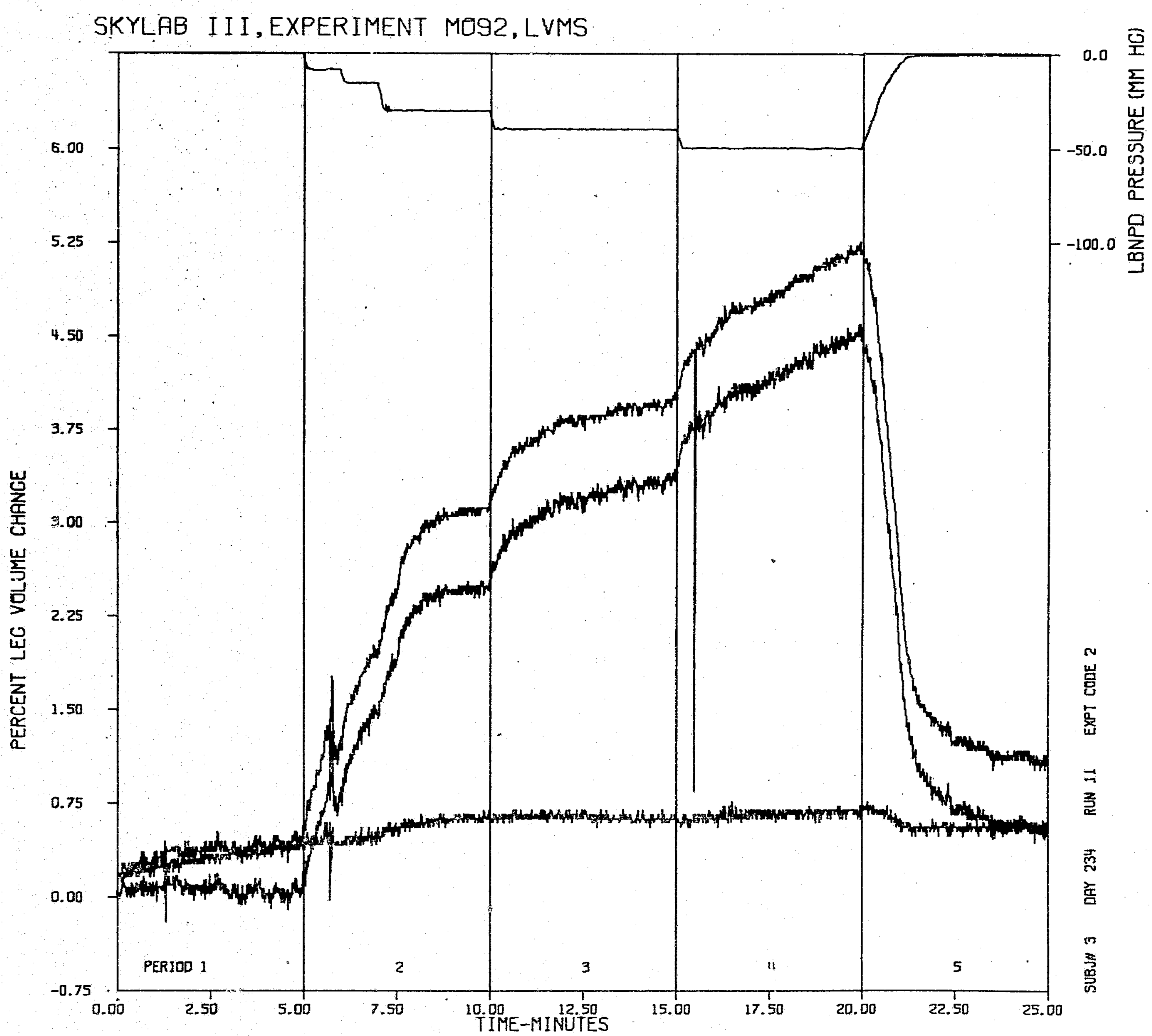

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 227 RUN 9 EXPT CODE 2
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00

C-3

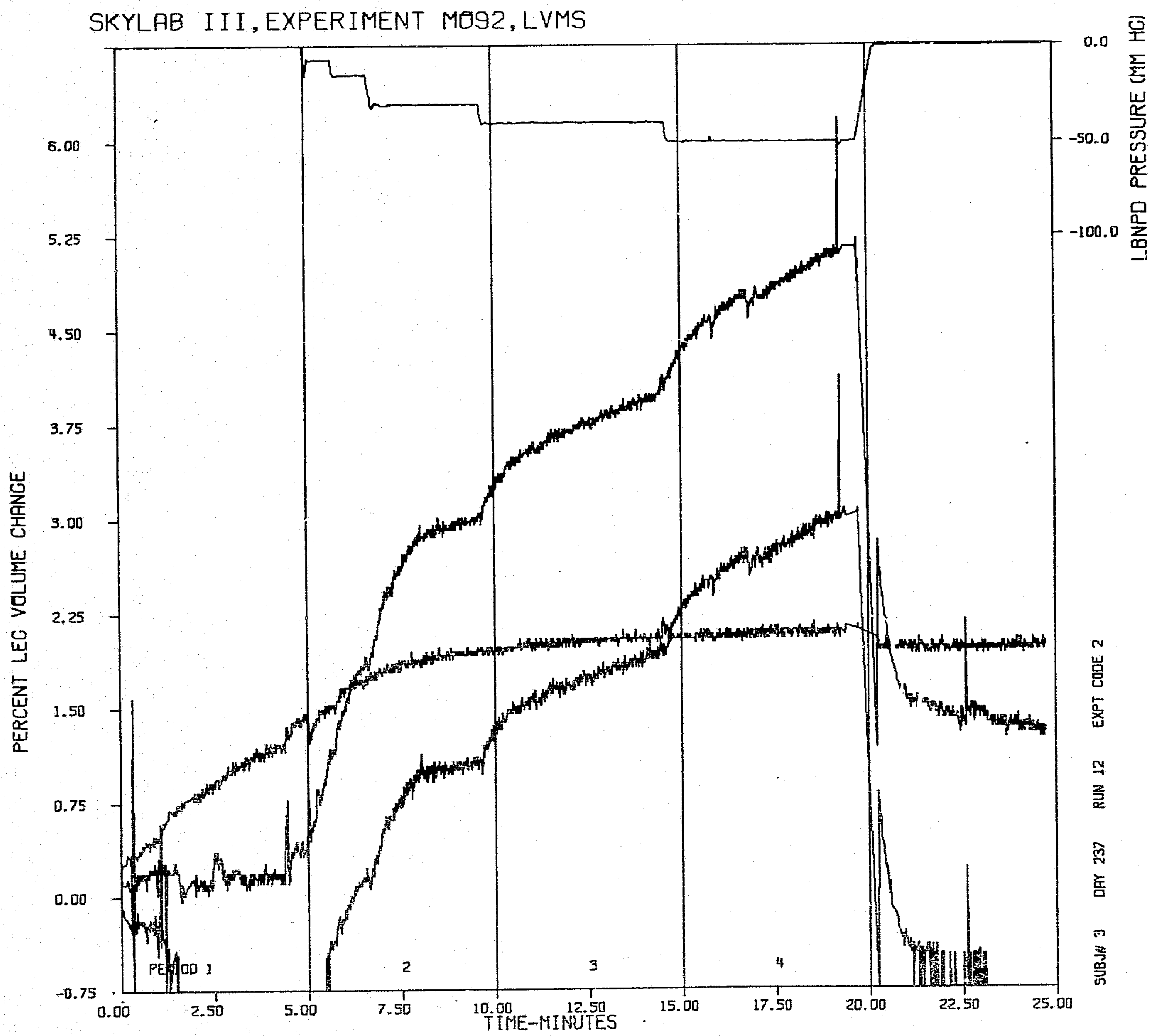
SKYLAB III, EXPERIMENT M092, LVMS



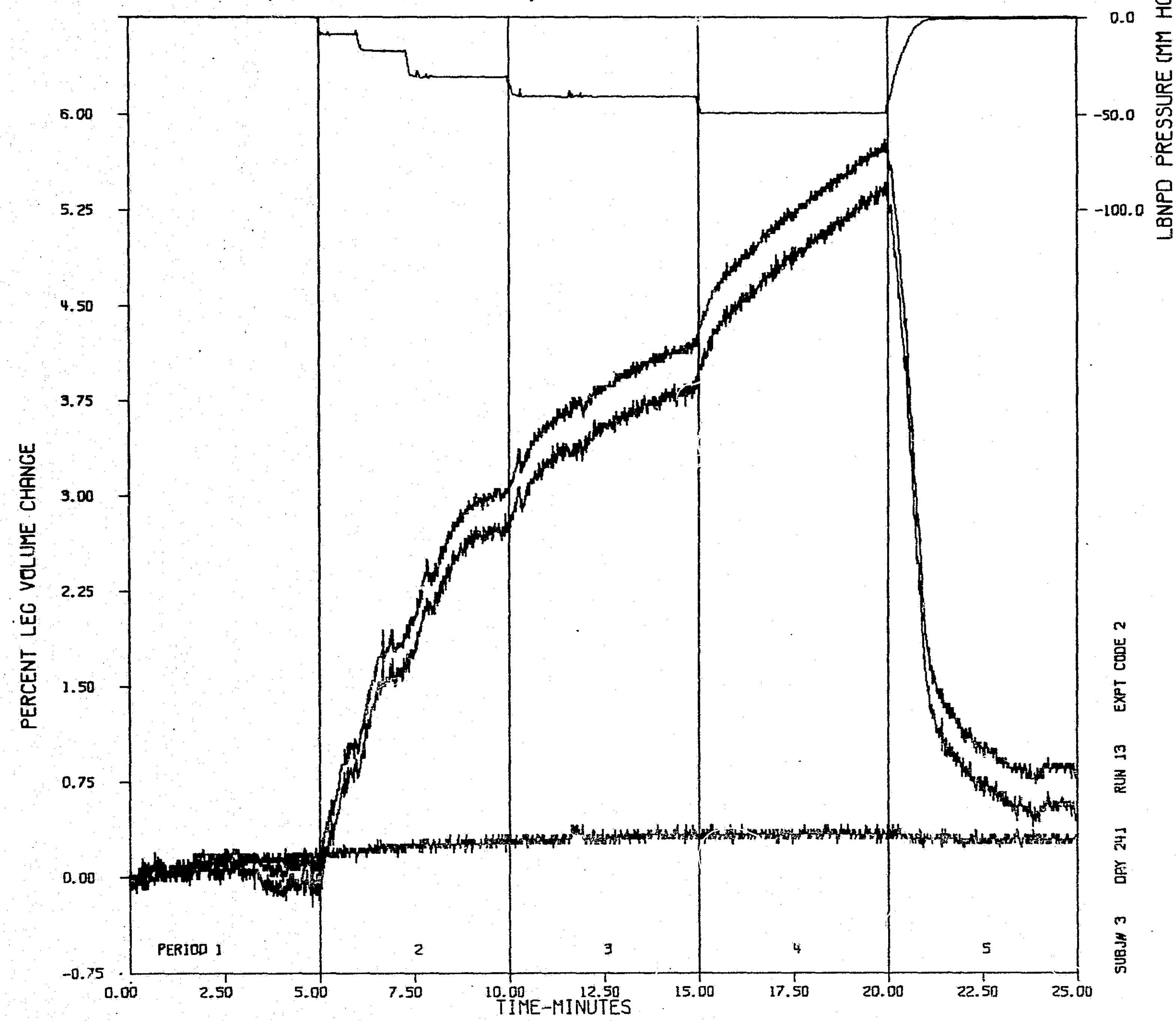
B-68

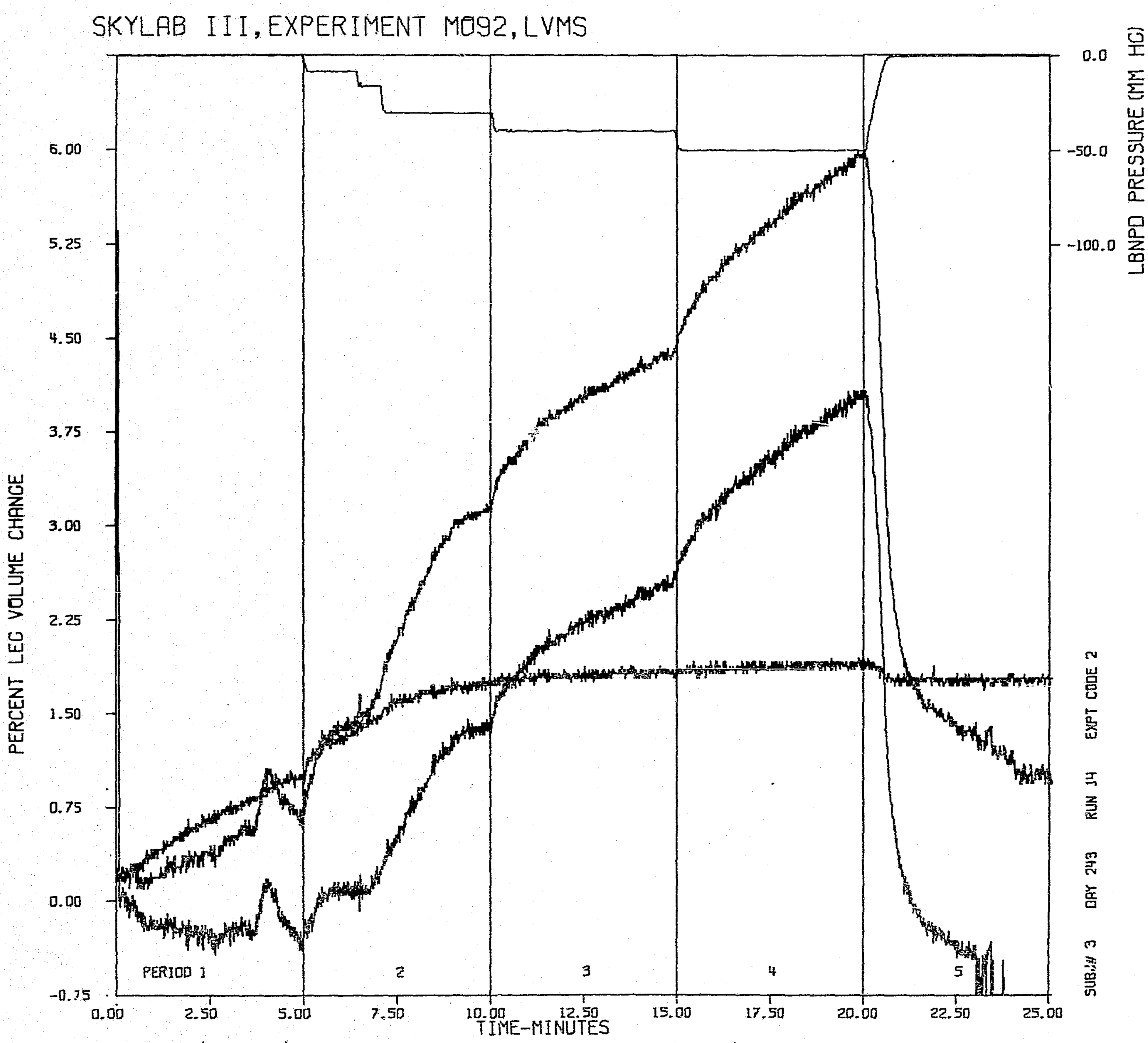


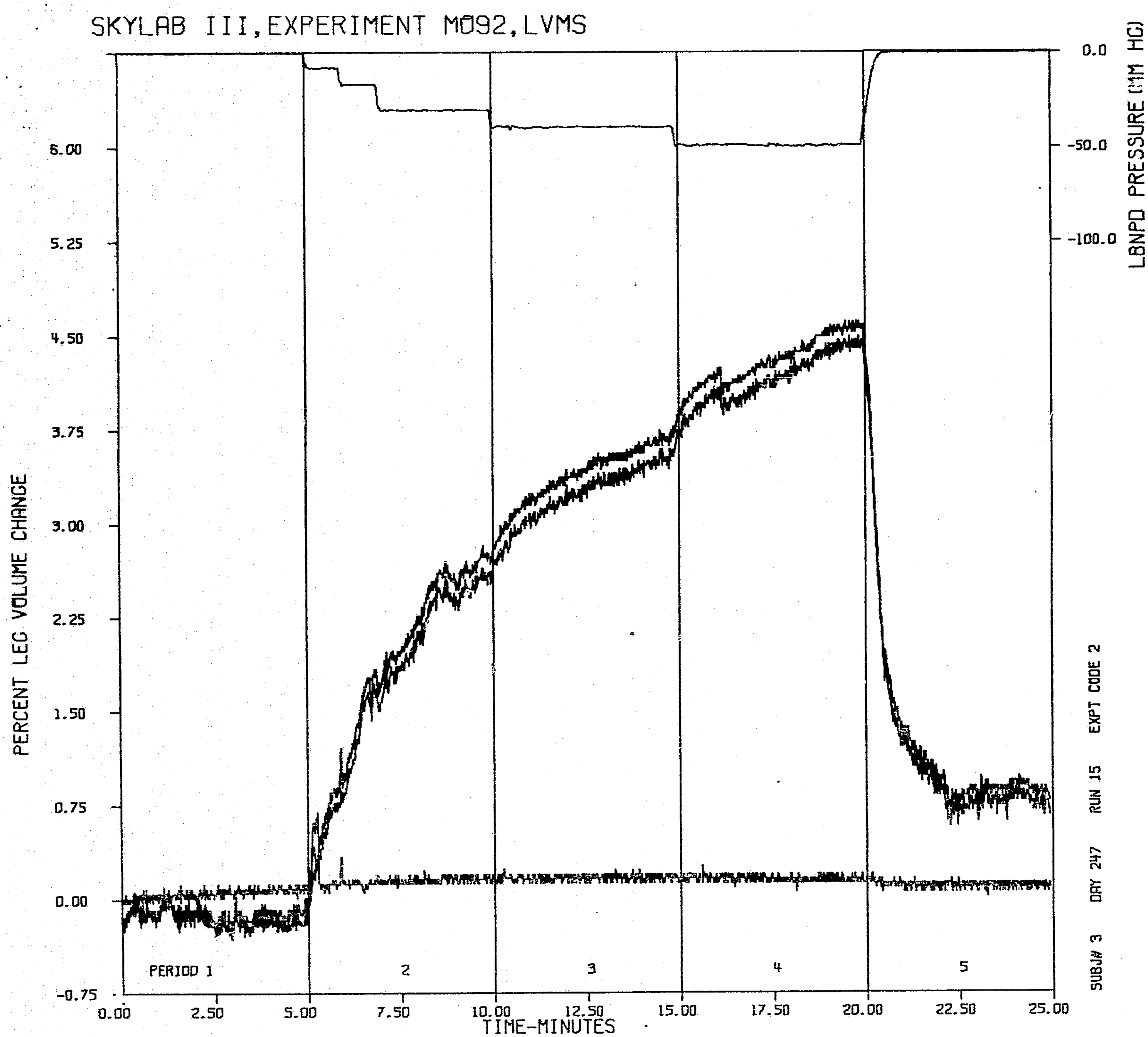
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 3
DAY 234
RUN 11
EXPT CODE 2

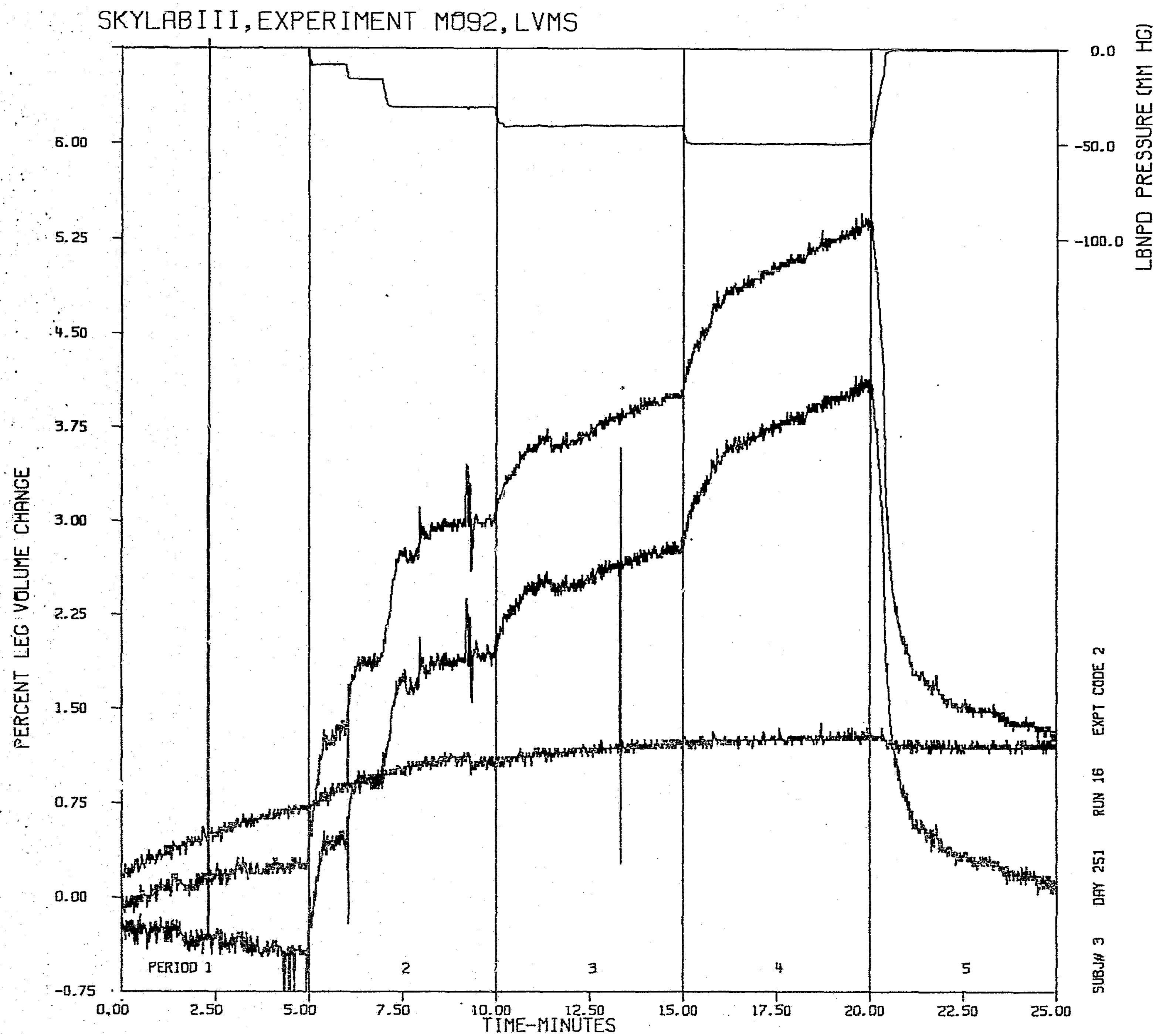

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
EXPT CODE 2
RUN 12
DAY 237
SUBJ# 3

SKYLAB III, EXPERIMENT M092, LVMS



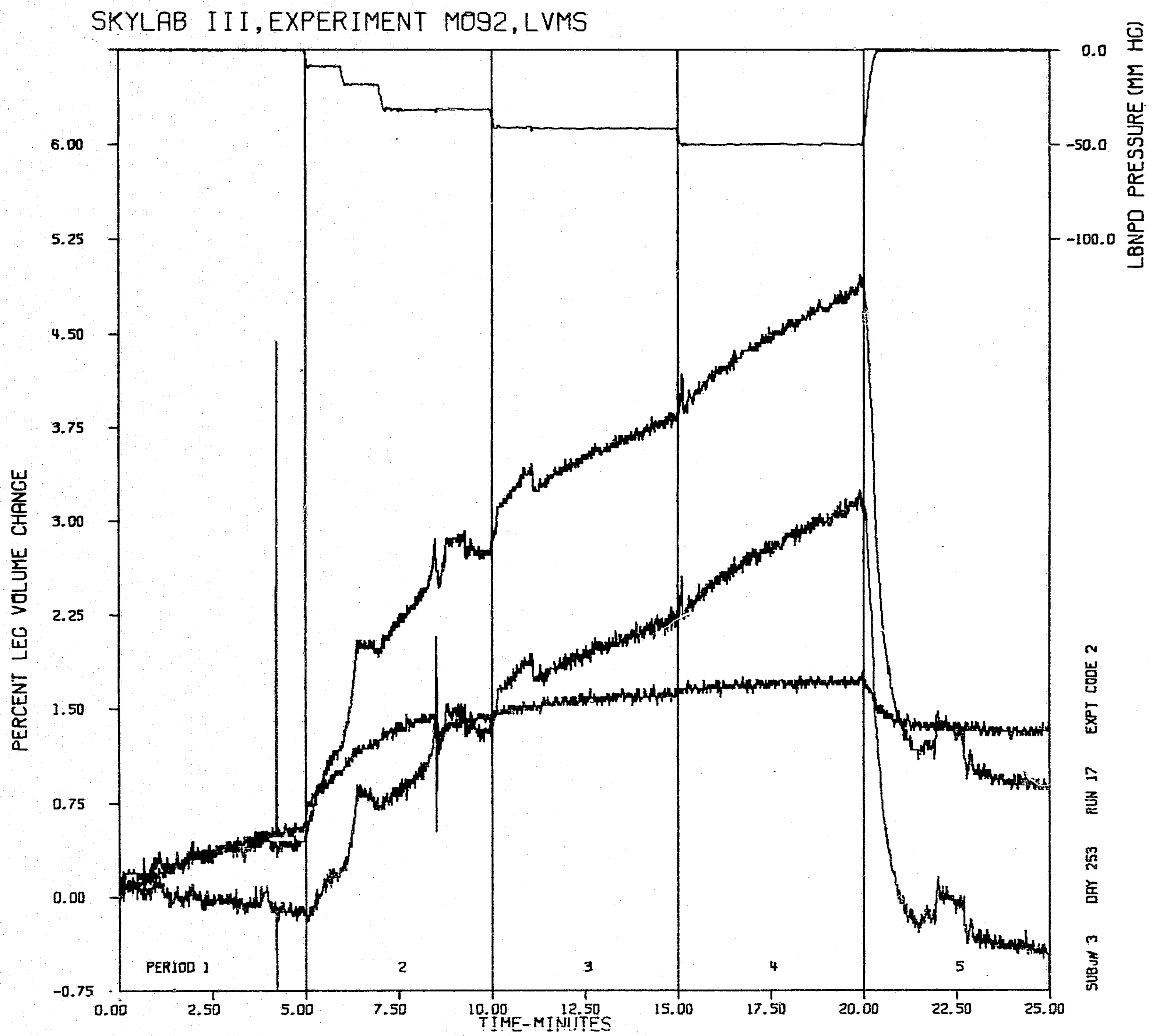

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
LBNPD PRESSURE (MM HG)
EXPT CODE 2
RUN 14
DAY 243
SUBJ# 3


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3
DAY 247
RUN 15
EXPT CODE 2



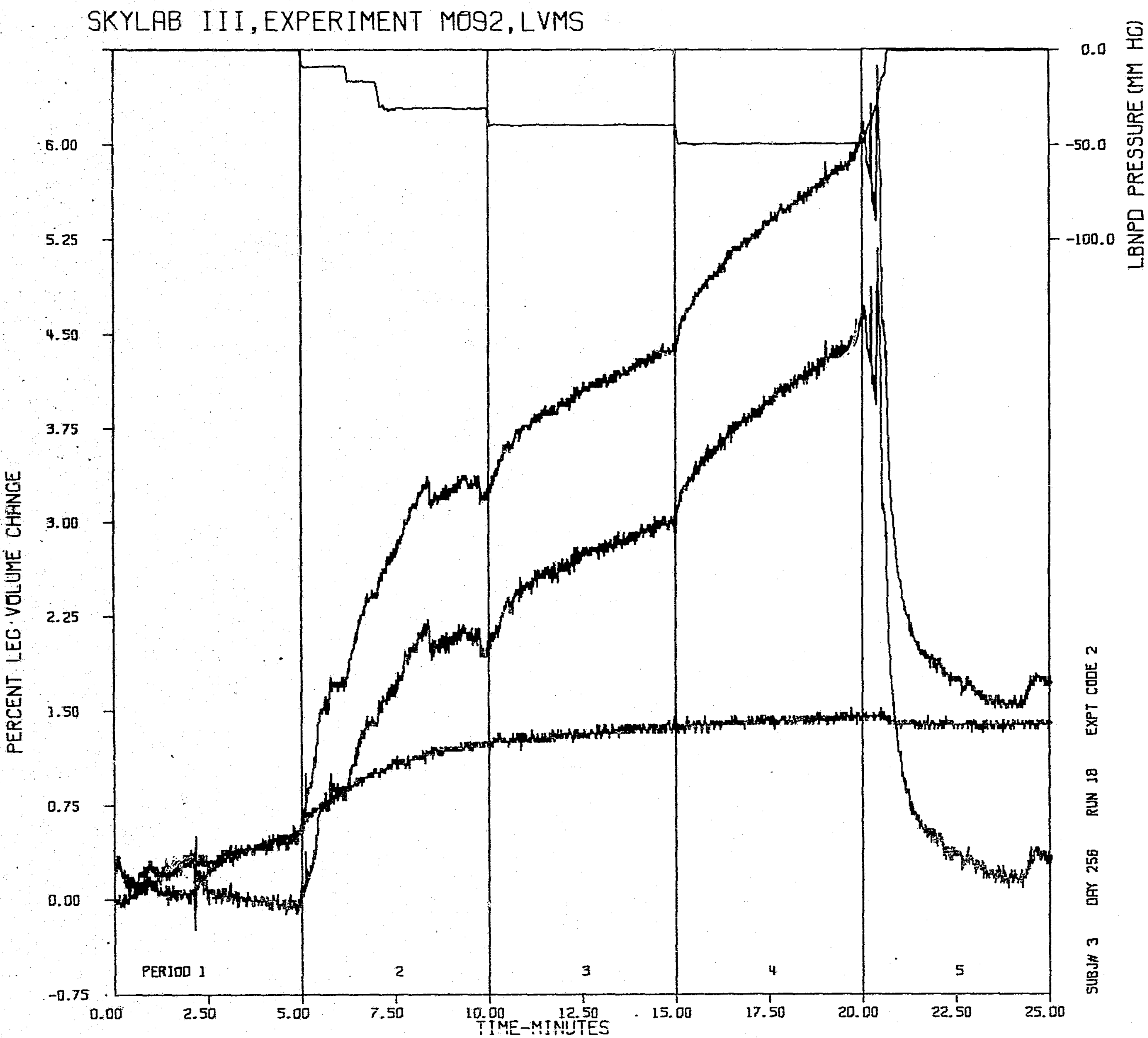
SKYLABIII, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 251 RUN 16 EXPT CODE 2
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
0.0
-50.0
-100.0

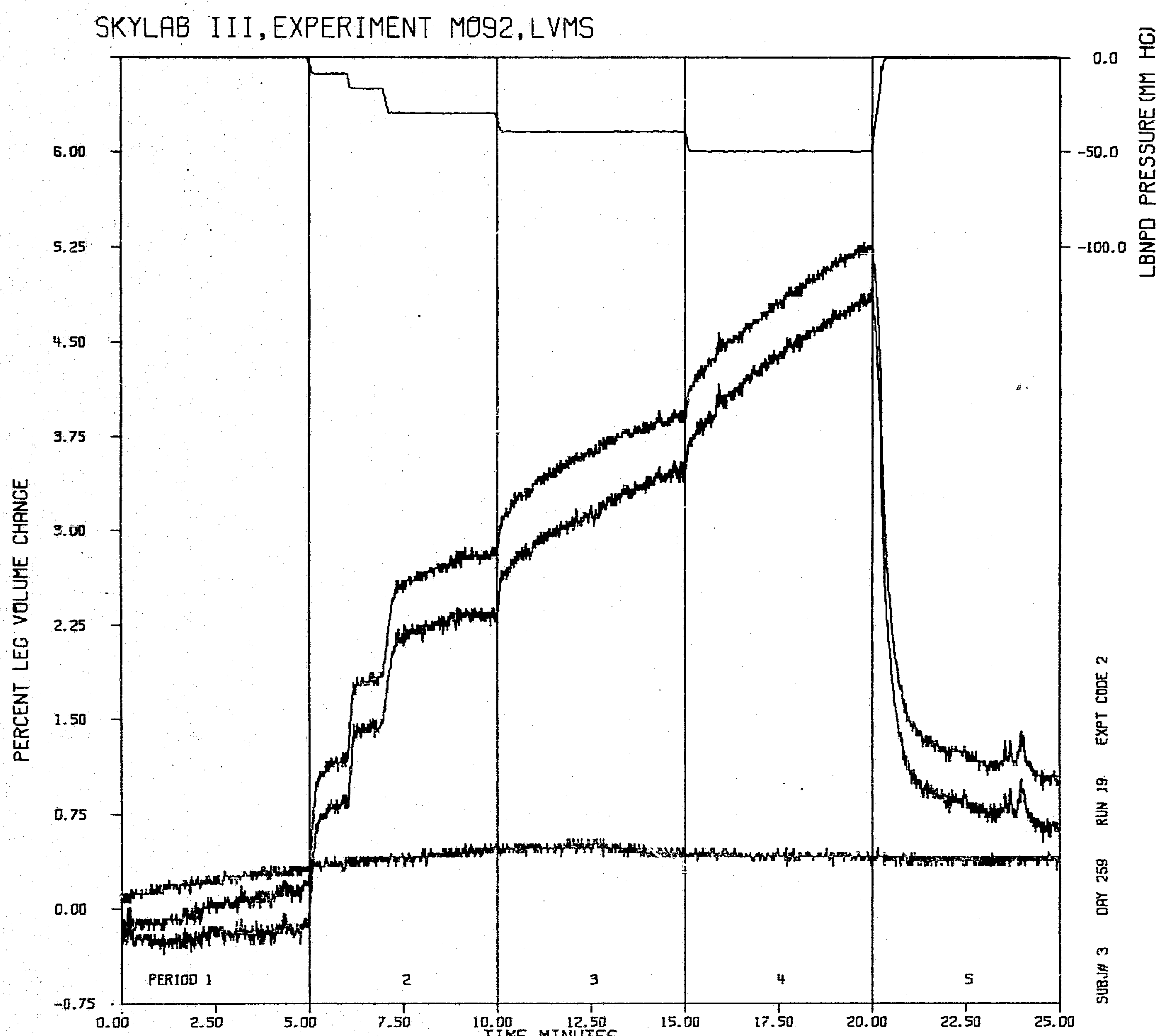
B-74

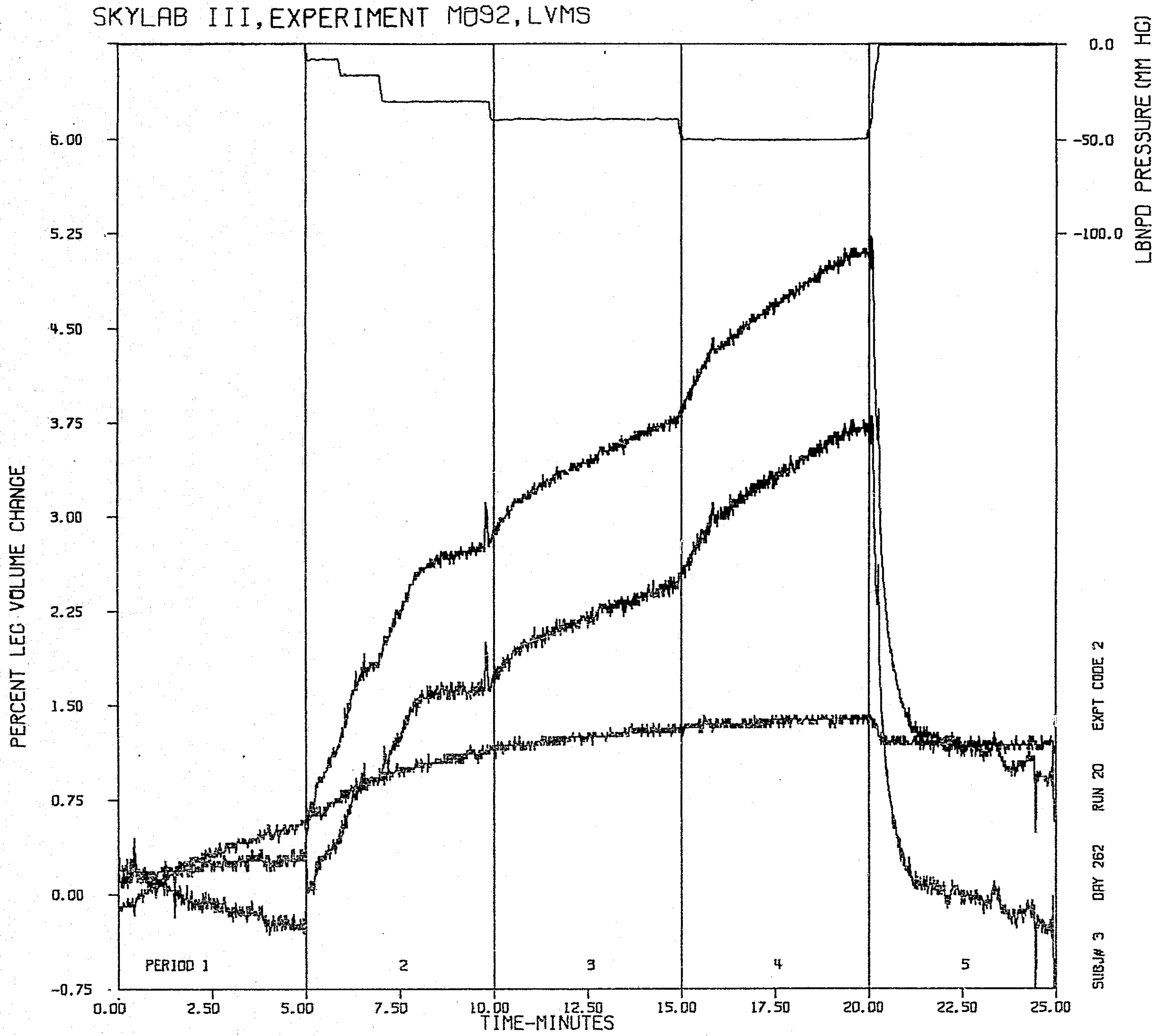


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
EXPT CODE 2
RUN 17
DAY 253
SUBJ# 3

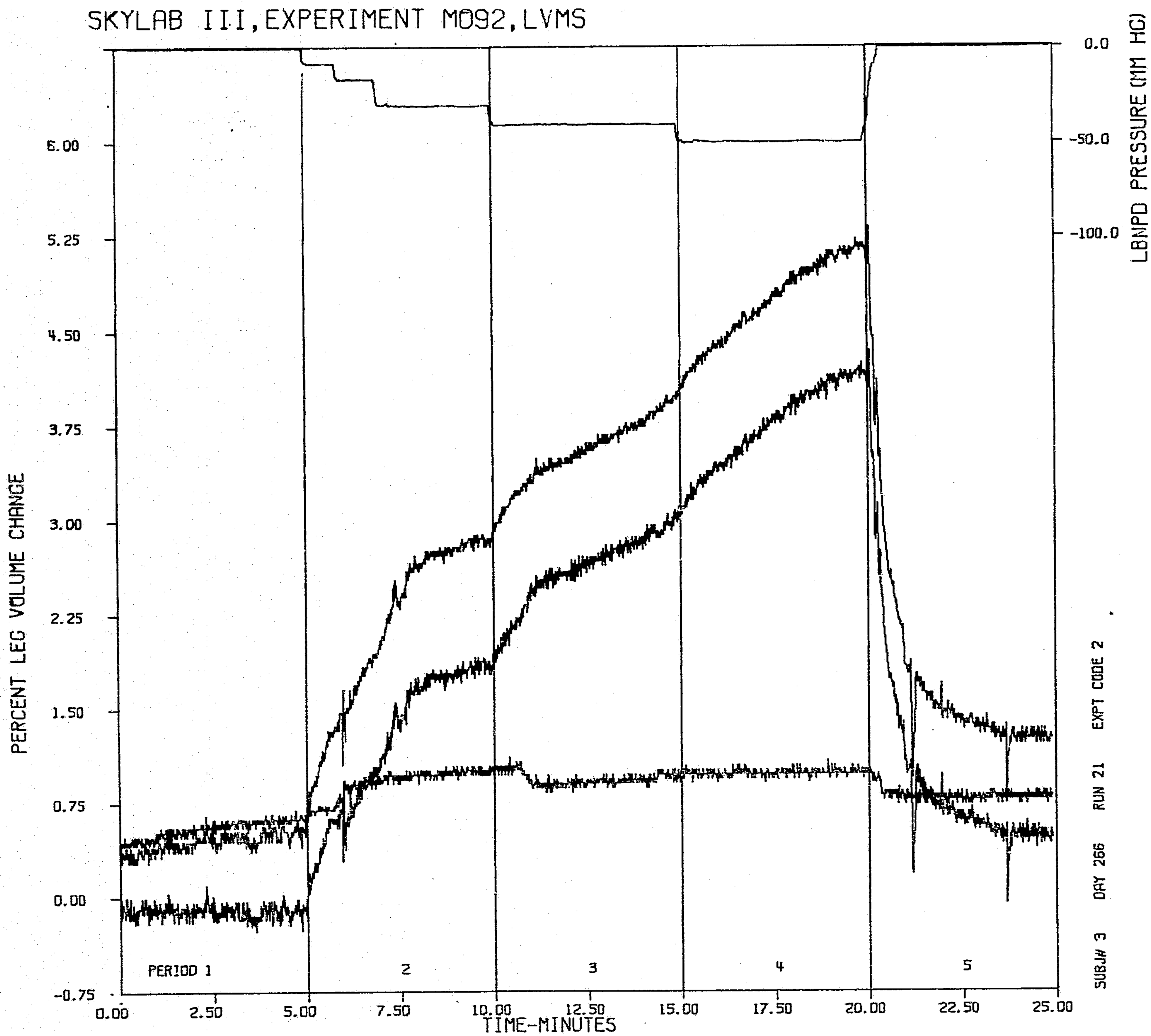
B-75


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
EXPT CODE 2
RUN 18
DAY 256
SUBJ# 3

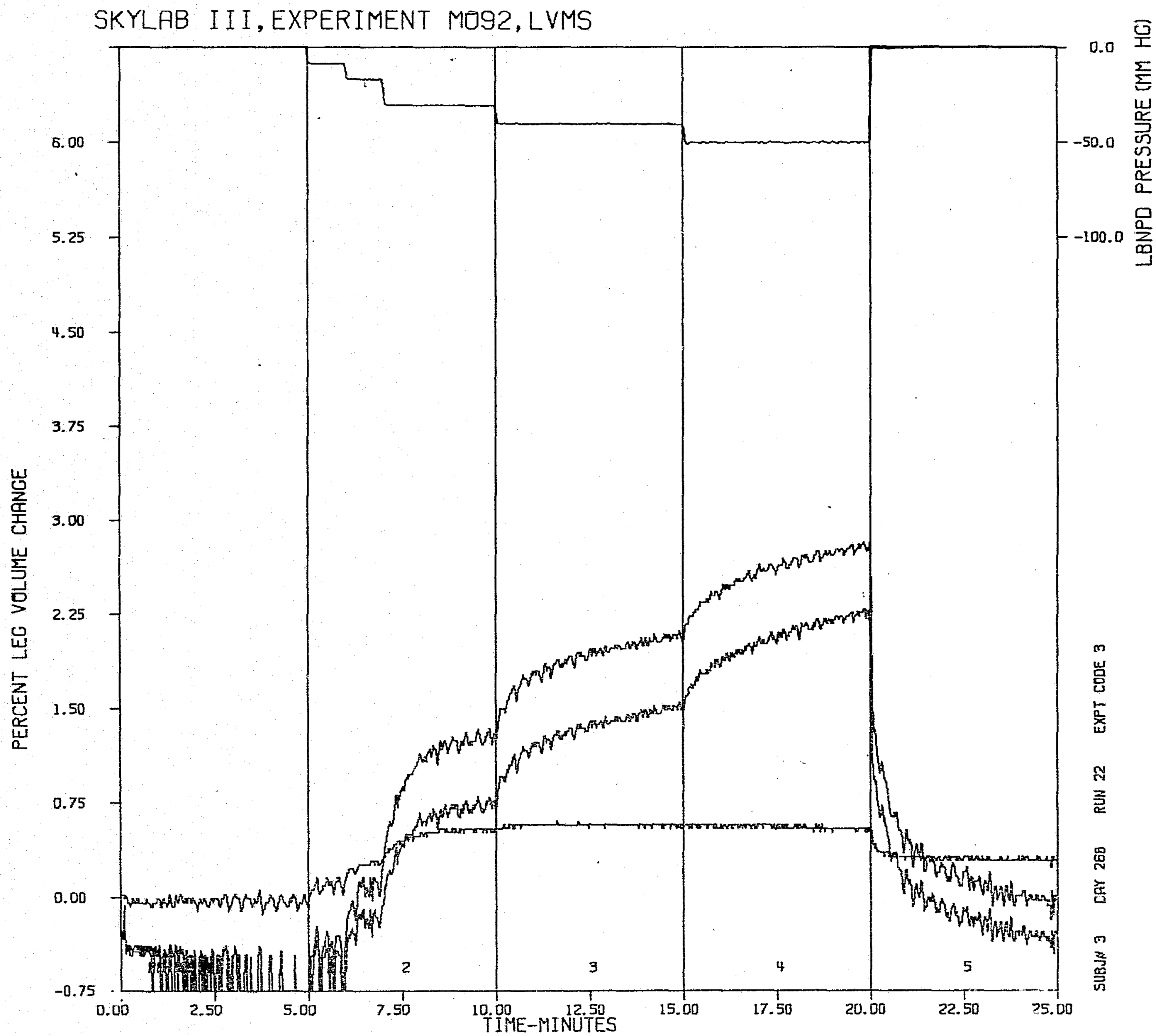

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 259 RUN 19 EXPT CODE 2



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
EXPT CODE 2
RUN 20
DAY 262
SUBJ# 3

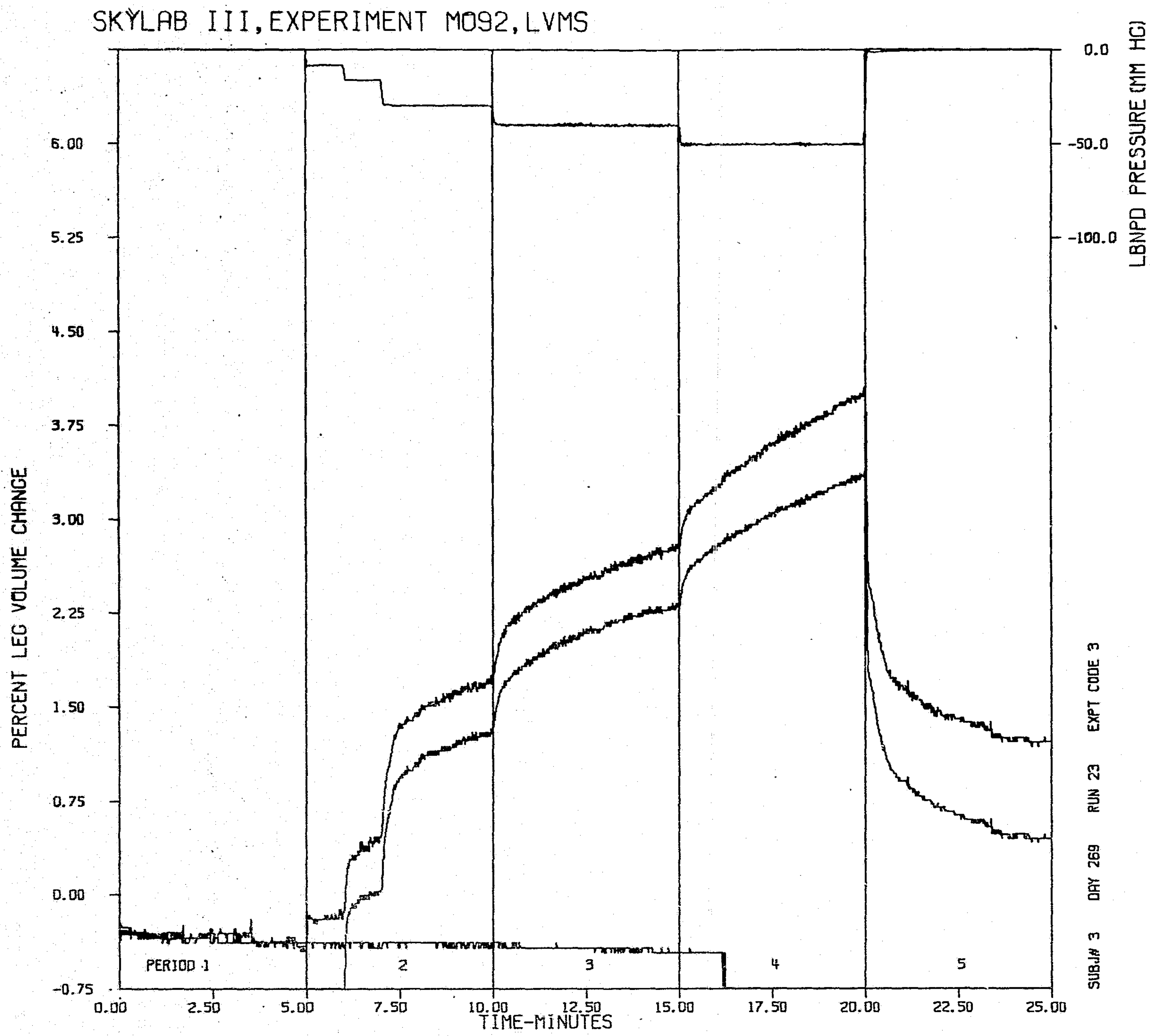


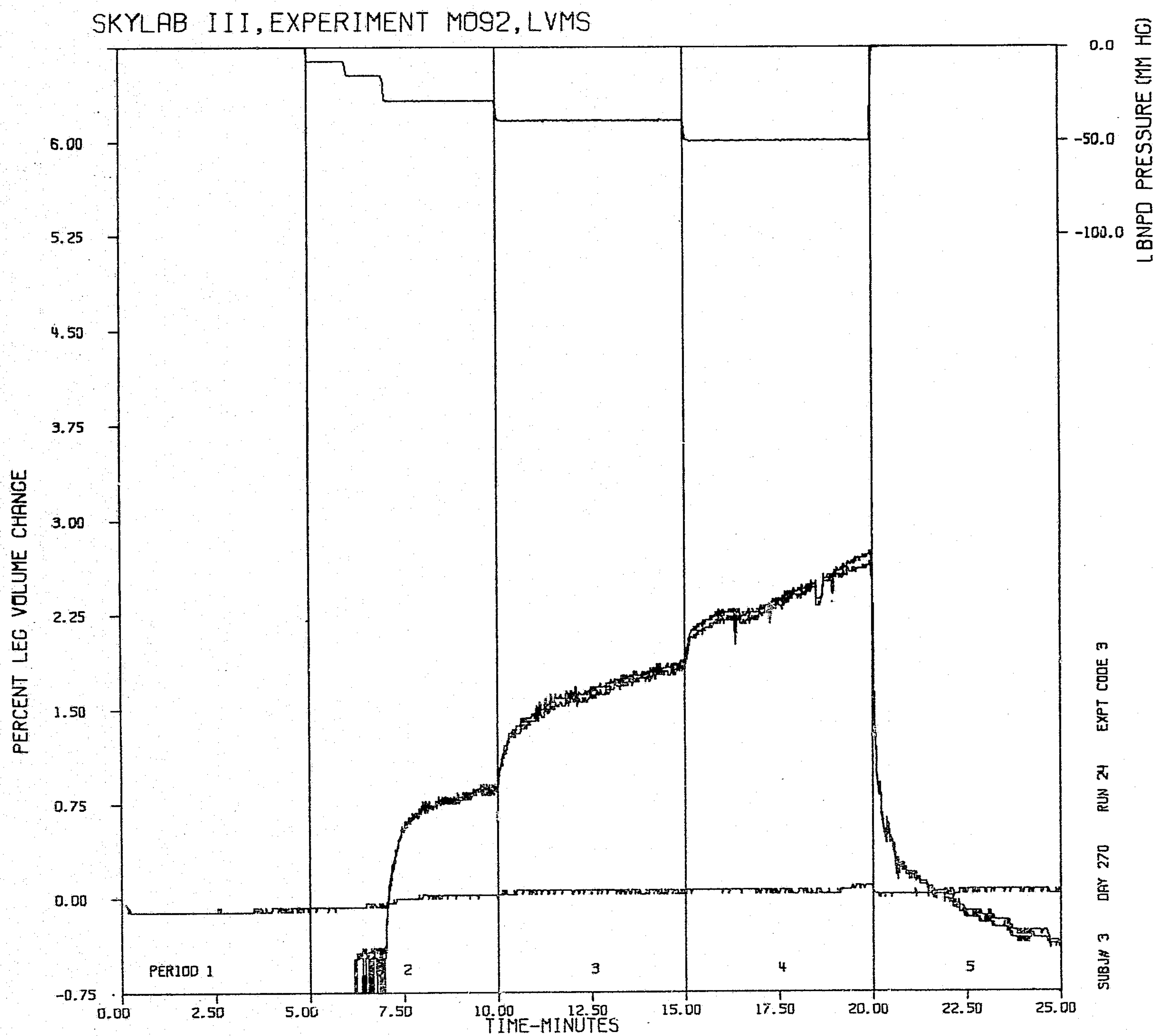
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
EXPT CODE 2
RUN 21
DAY 266
SUBJ# 3



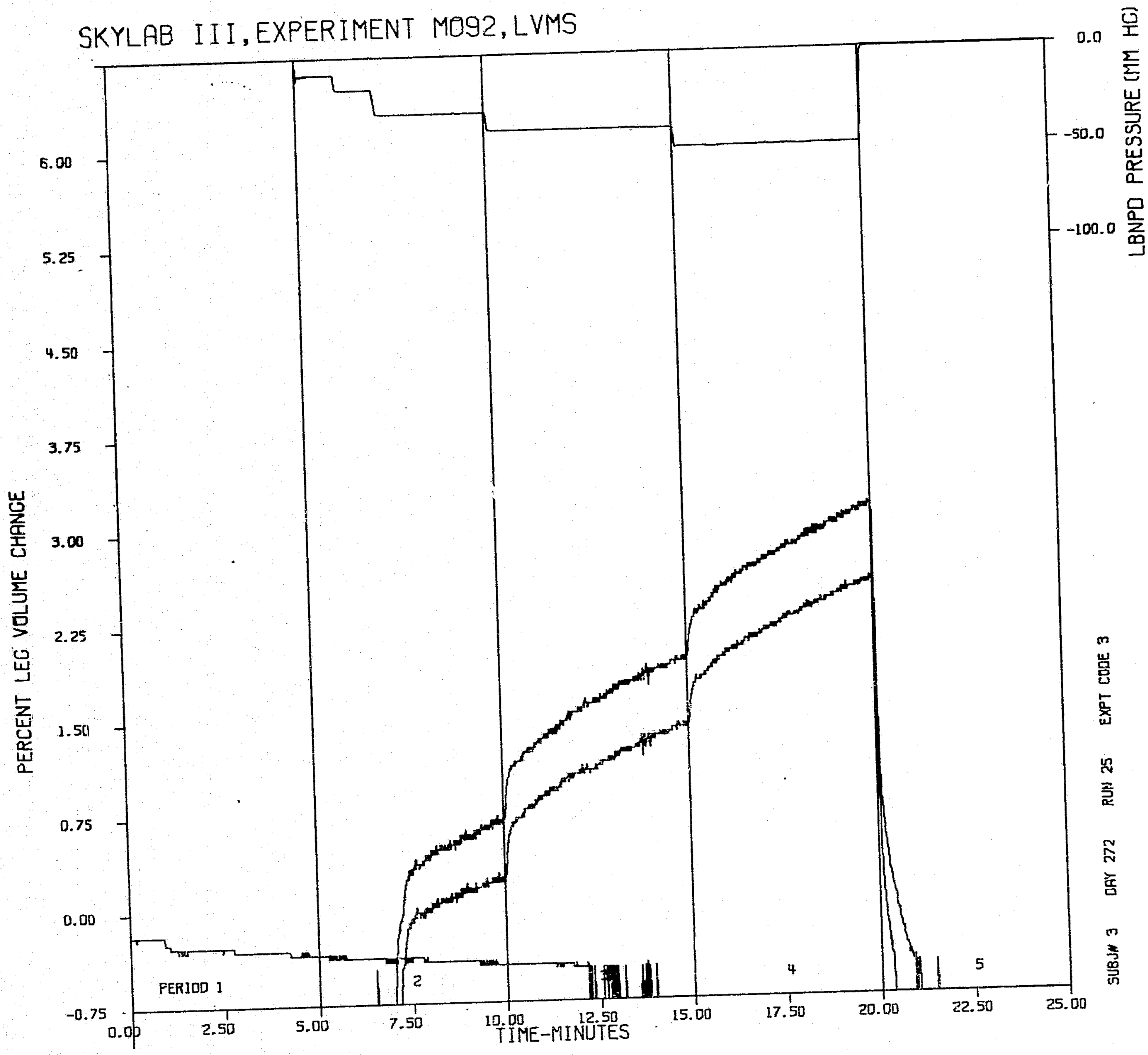
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
2
3
4
5
SUBJ# 3
DAY 268
RUN 22
EXPT CODE 3

B-80

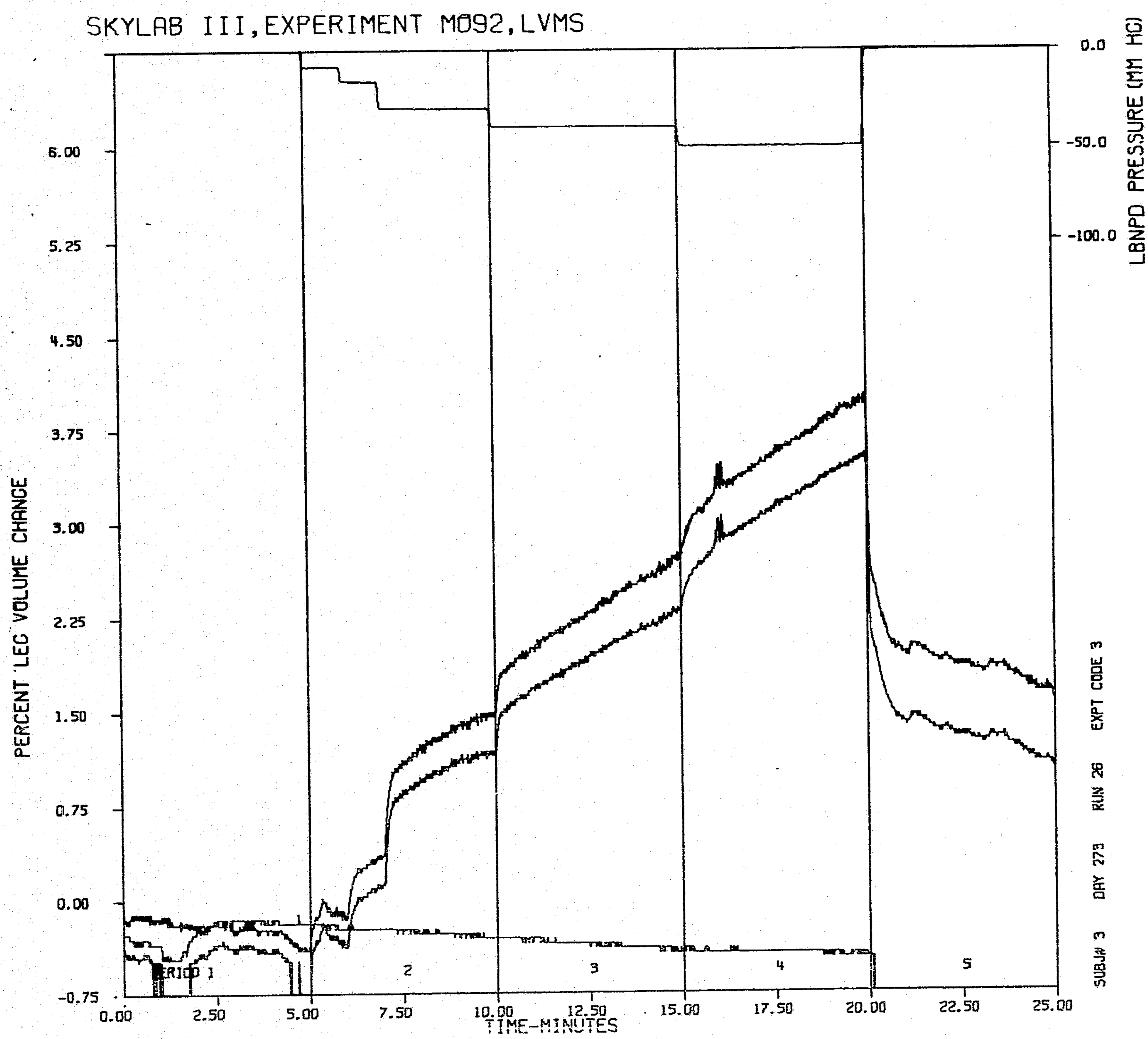

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 3 DAY 269 RUN 23 EXPT CODE 3

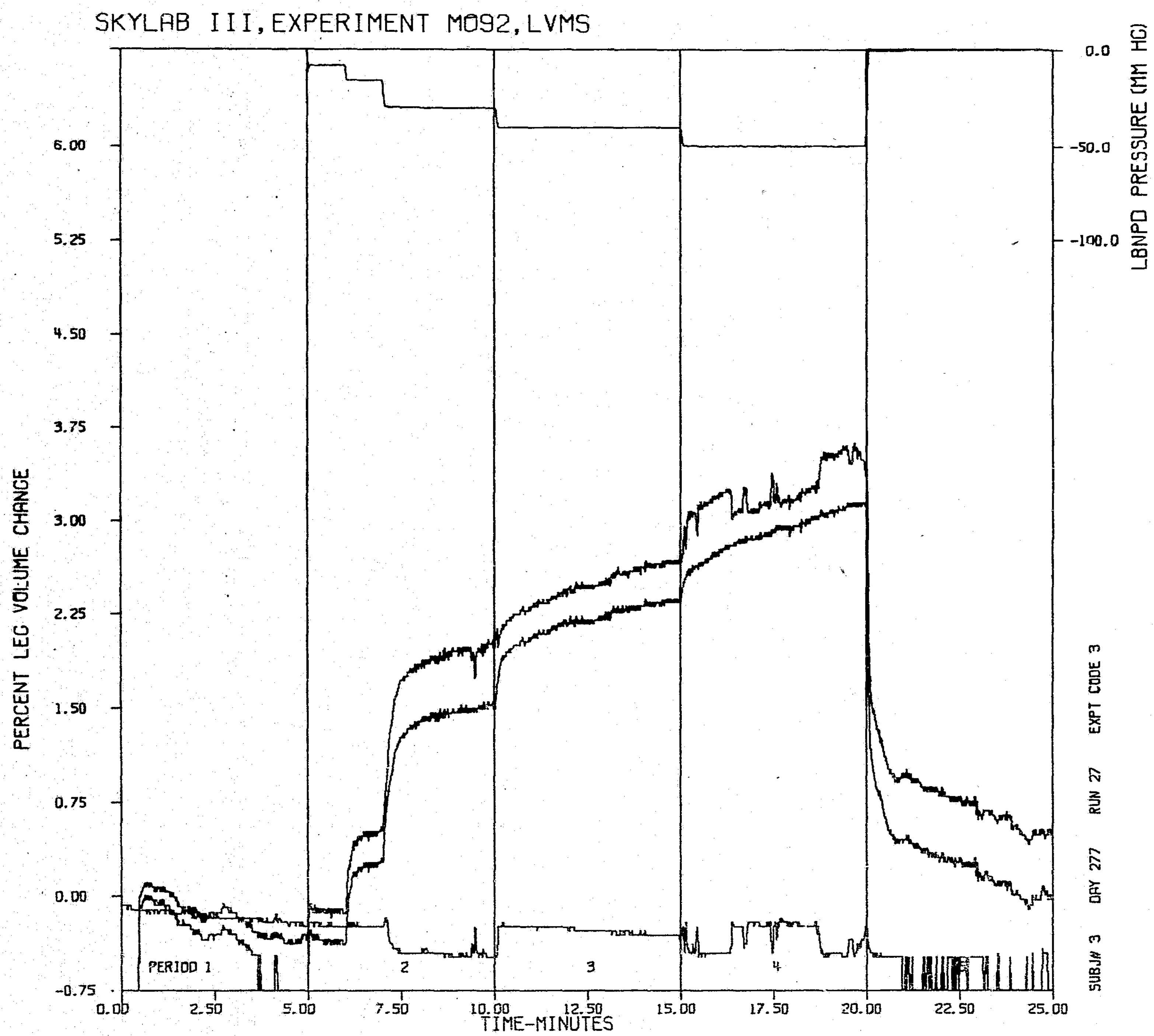


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 3 DAY 270 RUN 24 EXPT CODE 3

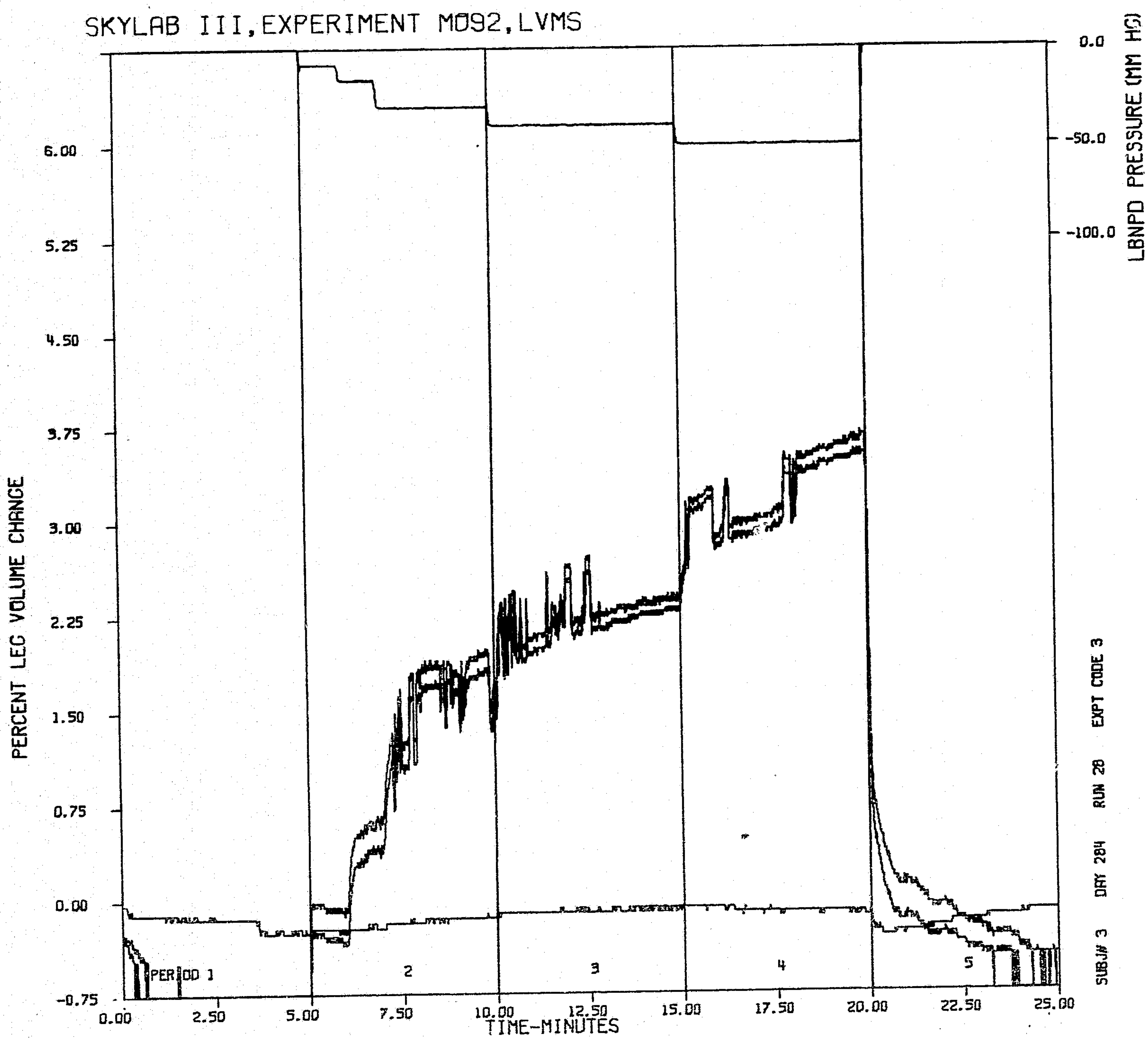


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
TIME-MINUTES
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
4
5
SUBJ# 3 DAY 272 RUN 25 EXPT CODE 3


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3
DAY 273
RUN 26
EXPT CODE 3

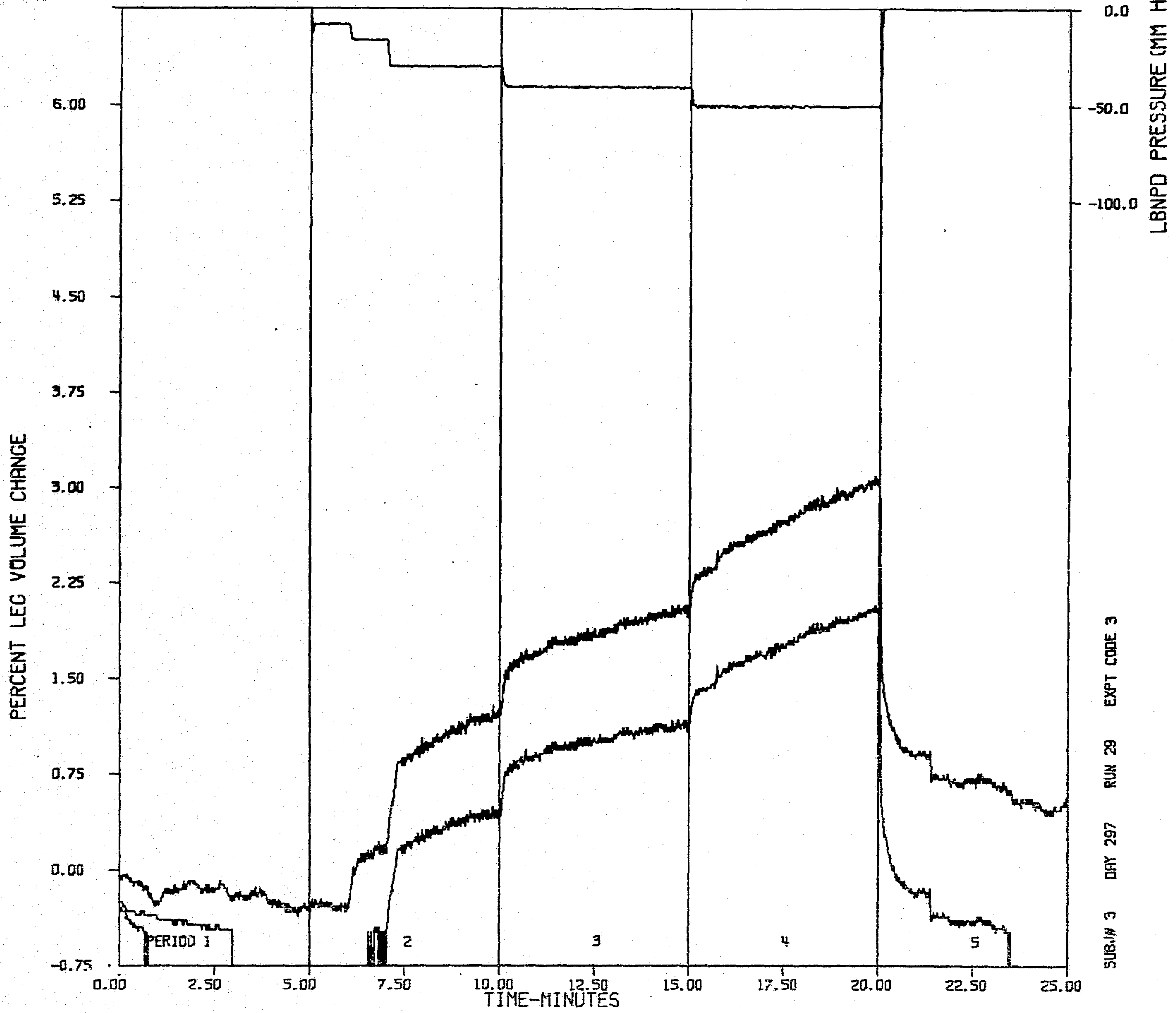


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 3 DAY 277 RUN 27 EXPT CODE 3



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3
DAY 284
RUN 28
EXPT CODE 3

SKYLAB III, EXPERIMENT M092, LVMS



APPENDIX C

DESCRIPTORS FOR RUN TYPE CODE

1. Data OK
2. Missing Data
3. Questionable or bad data
4. Short Record
5. Data over range
6. 10 min at -40 mm Hg
7. Timing off
8. Rt leg offset - used left leg instead of PLVC data
9.
10.

Combinations - 2nd digit indicates 2nd condition

21 -- 30 Missing data

31 -- 40 Questionable or bad data

41 -- 50 Presyncope

51 -- 60 Data over range

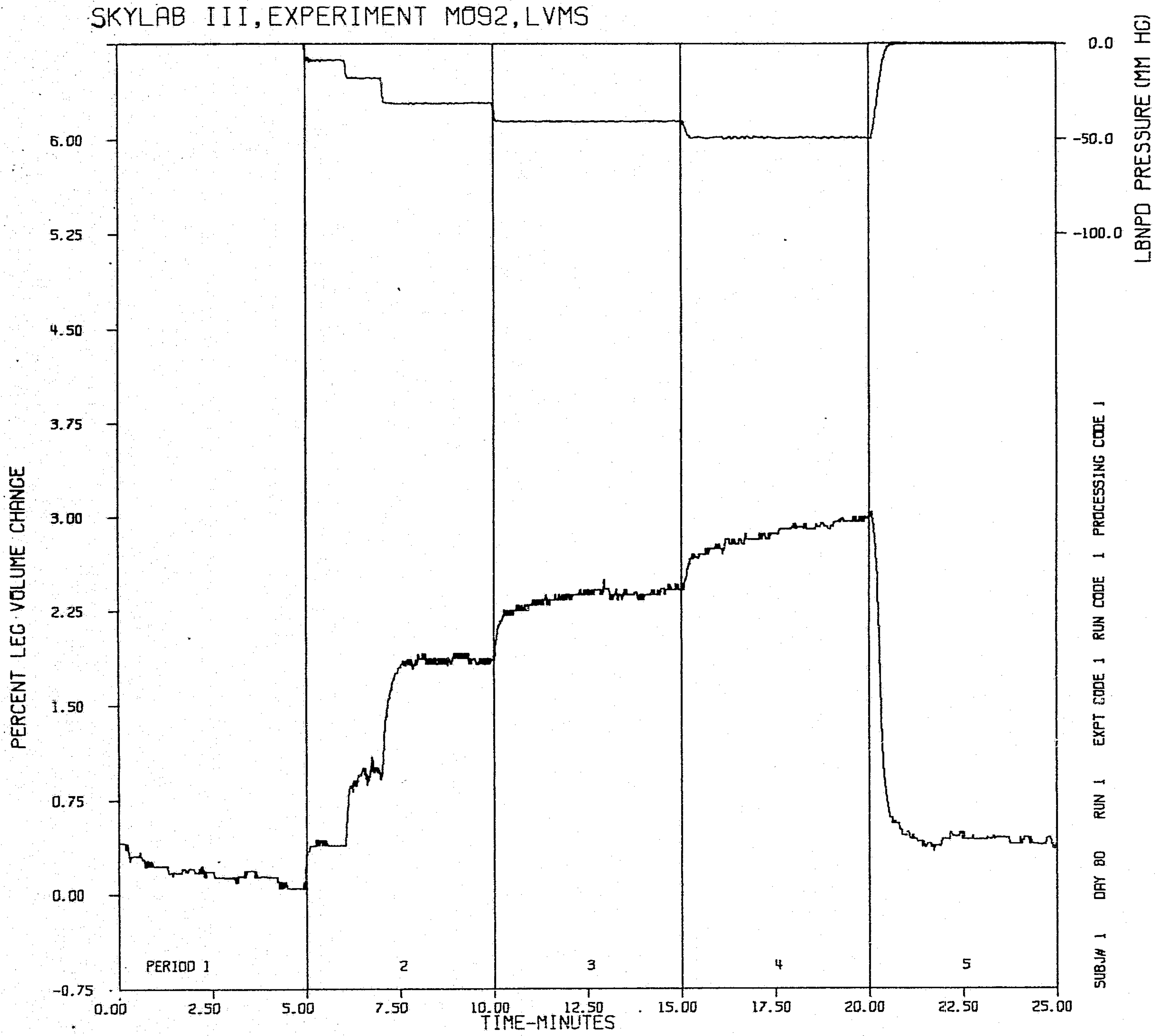
61 -- 70 10 min at -40 mm Hg

71 -- 80 Timing off

81 -- 90 Rt leg offset - used left leg

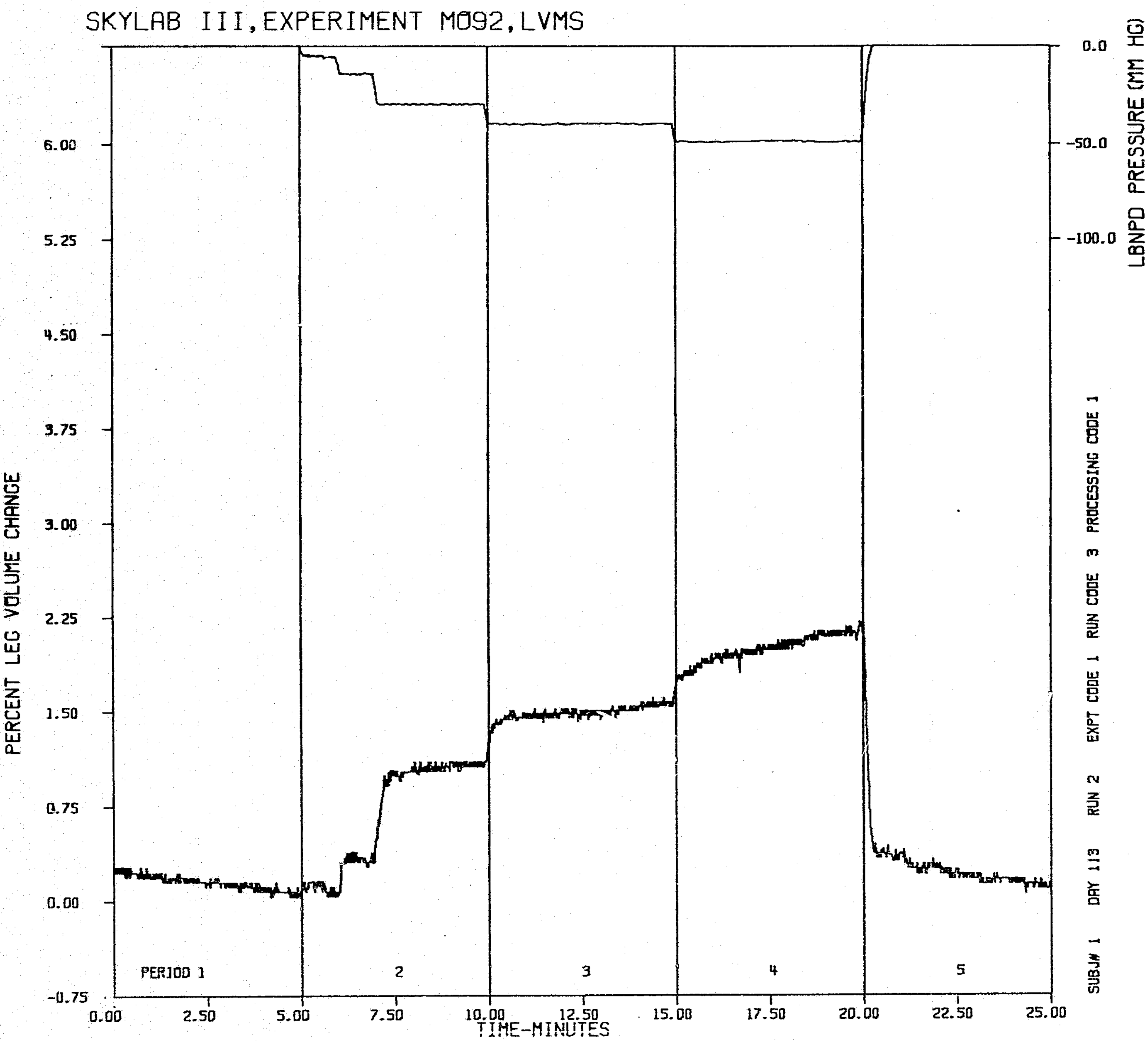
FOR COMBINATION CODES THE 2ND DIGIT SHOULD ALWAYS BE LARGER THAN THE FIRST DIGIT (i.e., 28, 78)

APPENDIX D

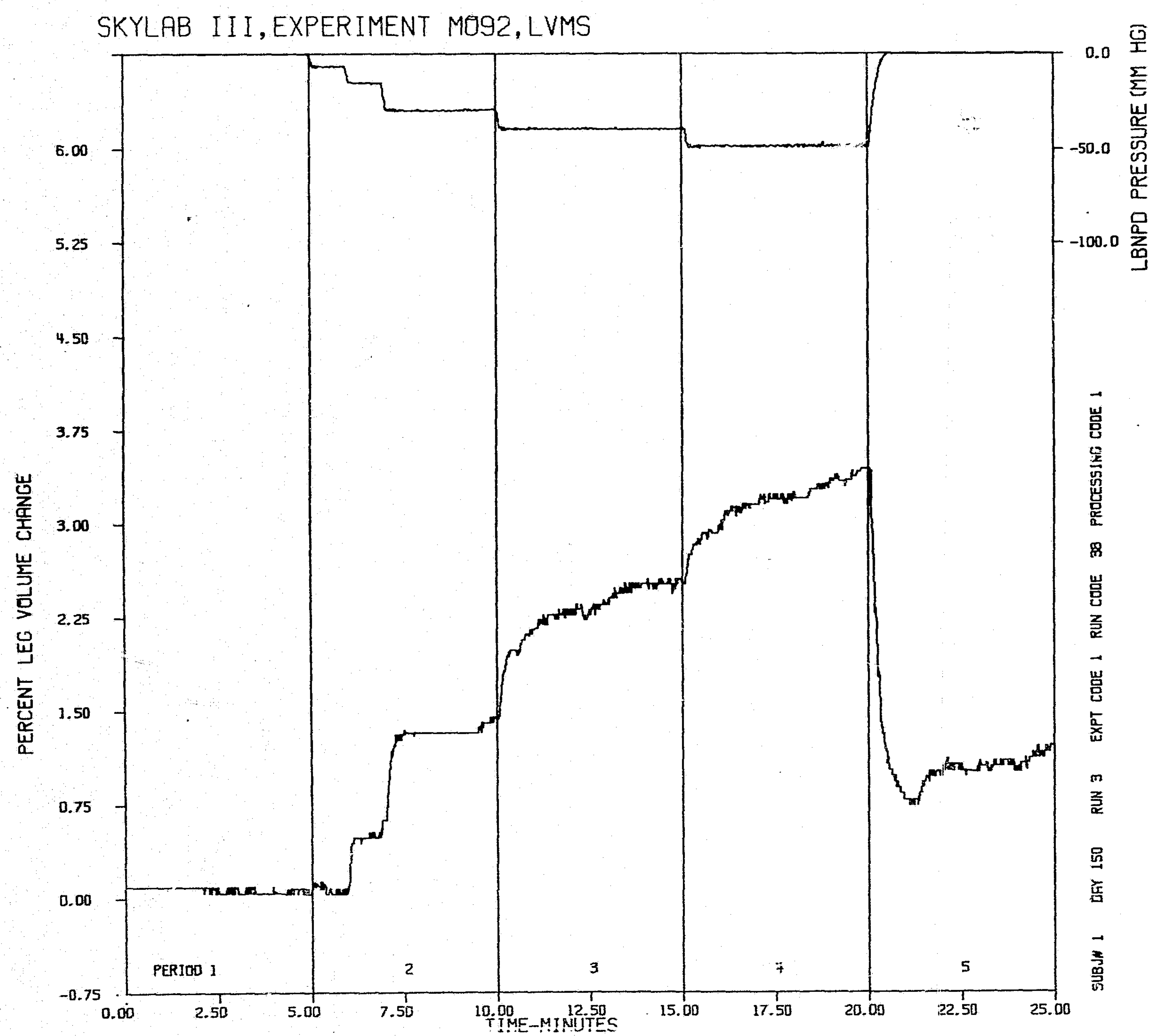


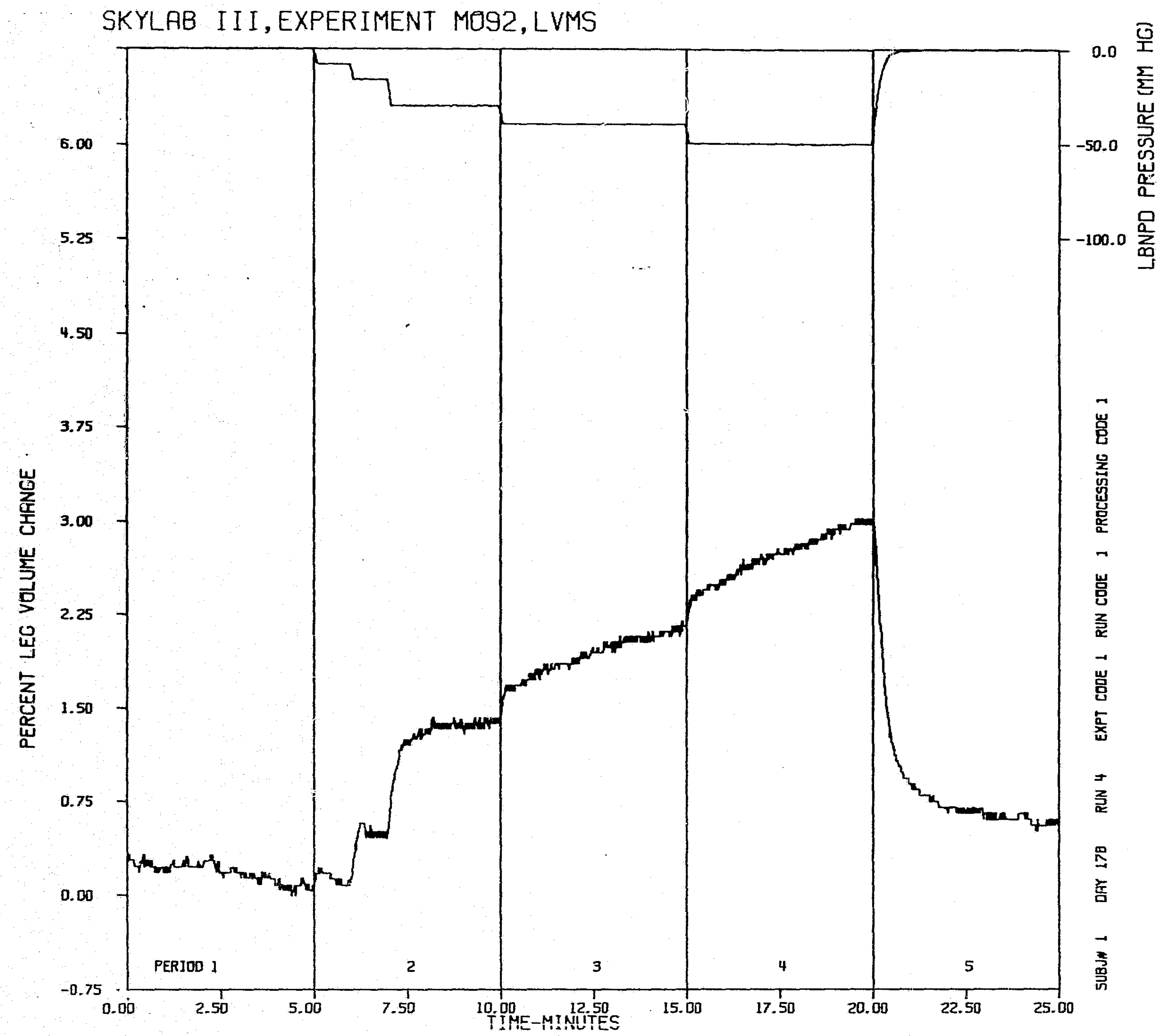
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 80 RUN 1 EXPT CODE 1 RUN CODE 1 PROCESSING CODE 1

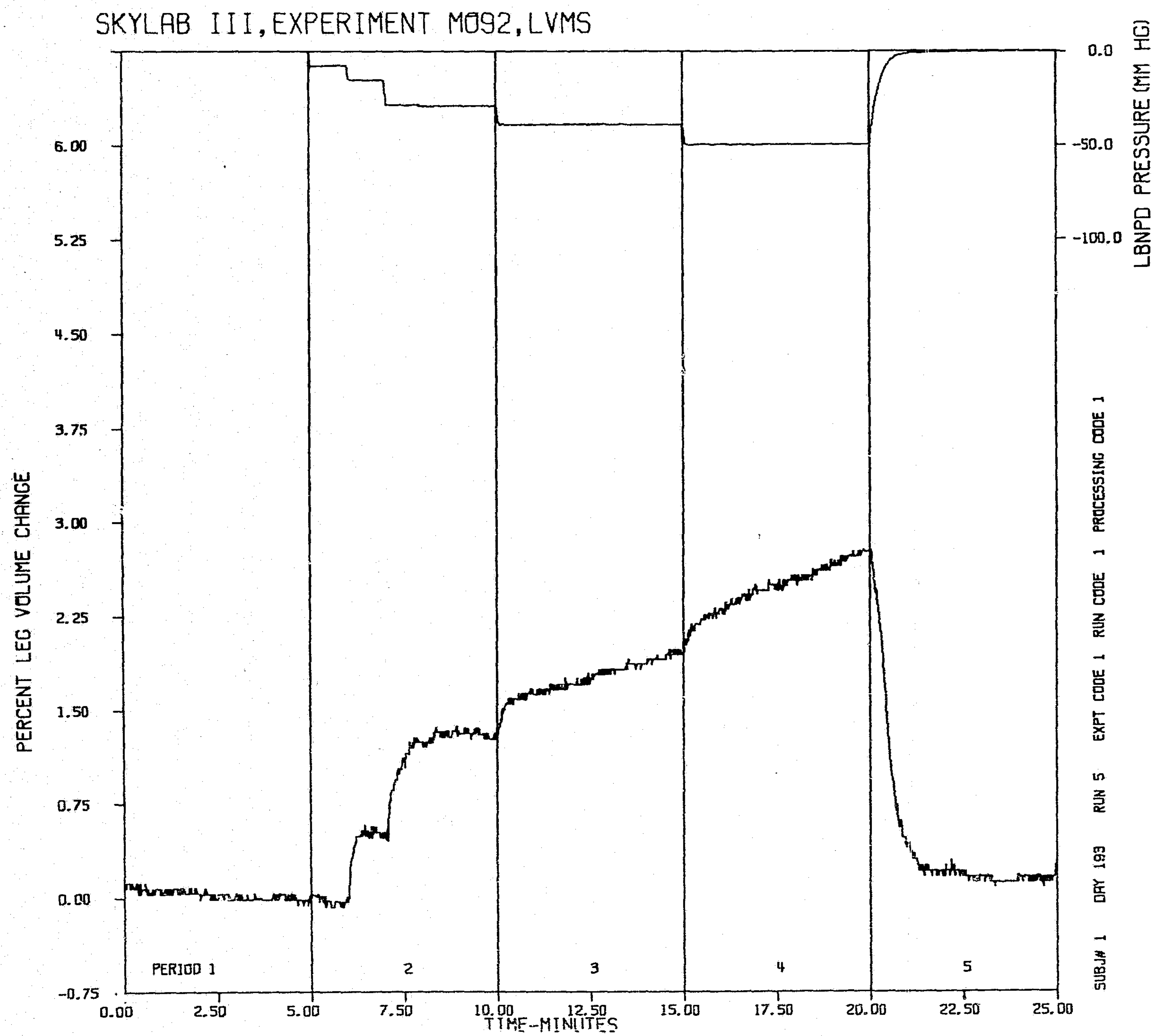
D-1



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
-0.75
0.75
1.50
2.25
3.00
3.75
4.50
5.25
6.00
0.0
-50.0
-100.0
SUBJ# 1 DAY 113 RUN 2 EXPT CODE 1 RUN CODE 3 PROCESSING CODE 1


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
LBNPD PRESSURE (MM HG)
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 1 DAY 150 RUN 3 EXPT CODE 1 RUN CODE 38 PROCESSING CODE 1

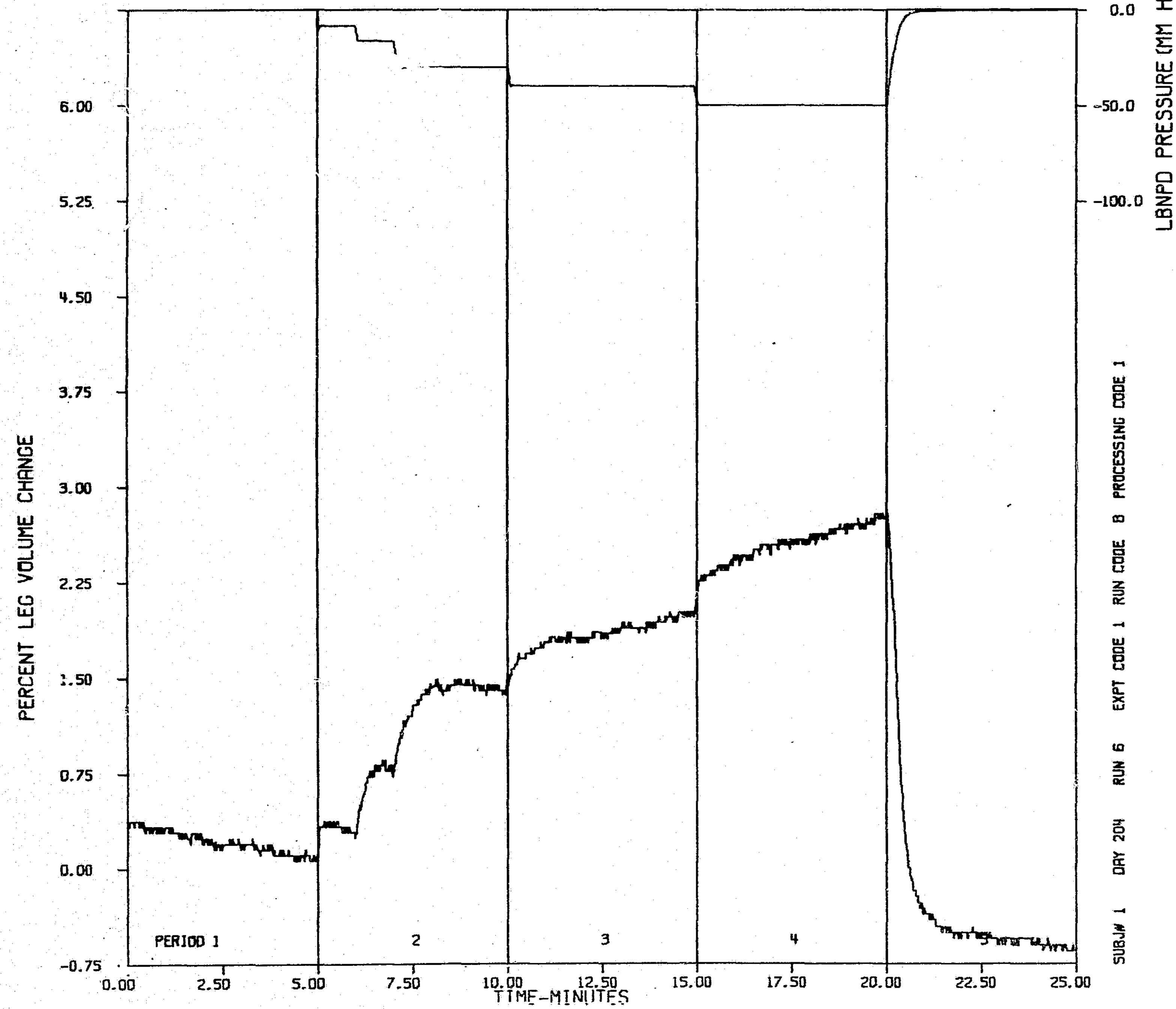

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 178 RUN 4 EXPT CODE 1 RUN CODE 1 PROCESSING CODE 1

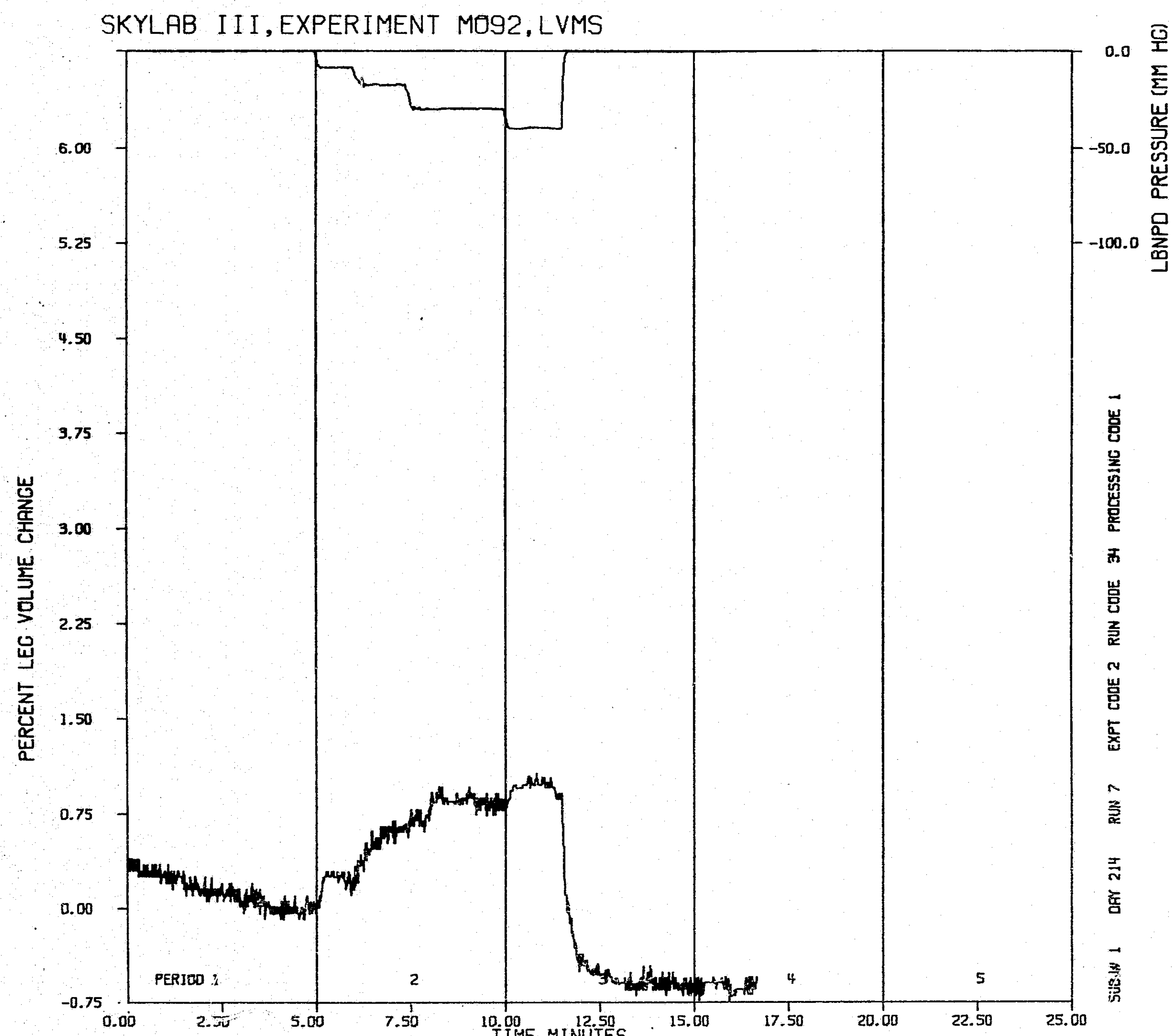


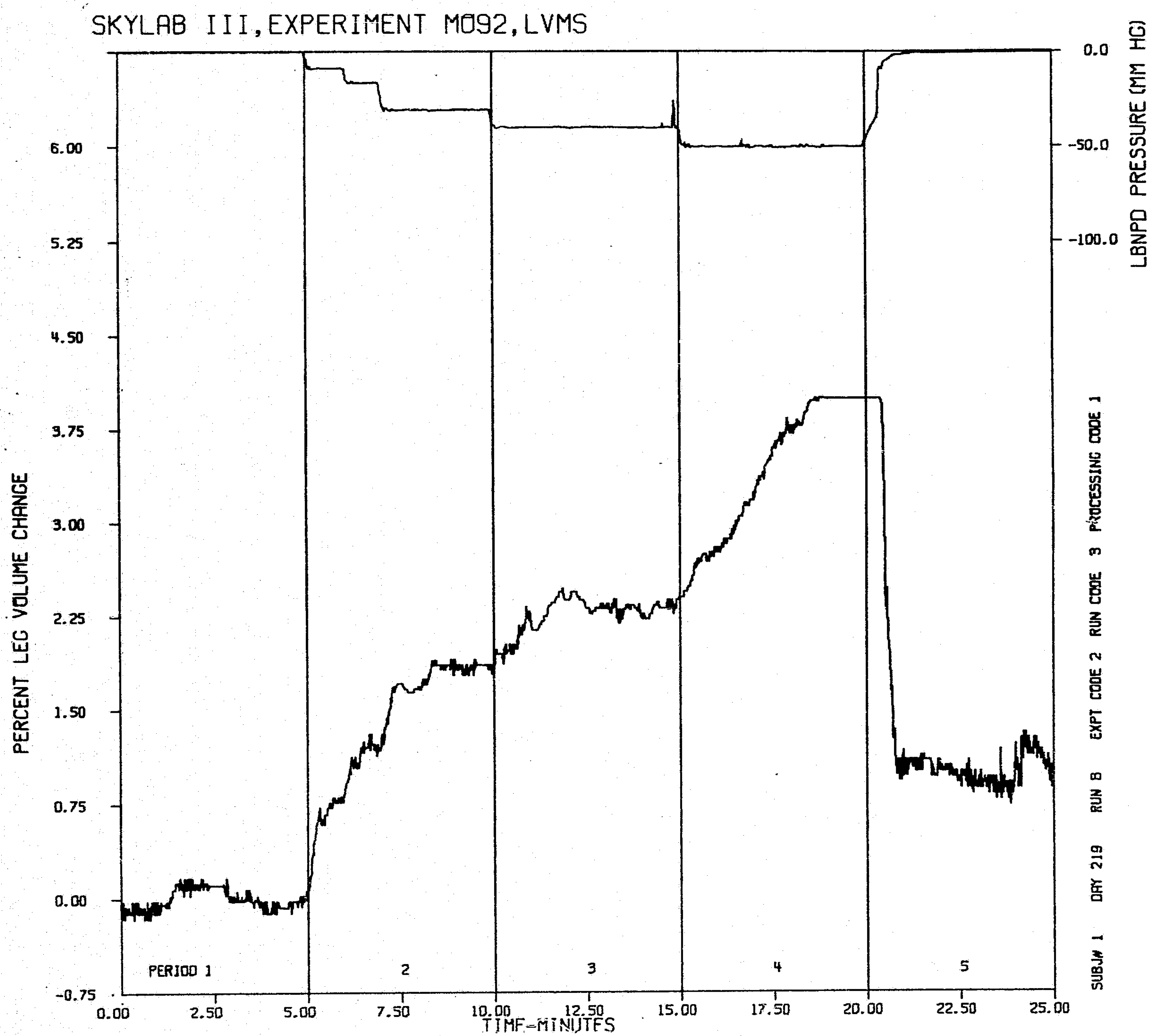
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 193 RUN 5 EXPT CODE 1 RUN CODE 1 PROCESSING CODE 1

D-5

SKYLAB III, EXPERIMENT M092, LVMS

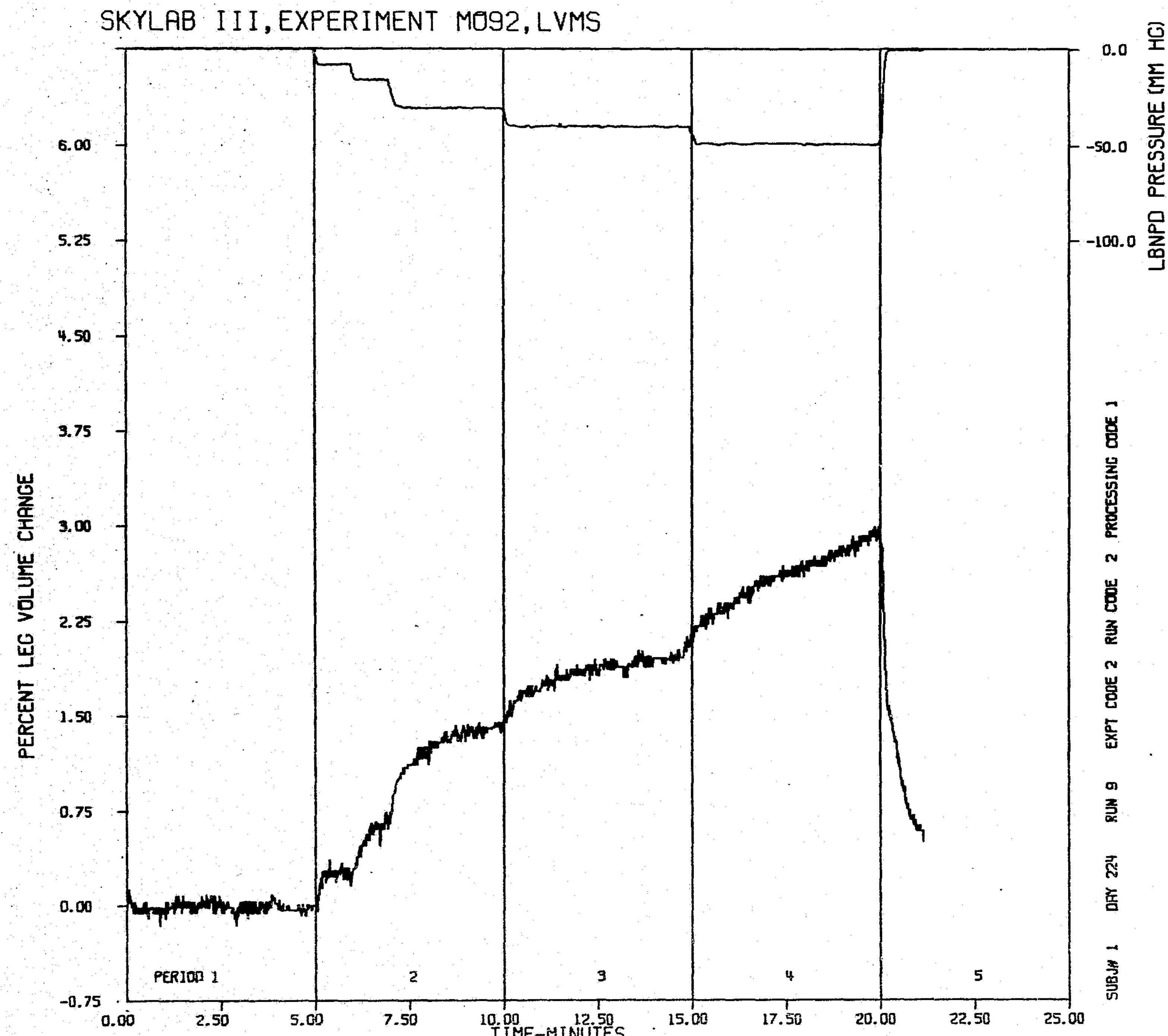



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ 1 DAY 214 RUN 7 EXPT CODE 2 RUN CODE 34 PROCESSING CODE 1

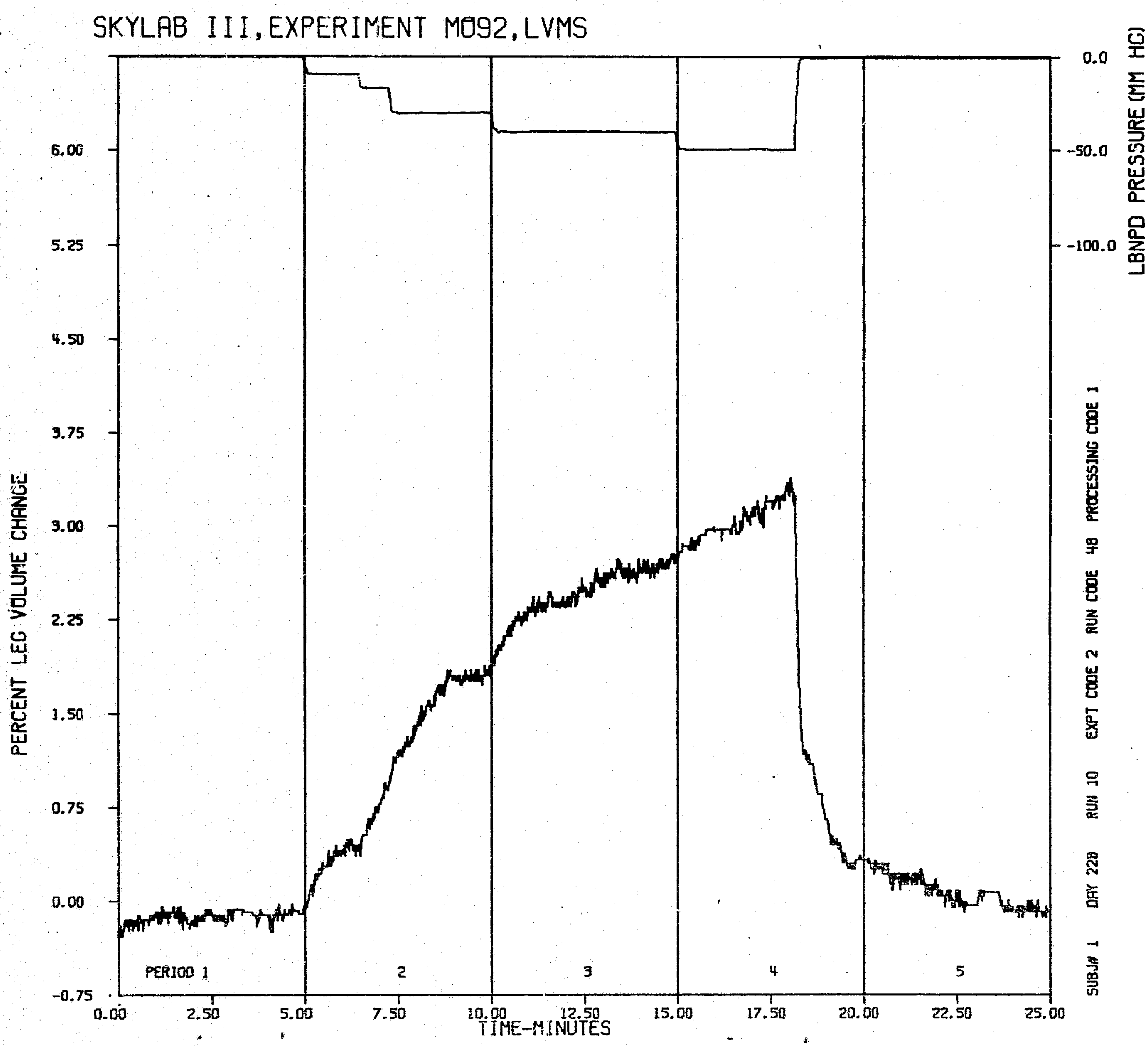


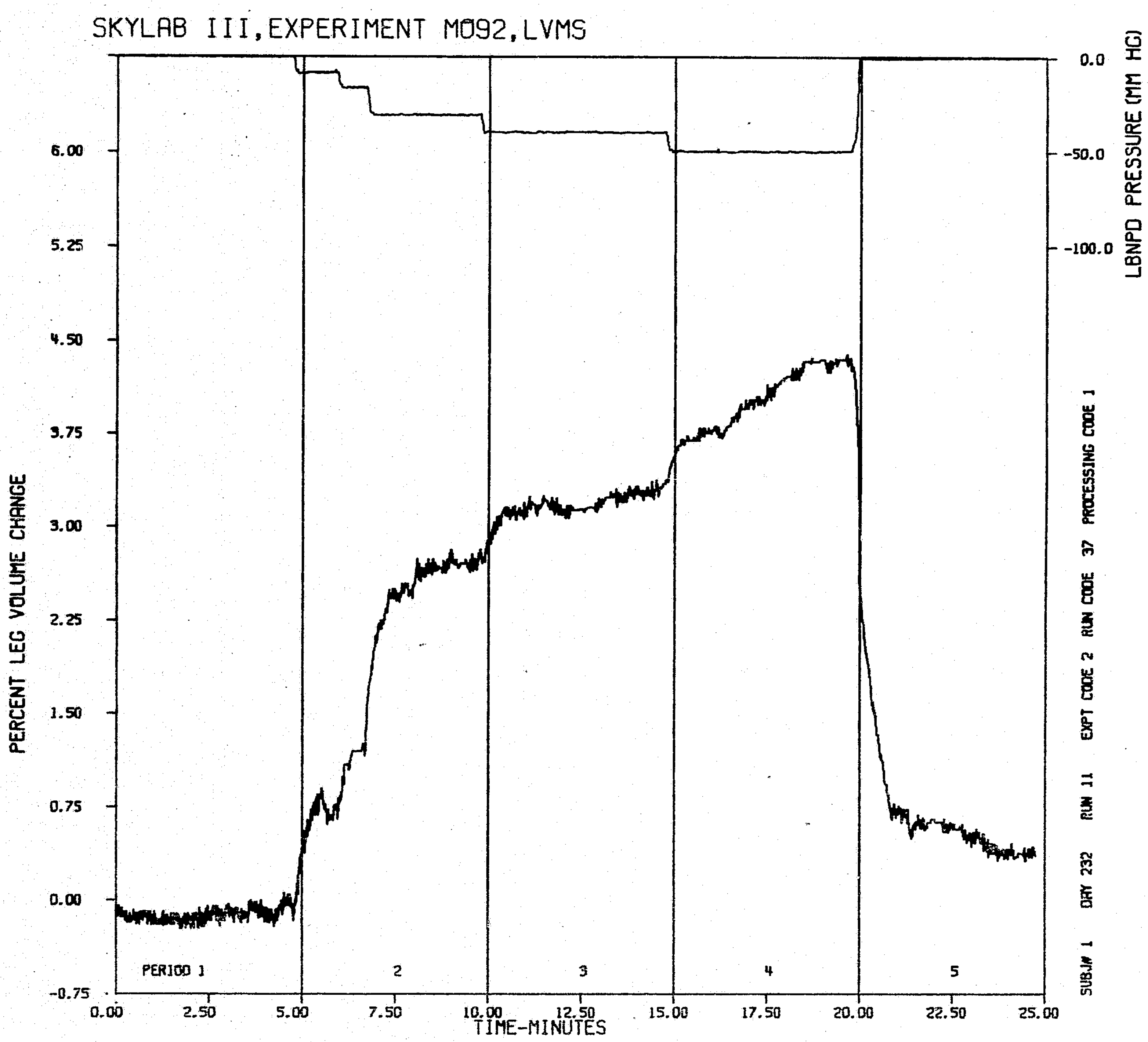
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 219 RUN 8 EXPT CODE 2 RUN CODE 3 PROCESSING CODE 1

D-8



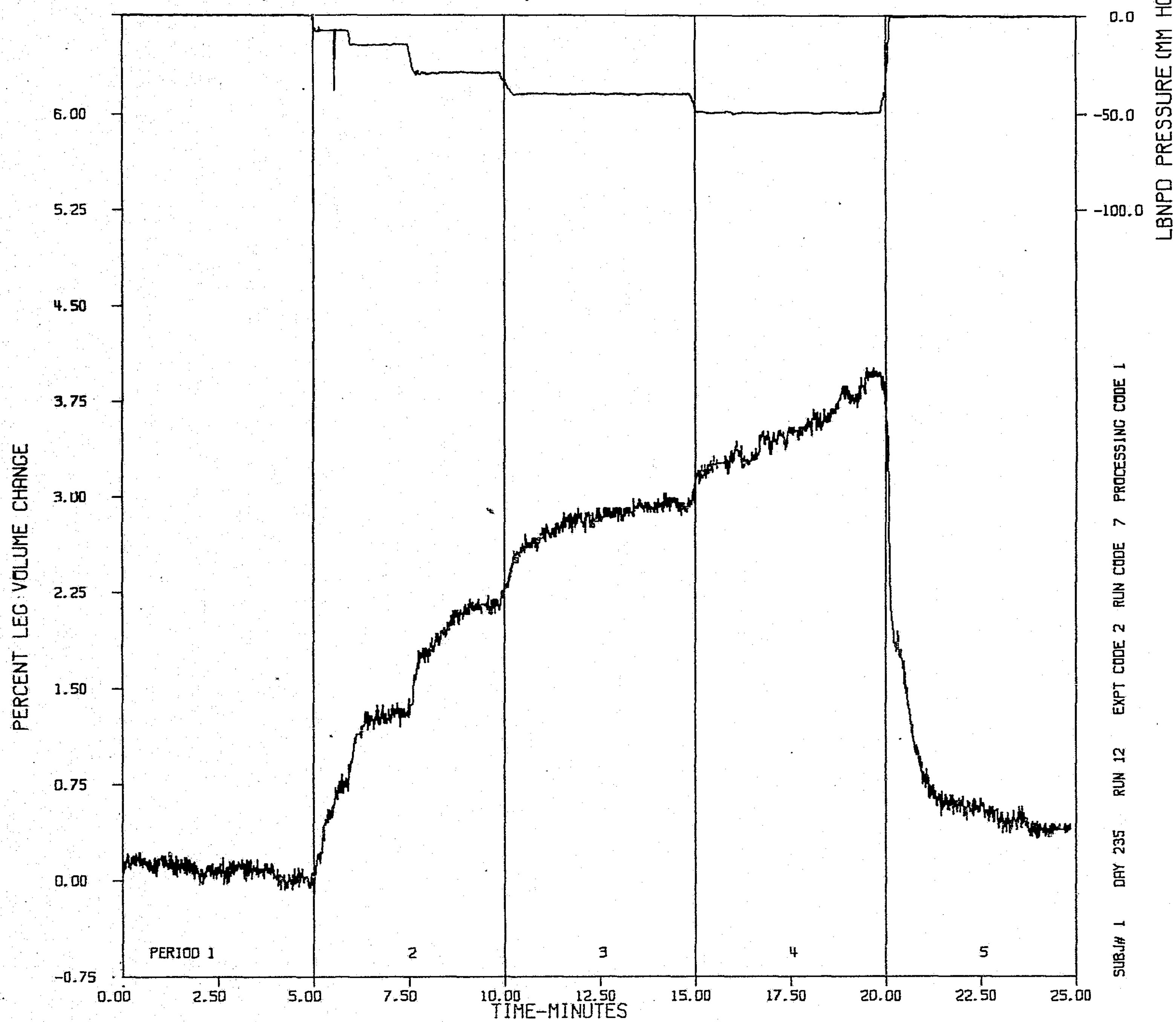
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 224 RUN 9 EXPT CODE 2 RUN CODE 2 PROCESSING CODE 1


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 228 RUN 10 EXPT CODE 2 RUN CODE 48 PROCESSING CODE 1

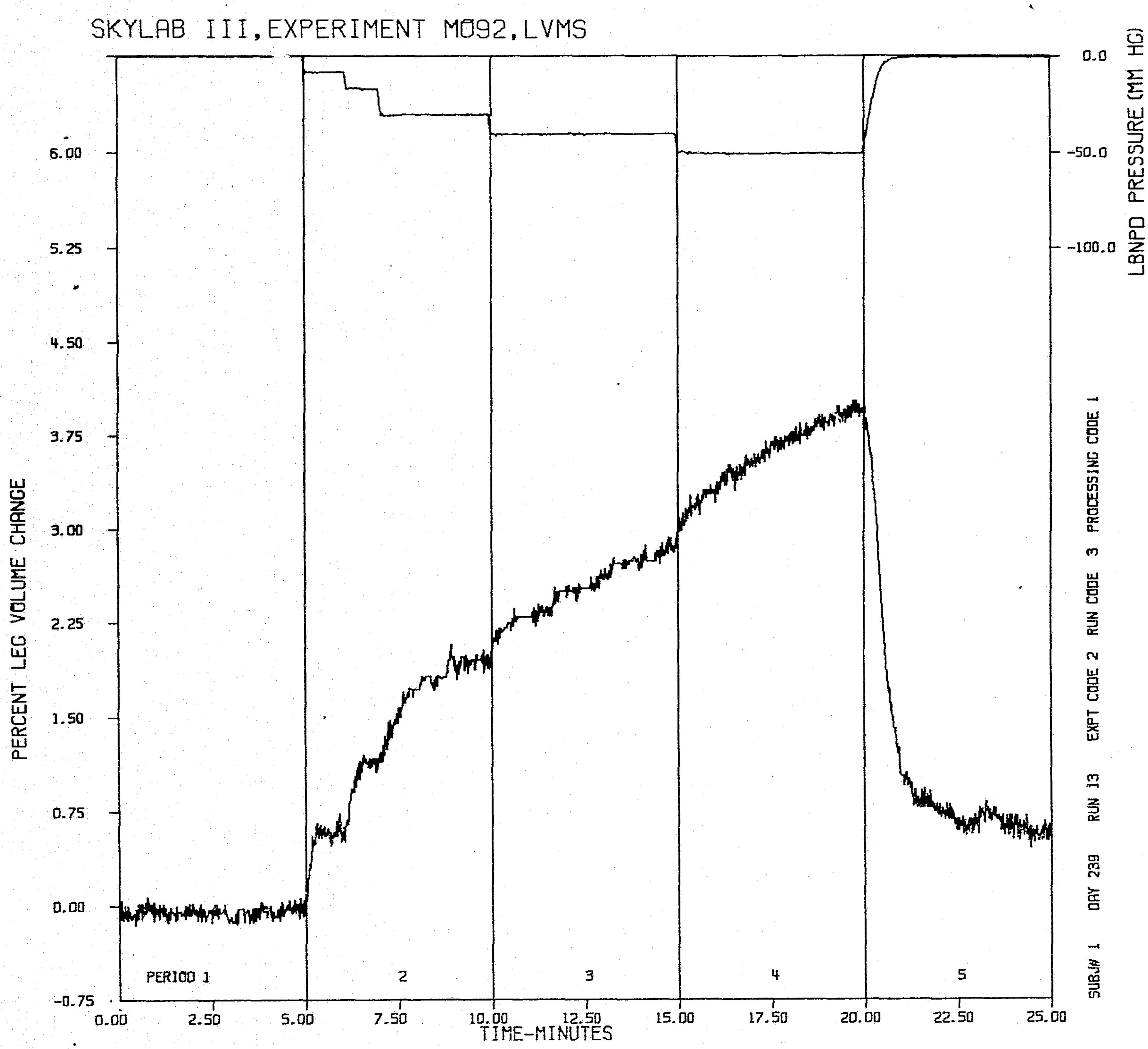


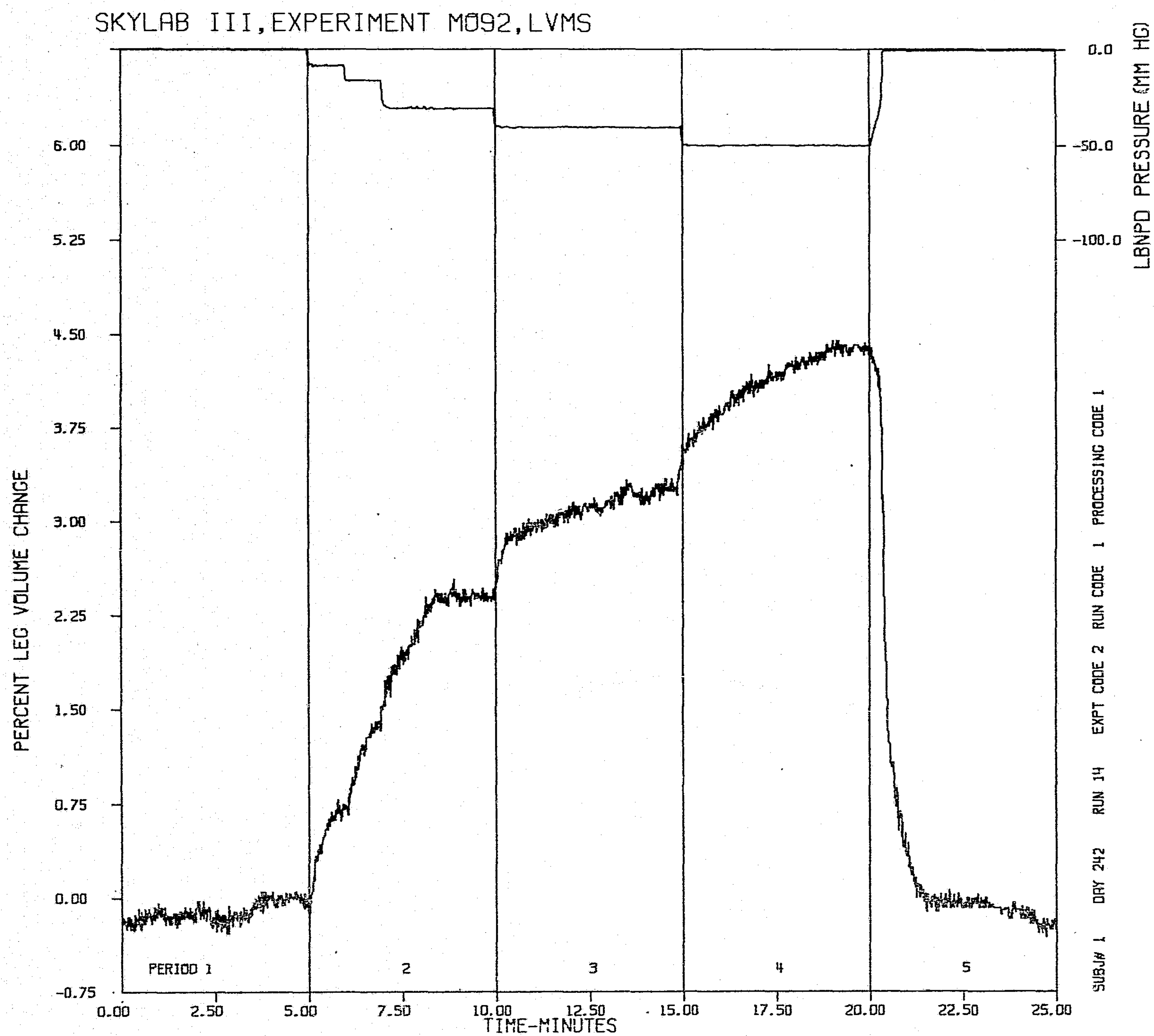
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 232 RUN 11 EXPT CODE 2 RUN CODE 37 PROCESSING CODE 1

SKYLAB III, EXPERIMENT M092, LVMS

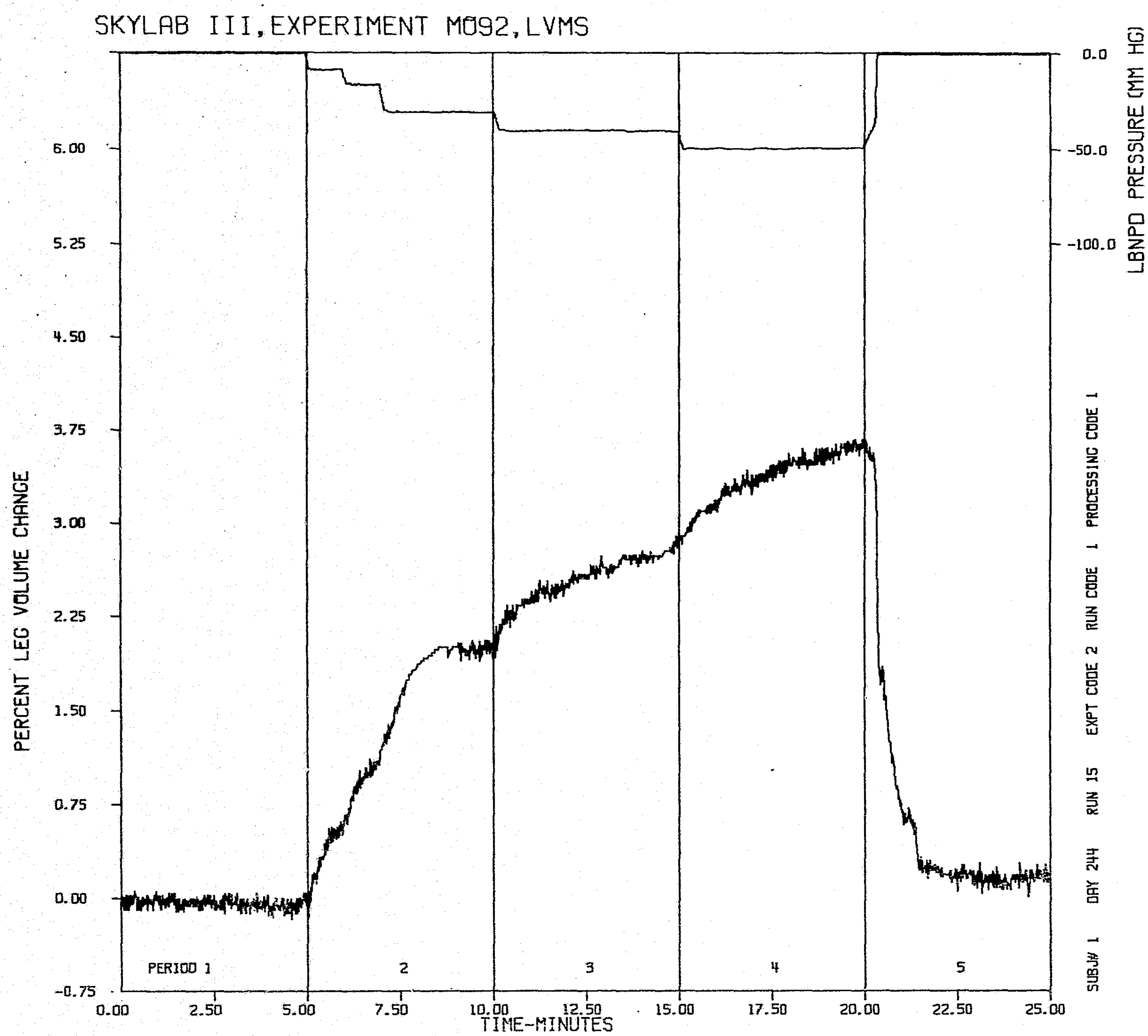


D-12

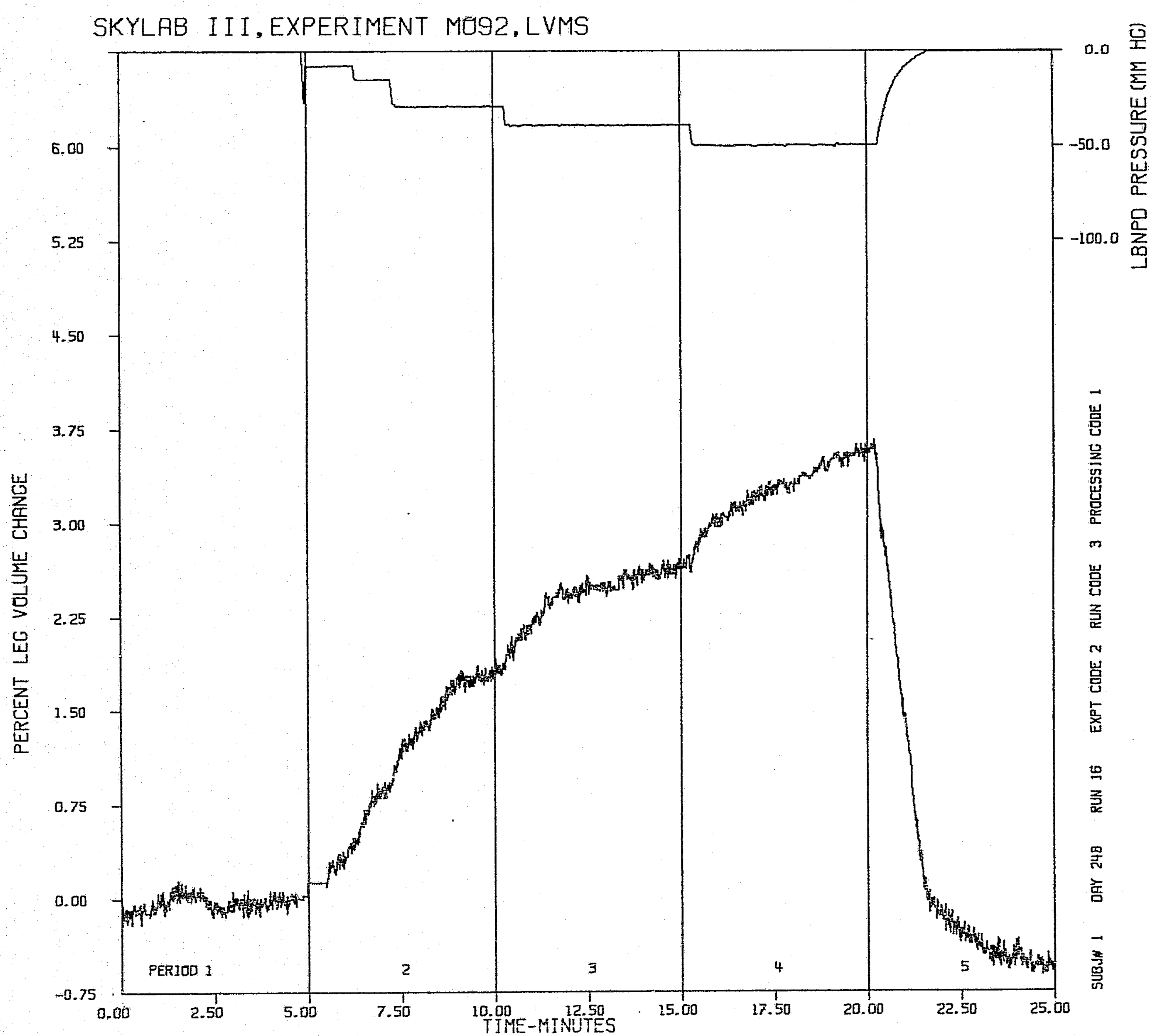

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 239 RUN 13 EXPT CODE 2 RUN CODE 3 PROCESSING CODE 1



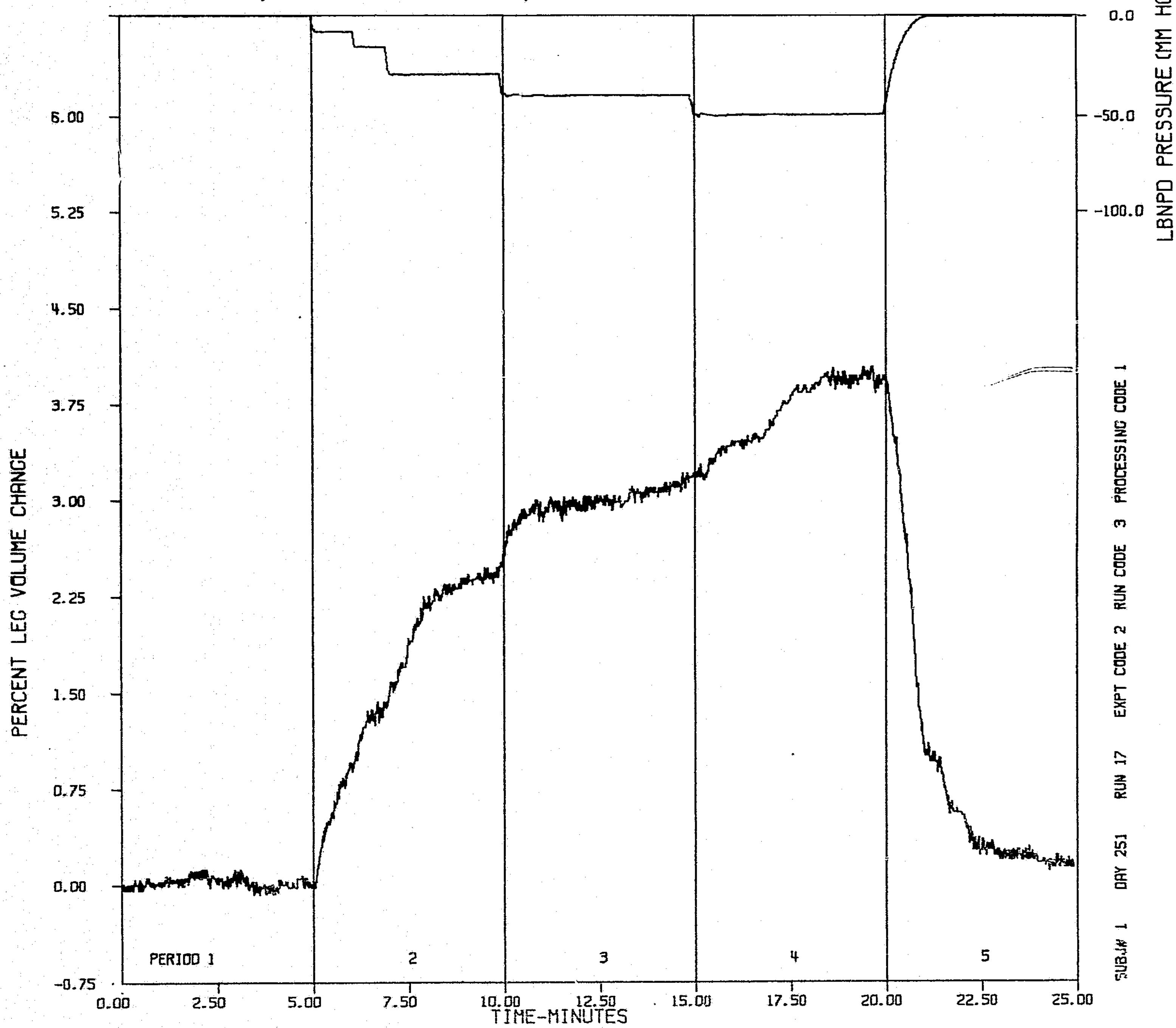
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 242 RUN 14 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1

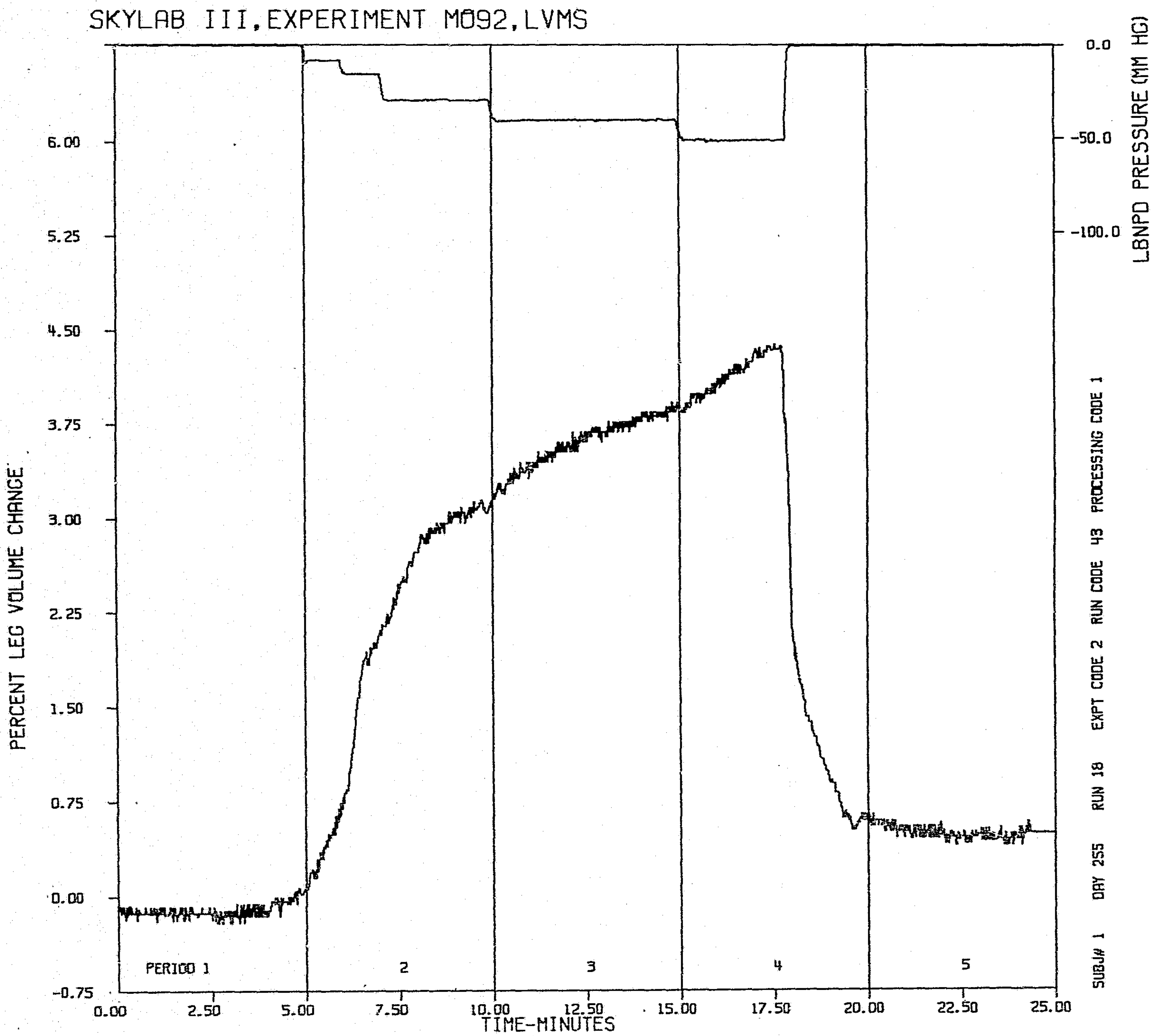


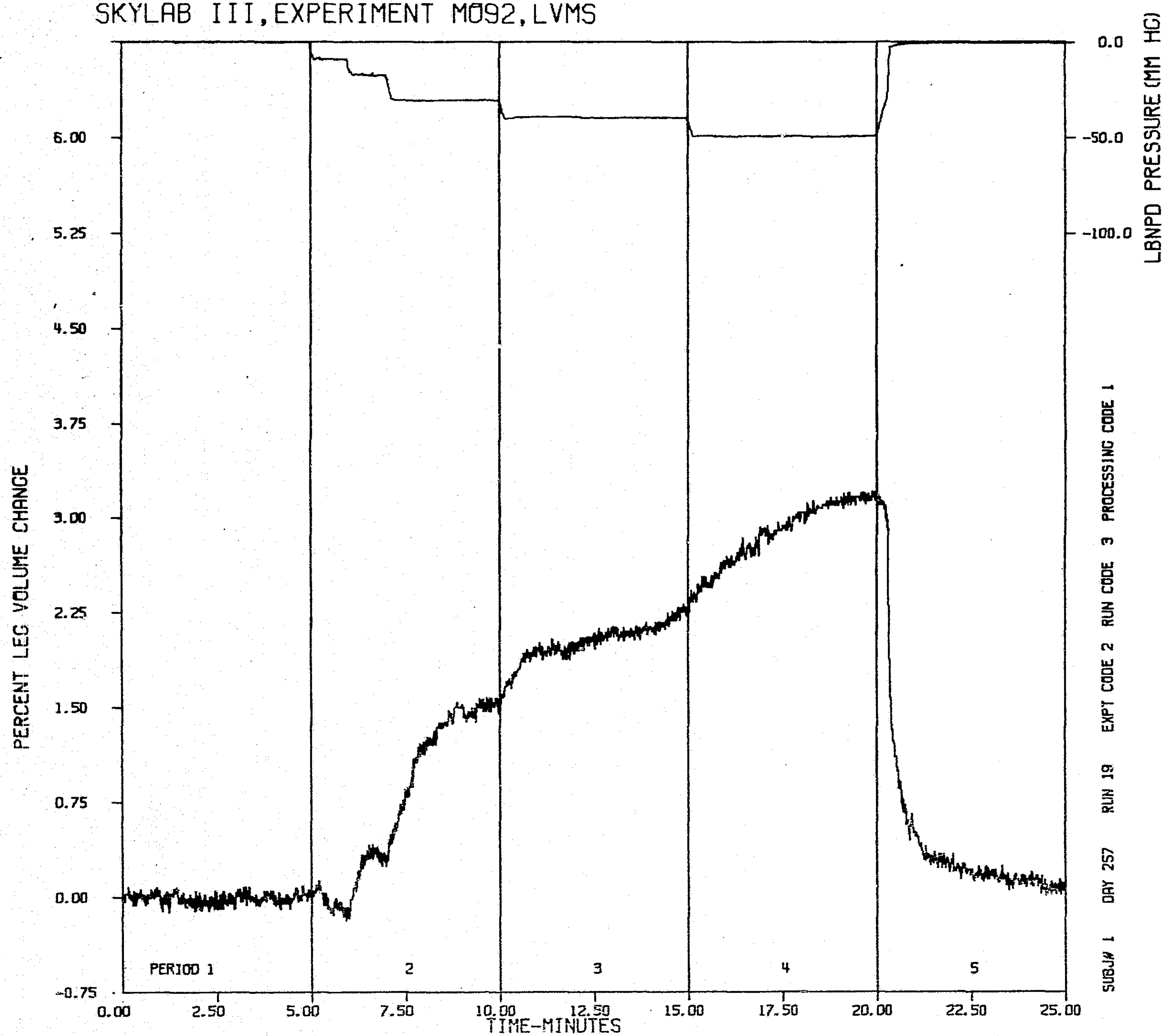
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 244 RUN 15 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 1 DAY 248 RUN 16 EXPT CODE 2 RUN CODE 3 PROCESSING CODE 1

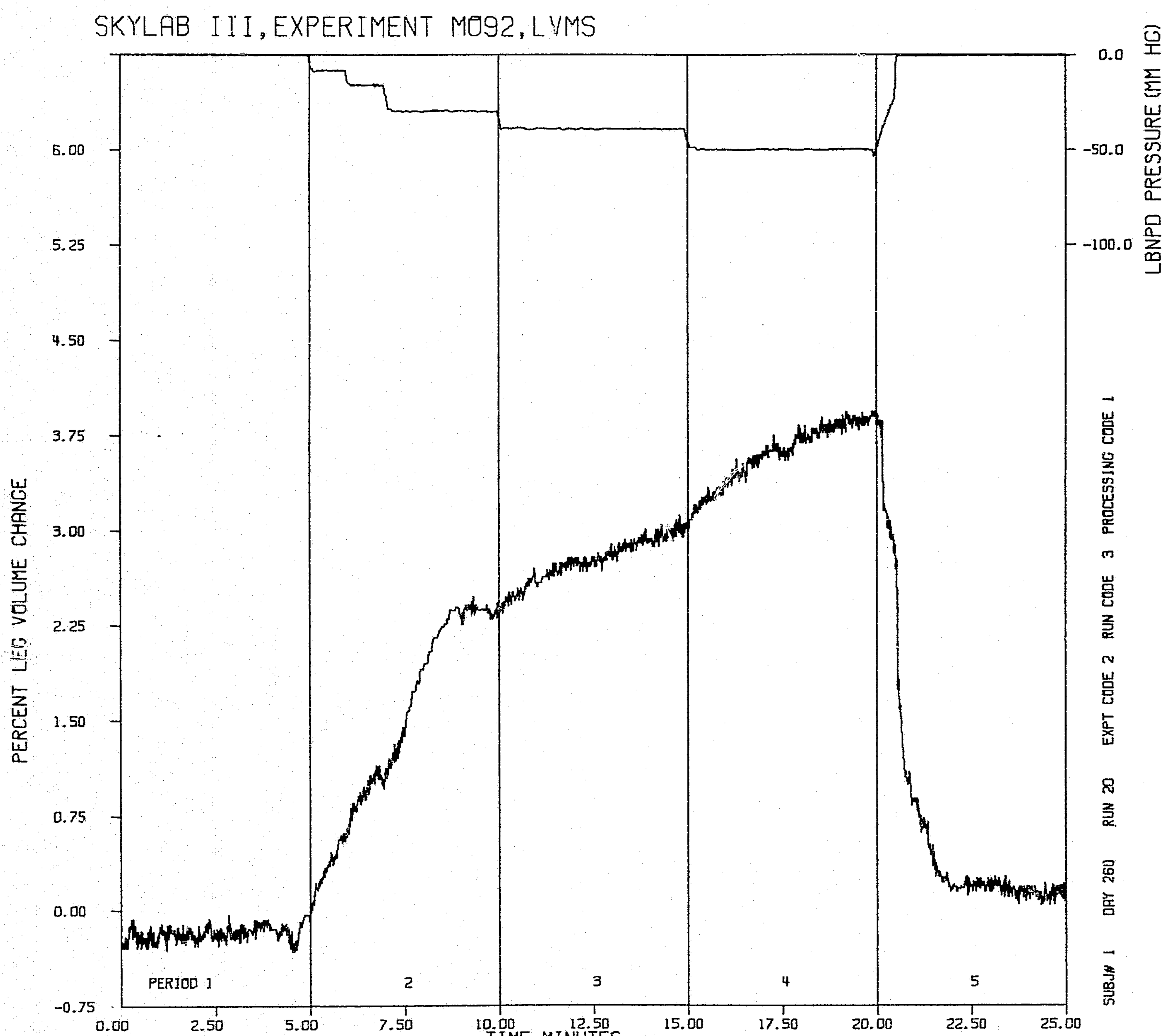
SKYLAB III, EXPERIMENT M092, LVMS



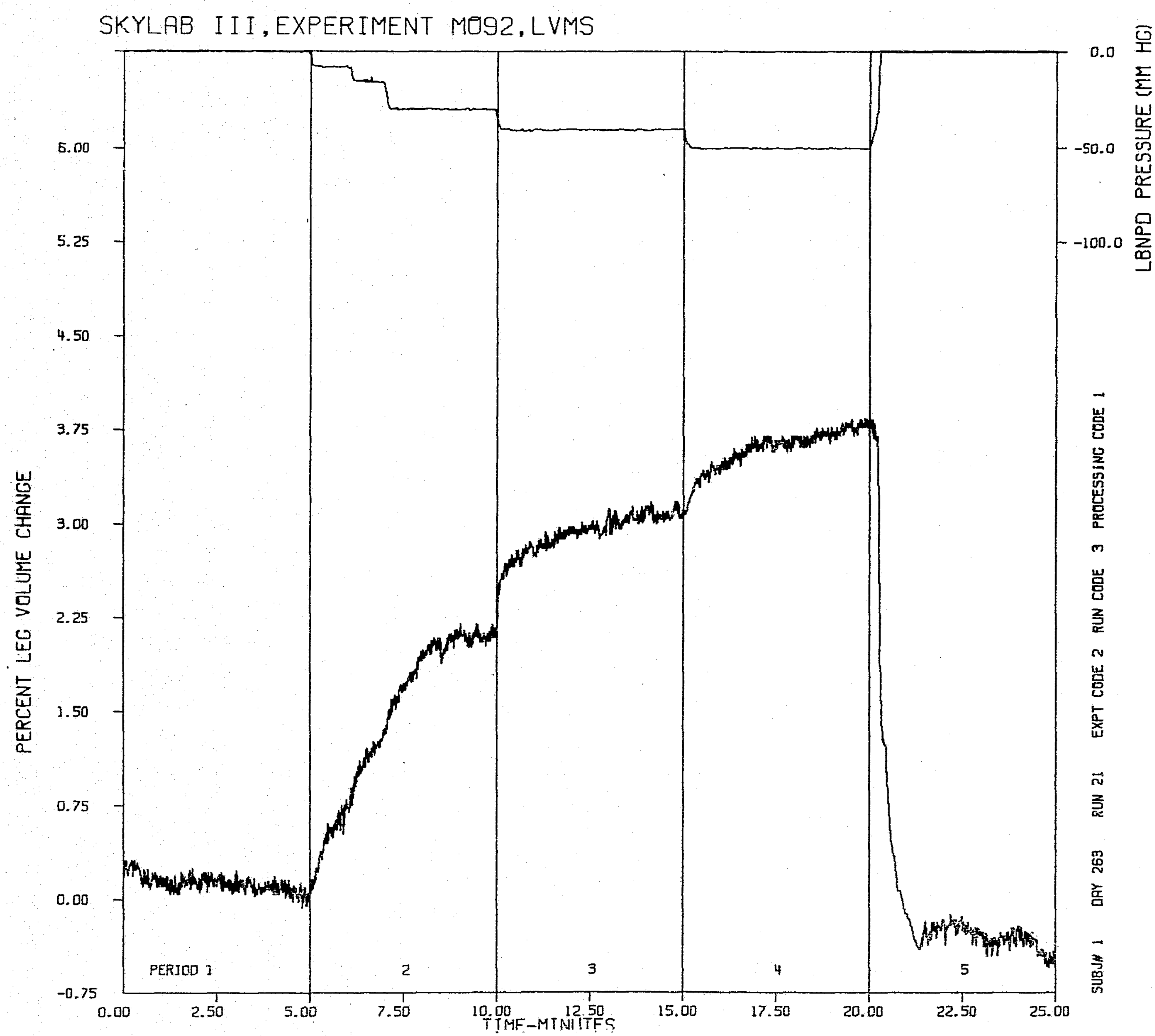

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
TIME-MINUTES
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 255 RUN 18 EXPT CODE 2 RUN CODE 43 PROCESSING CODE 1

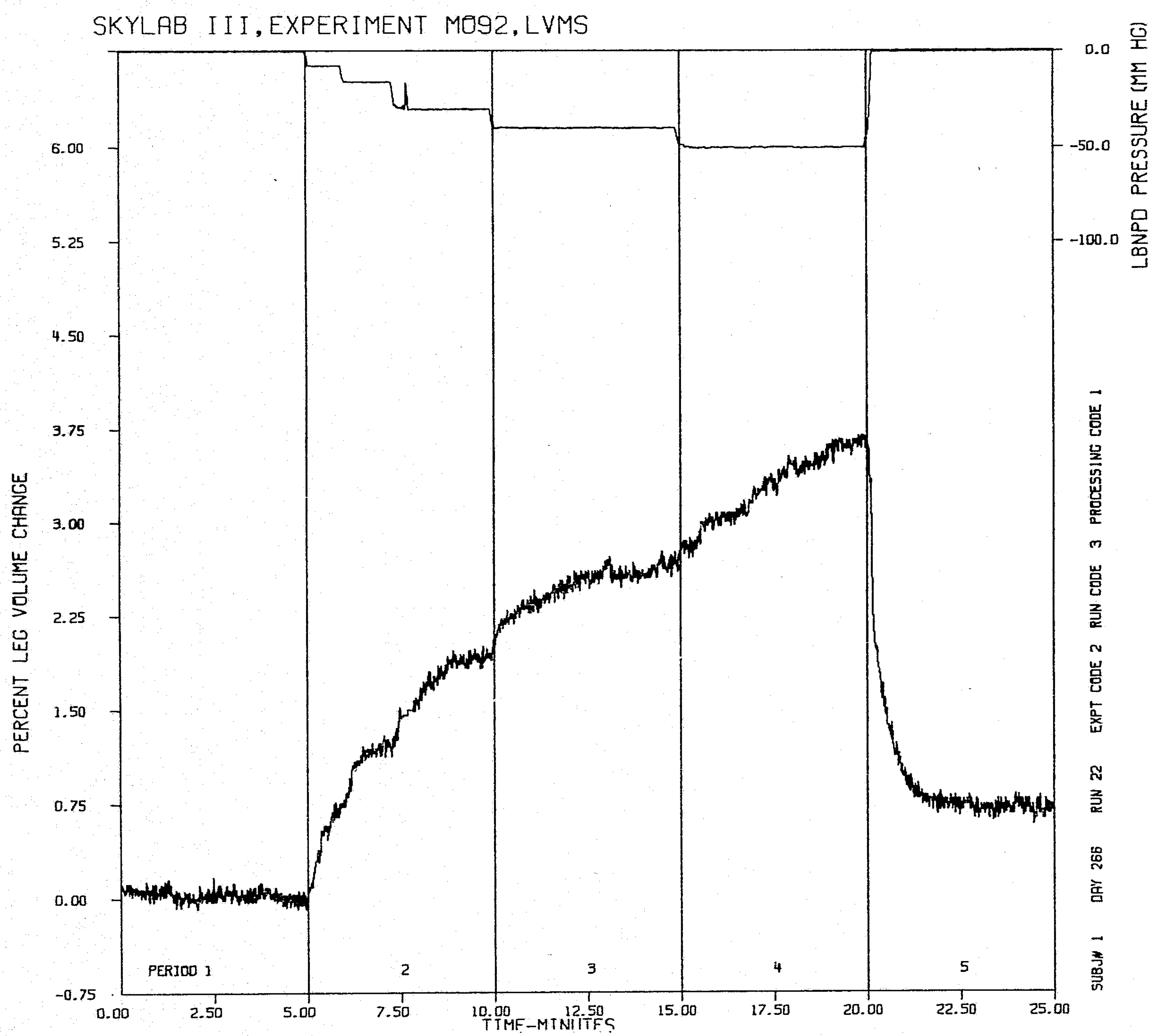


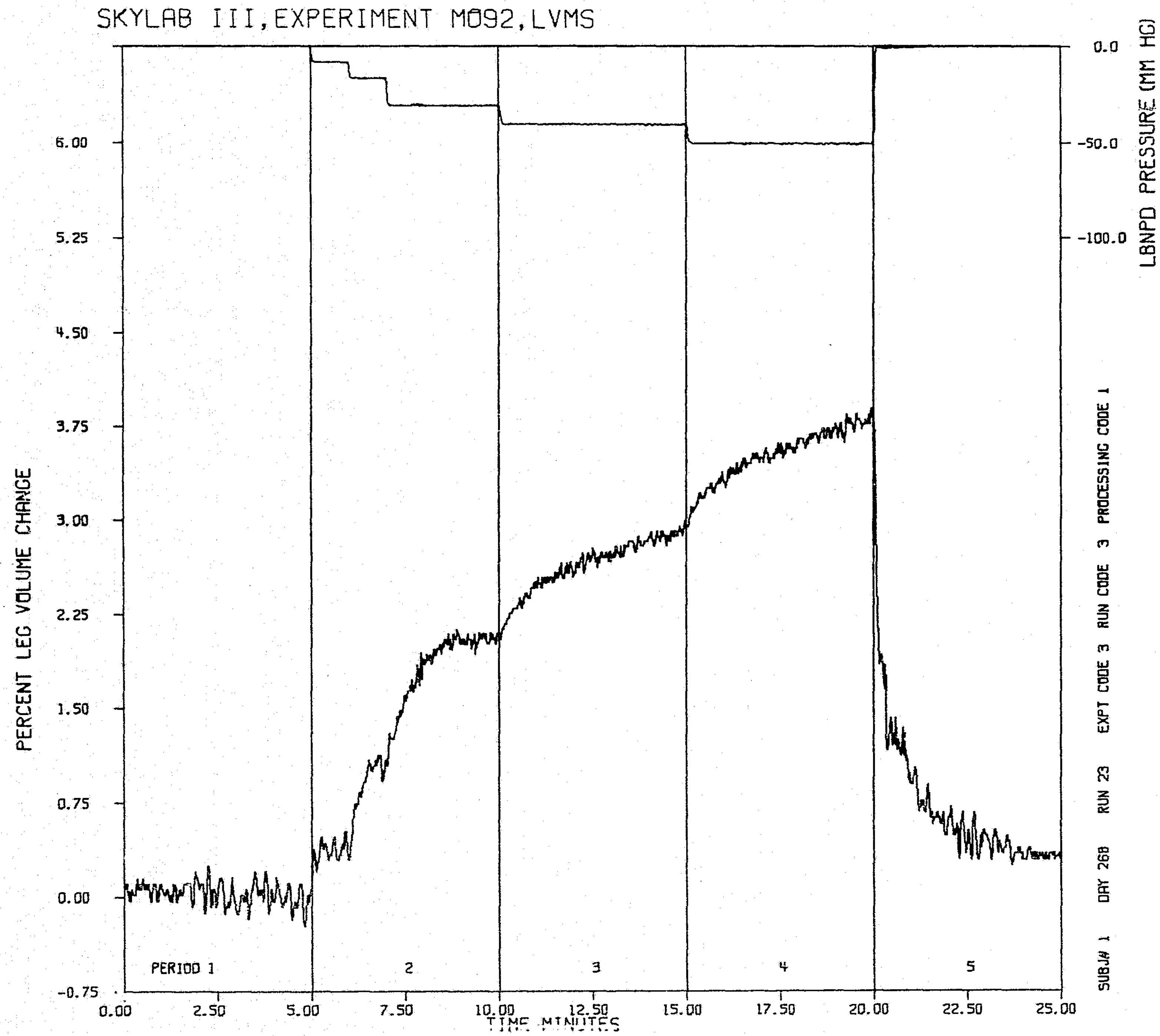
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 257 RUN 19 EXPT CODE 2 RUN CODE 3 PROCESSING CODE 1


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 1 DAY 260 RUN 20 EXPT CODE 2 RUN CODE 3 PROCESSING CODE 1

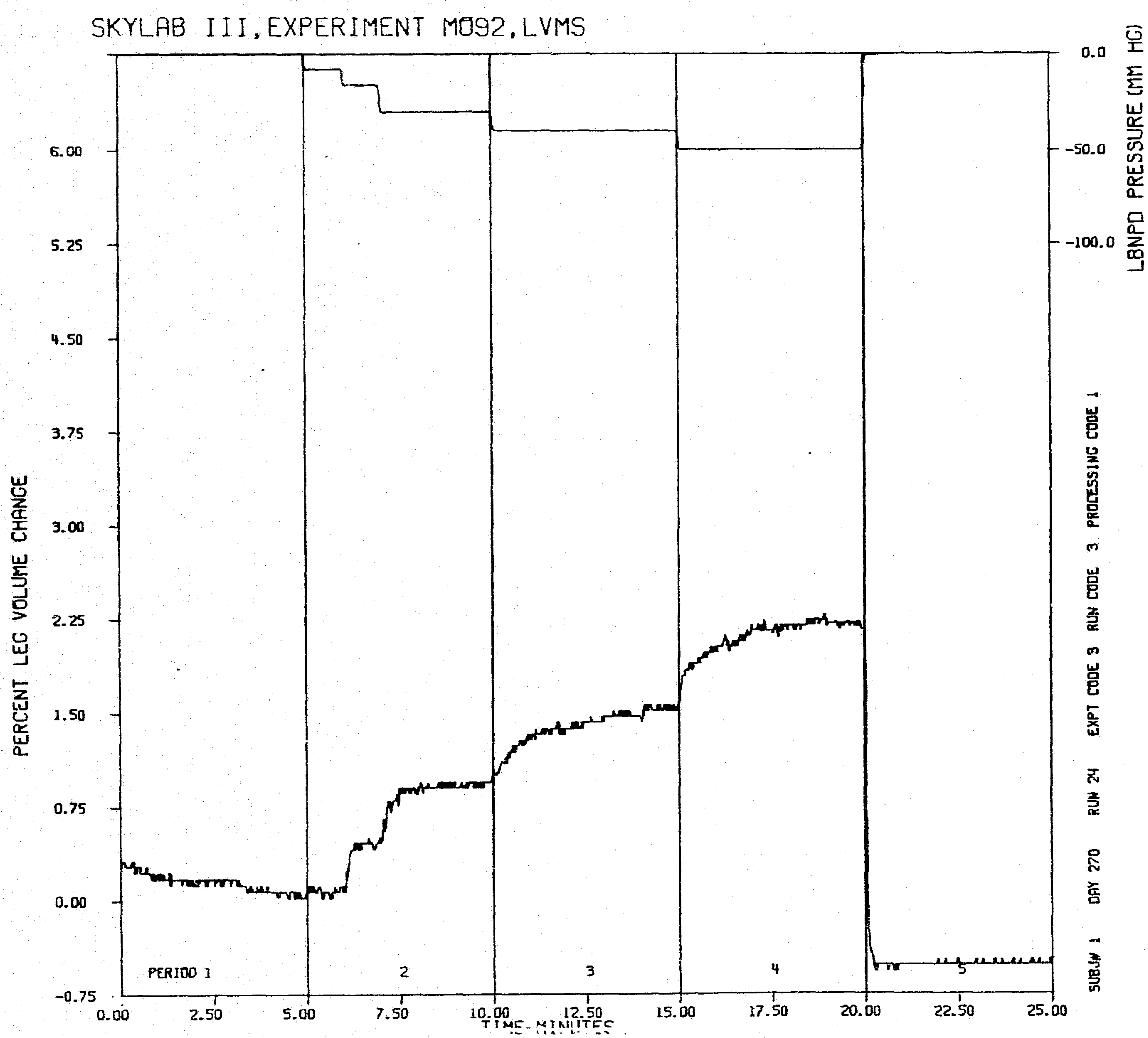
D-20


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 263 RUN 21 EXPT CODE 2 RUN CODE 3 PROCESSING CODE 1

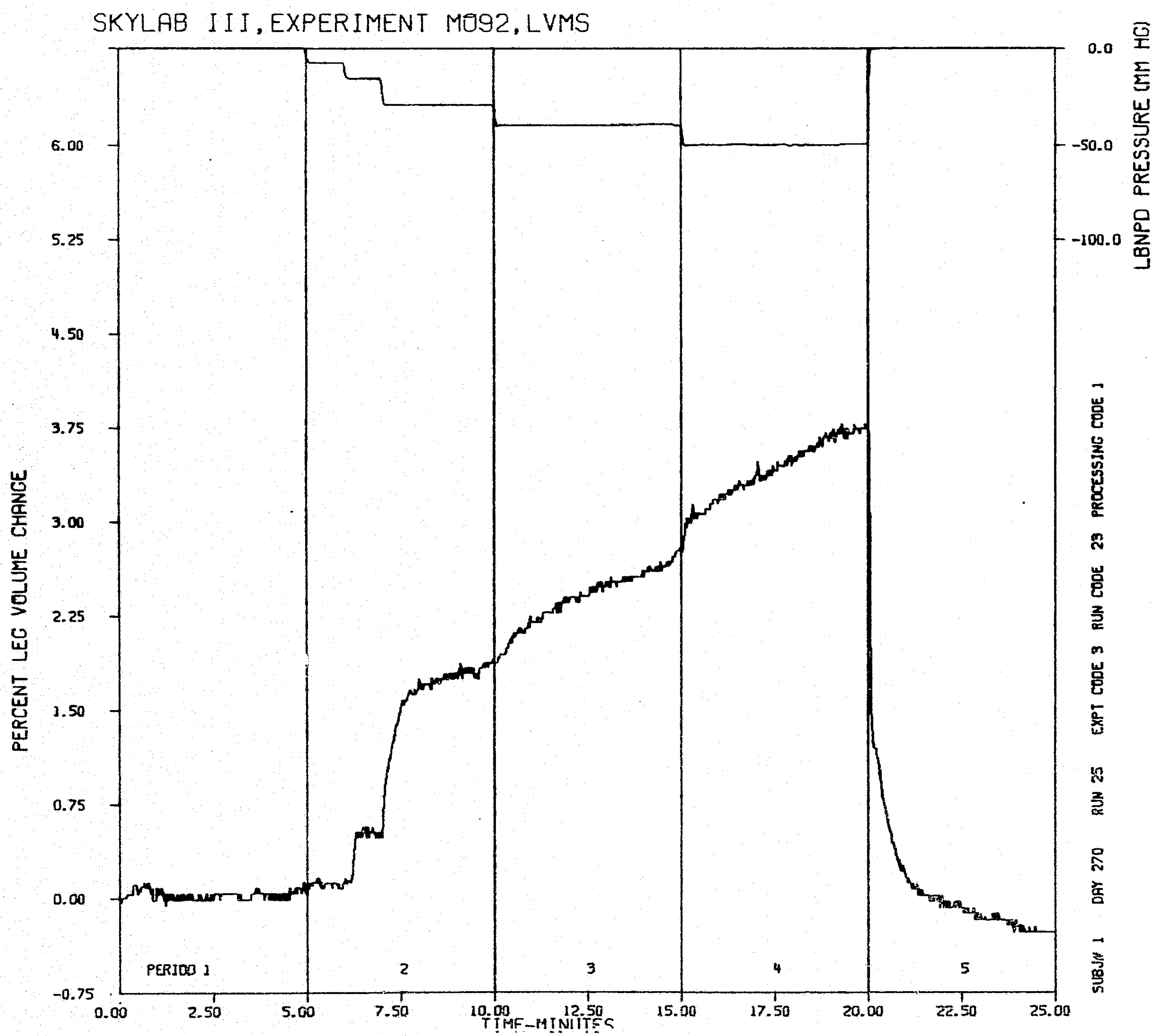

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 266 RUN 22 EXPT CODE 2 RUN CODE 3 PROCESSING CODE 1



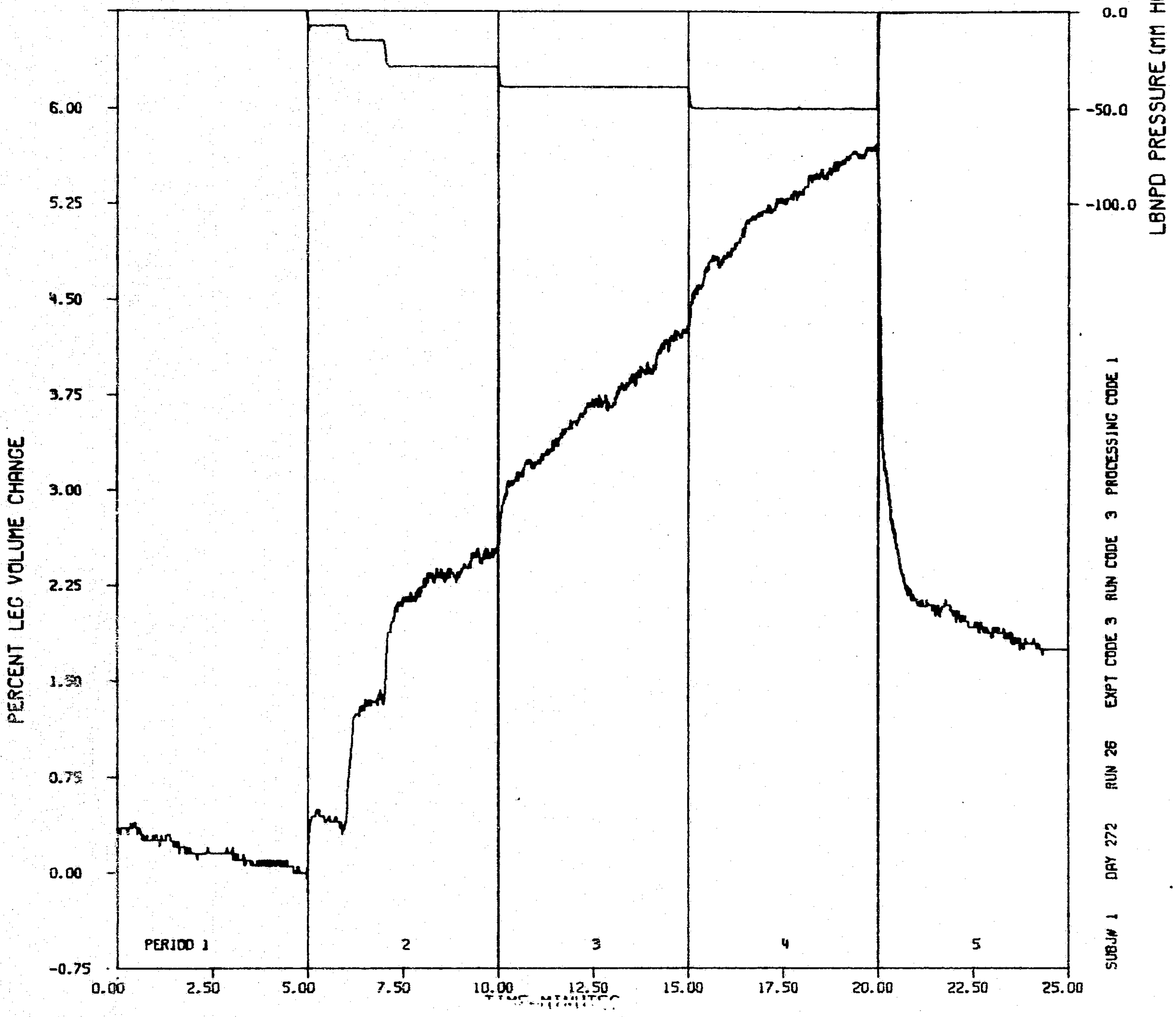
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME MINUTES
SUBJ# 1 DAY 268 RUN 23 EXPT CODE 3 RUN CODE 3 PROCESSING CODE 1

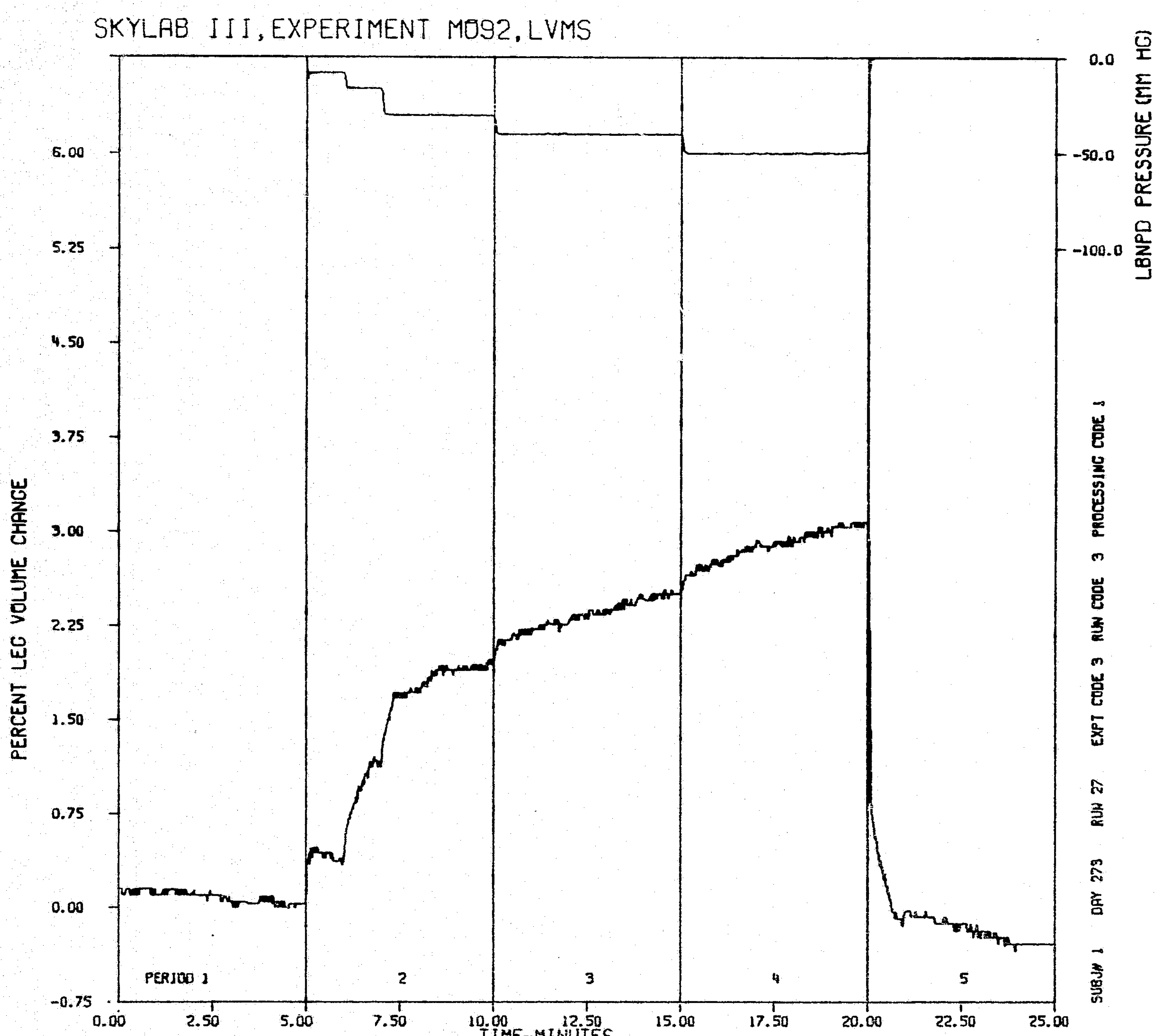


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 1 DAY 270 RUN 24 EXPT CODE 3 RUN CODE 3 PROCESSING CODE 1

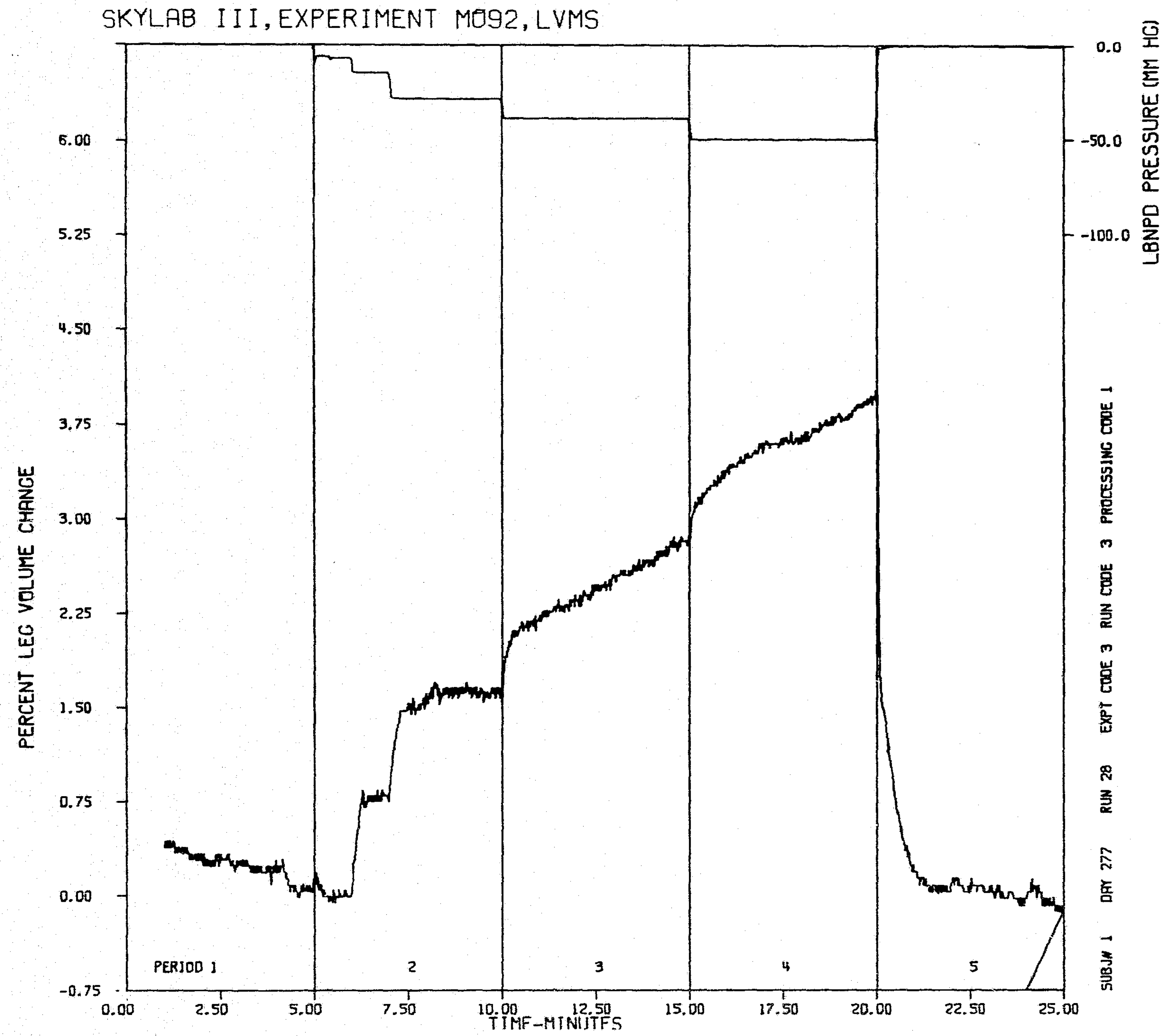

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 270 RUN 25 EXPT CODE 3 RUN CODE 23 PROCESSING CODE 1

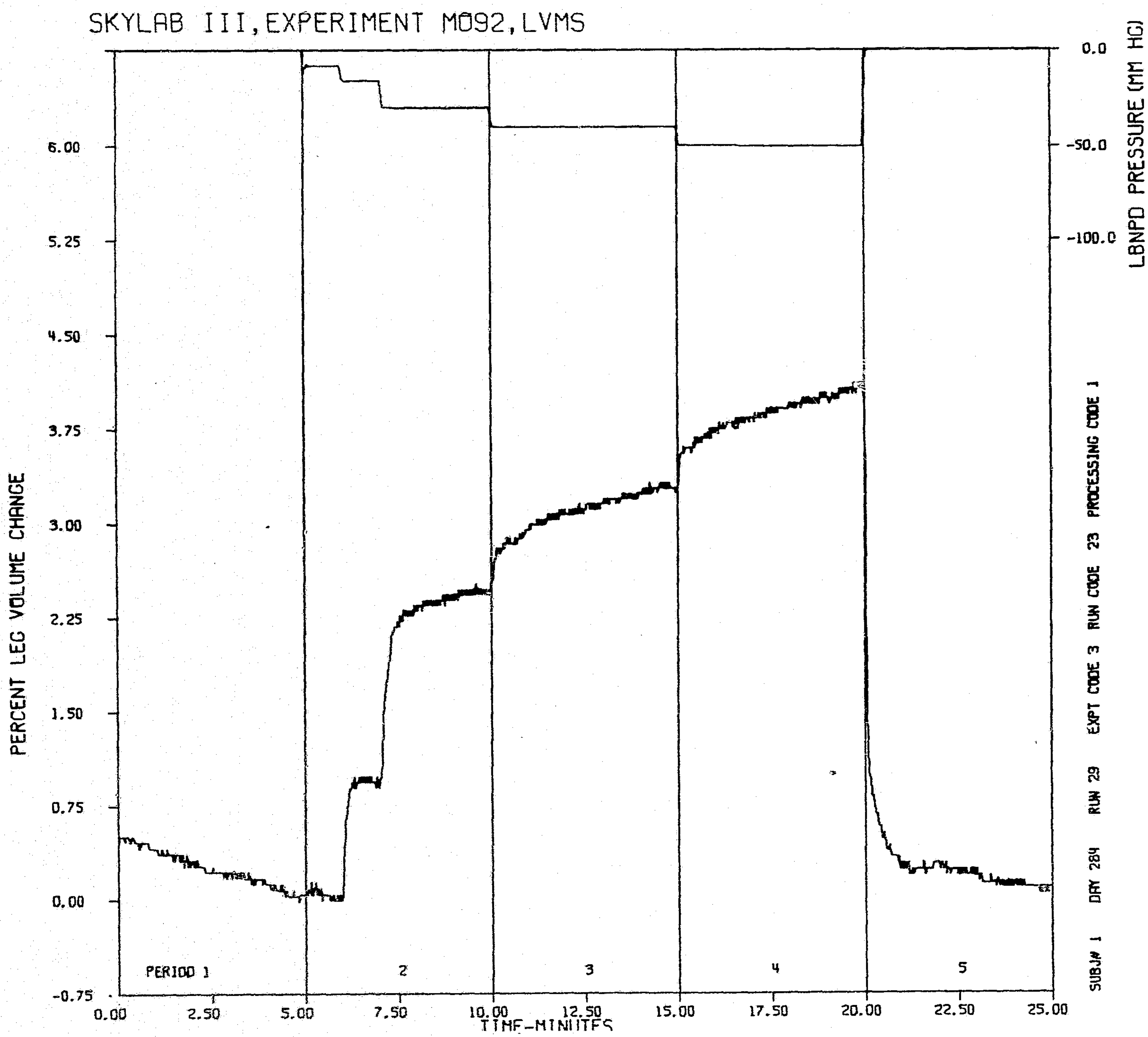
SKYLAB III, EXPERIMENT M092, LVMS

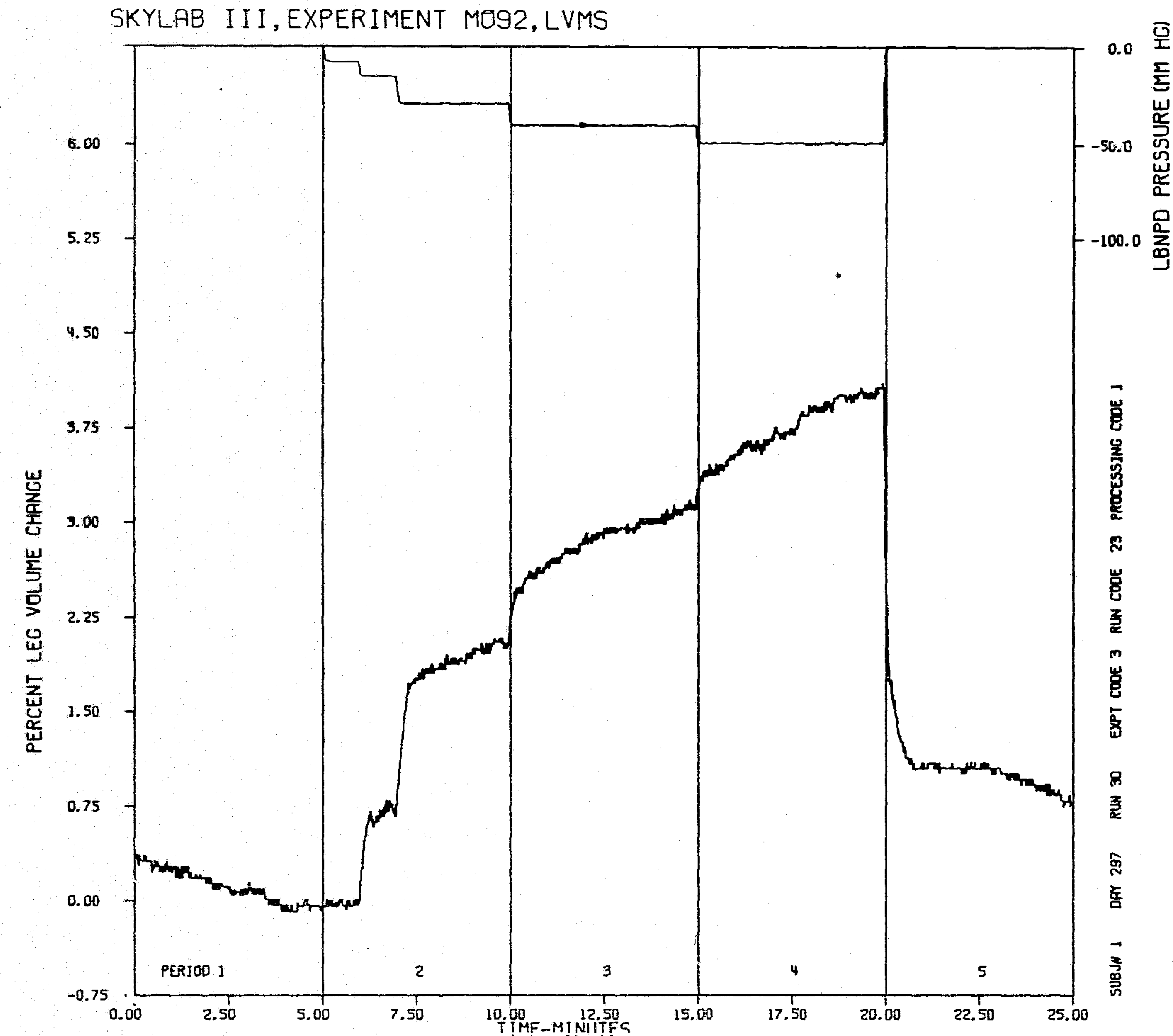


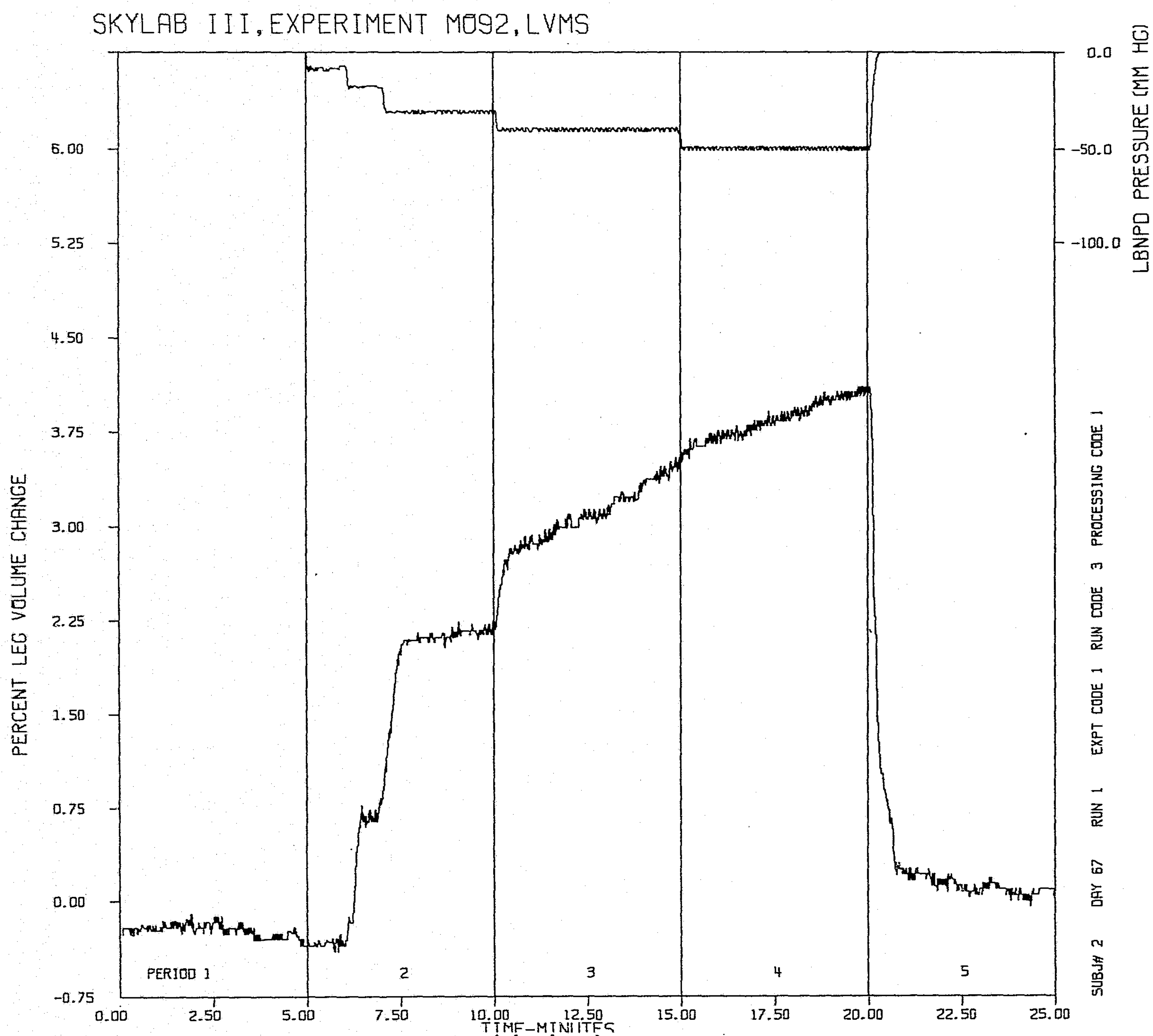


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEC VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 1 DAY 273 RUN 27 EXPT CODE 3 RUN CODE 3 PROCESSING CODE 1

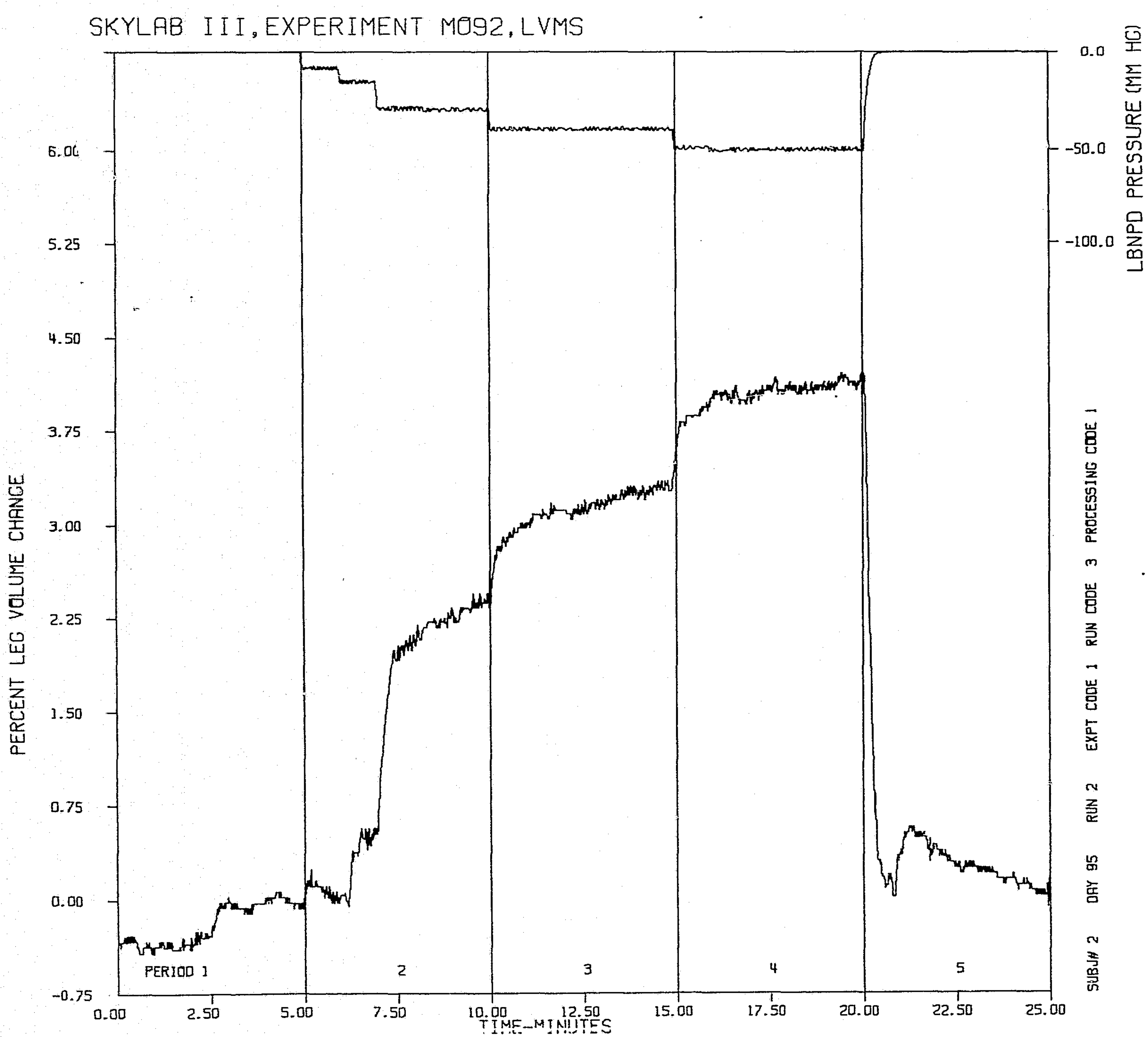

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 277 RUN 28 EXPT CODE 3 RUN CODE 3 PROCESSING CODE 1

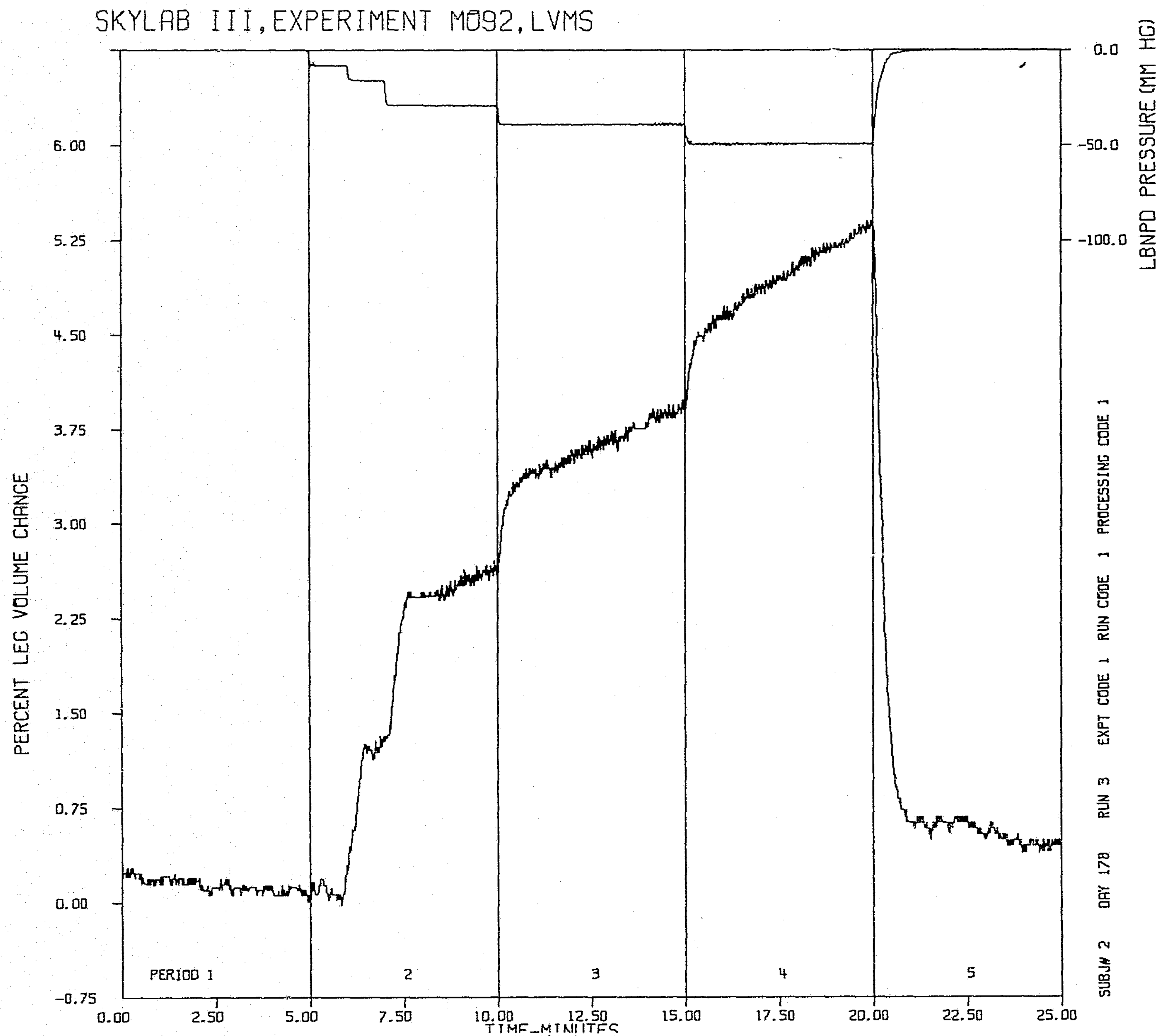

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 1 DAY 284 RUN 29 EXPT CODE 3 RUN CODE 23 PROCESSING CODE 1


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 1 DAY 297 RUN 30 EXPT CODE 3 RUN CODE 23 PROCESSING CODE 1

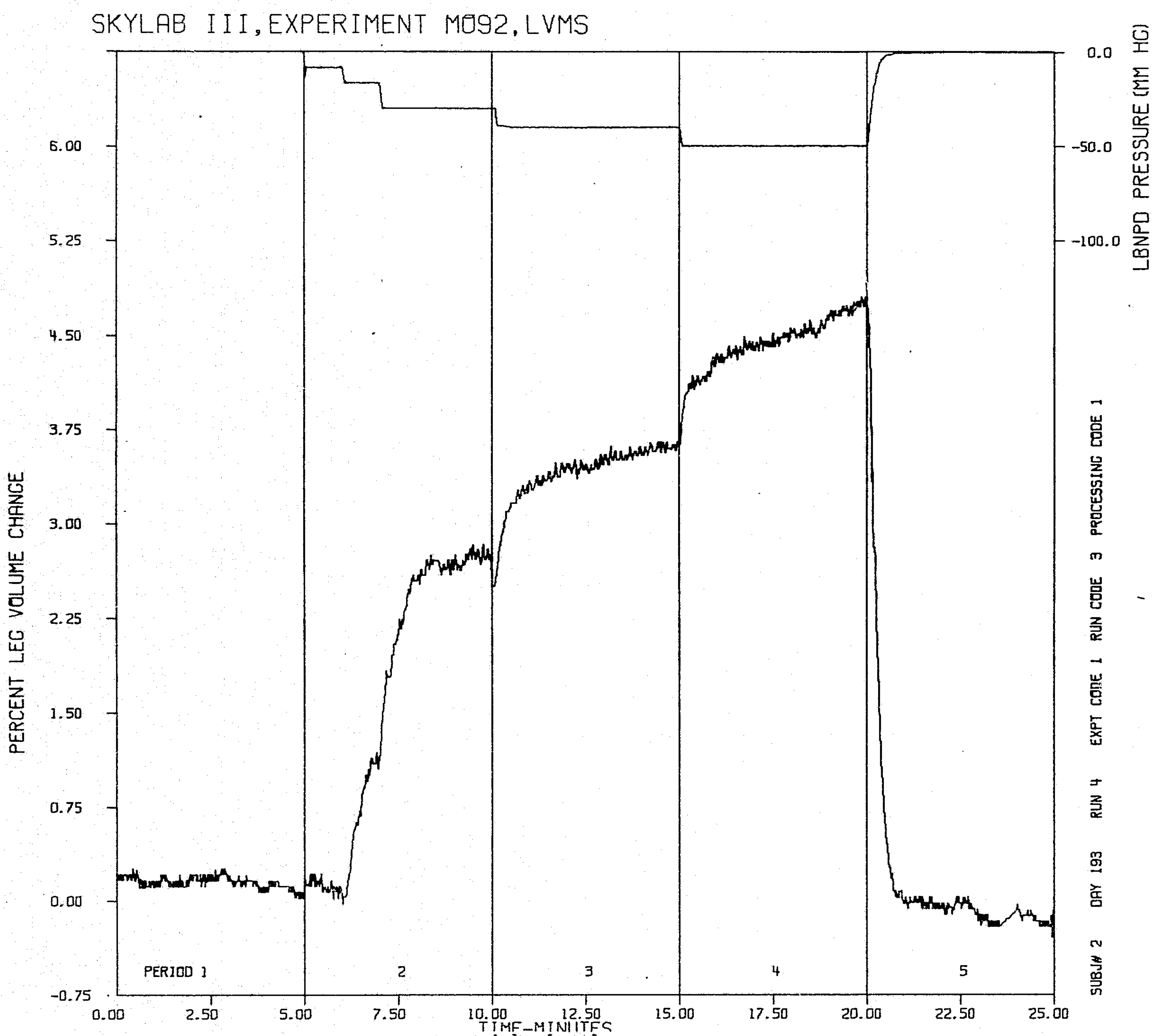


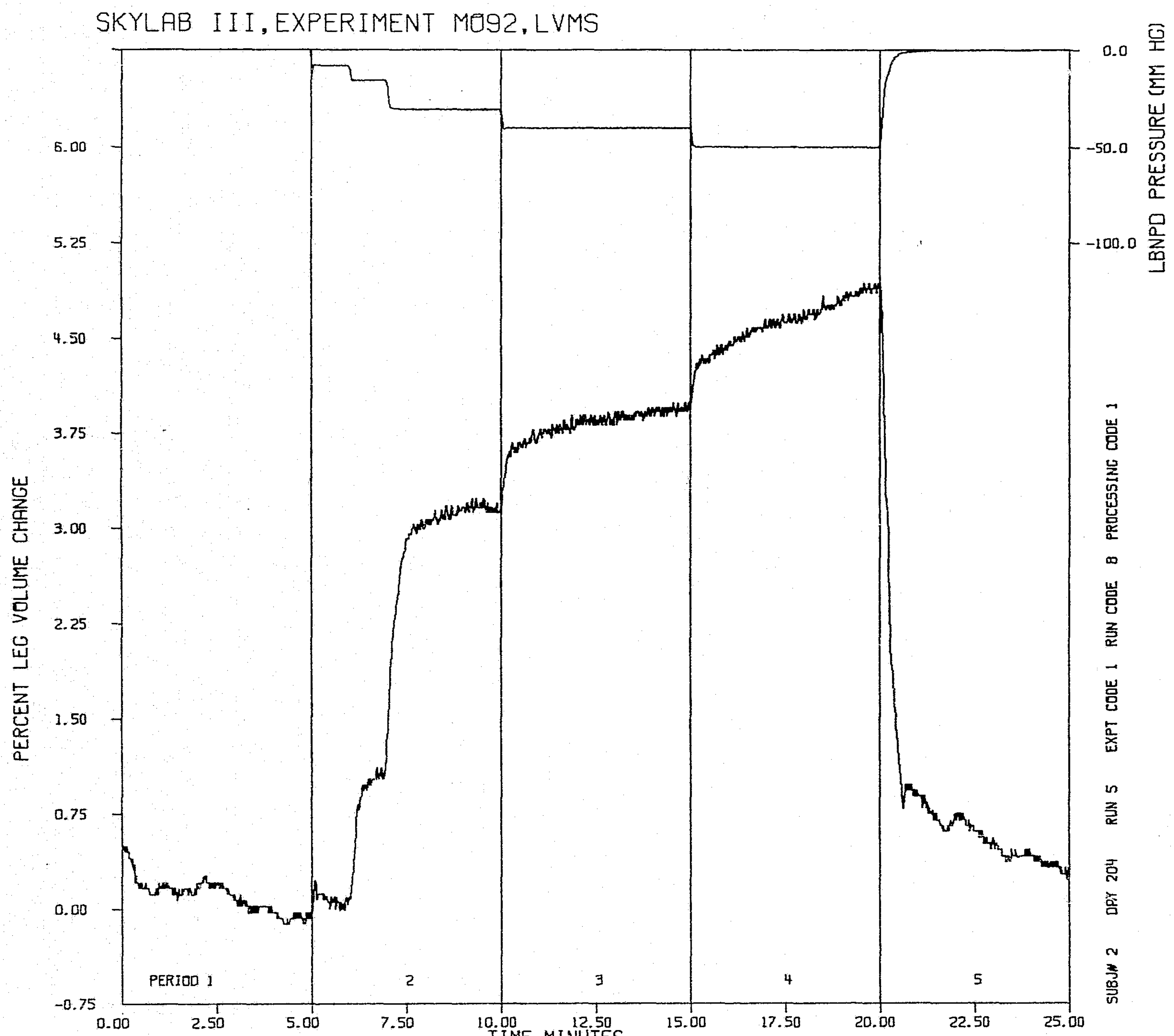
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
LBNPD PRESSURE (MM HG)
SUBJ# 2 DAY 67 RUN 1 EXPT CODE 1 RUN CODE 3 PROCESSING CODE 1

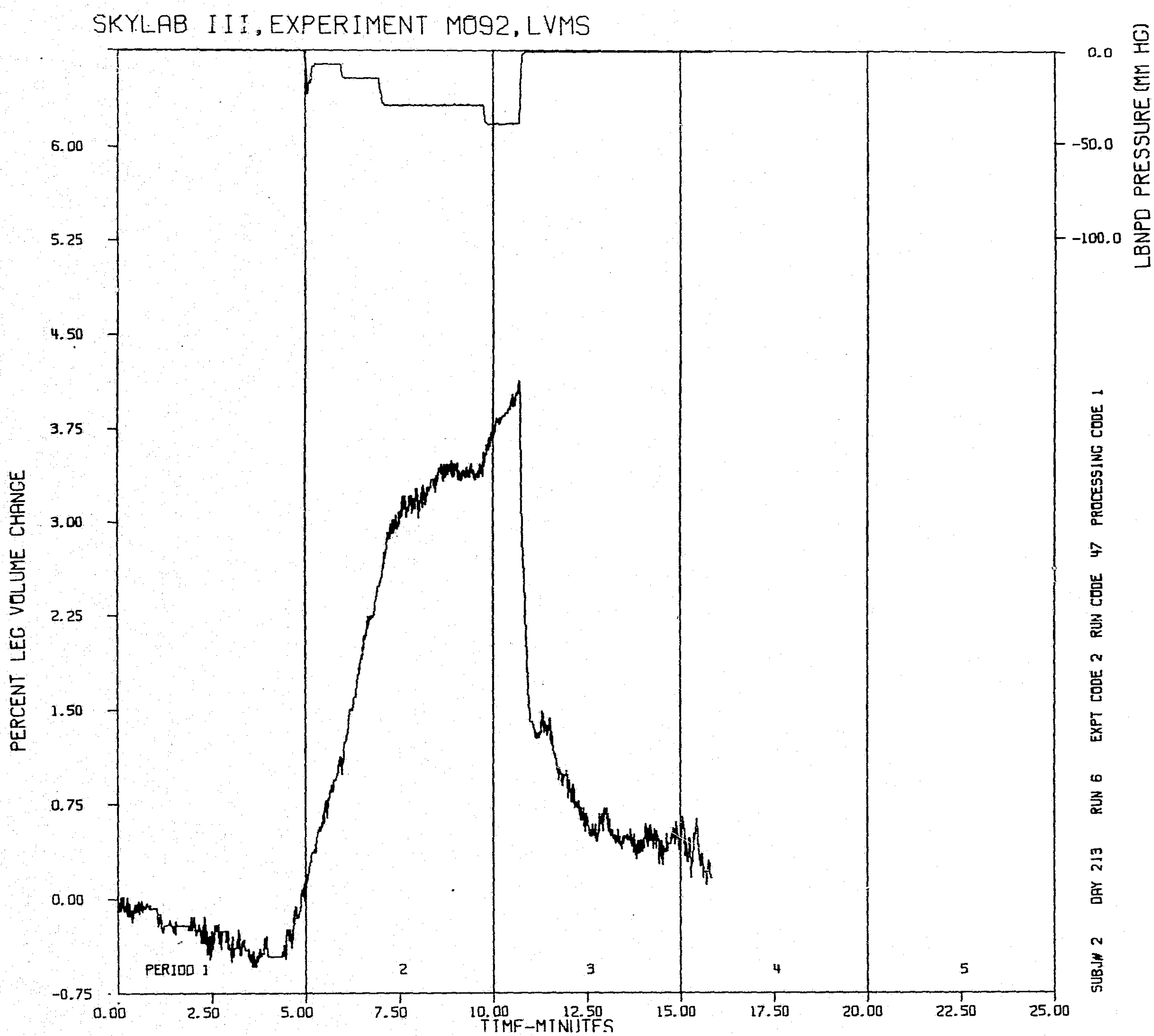

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 95 RUN 2 EXPT CODE 1 RUN CODE 3 PROCESSING CODE 1



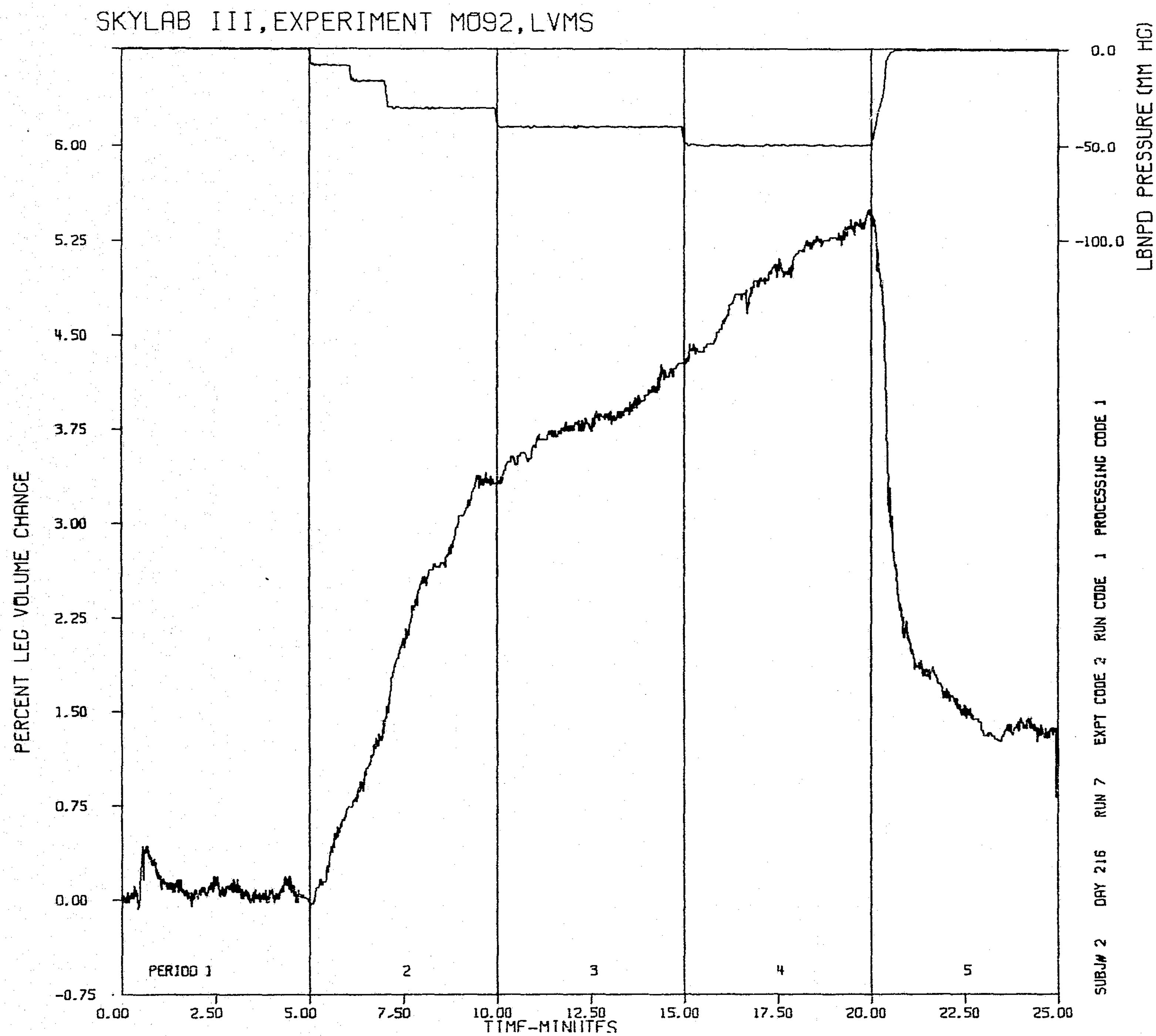
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 178 RUN 3 EXPT CODE 1 RUN CODE 1 PROCESSING CODE 1

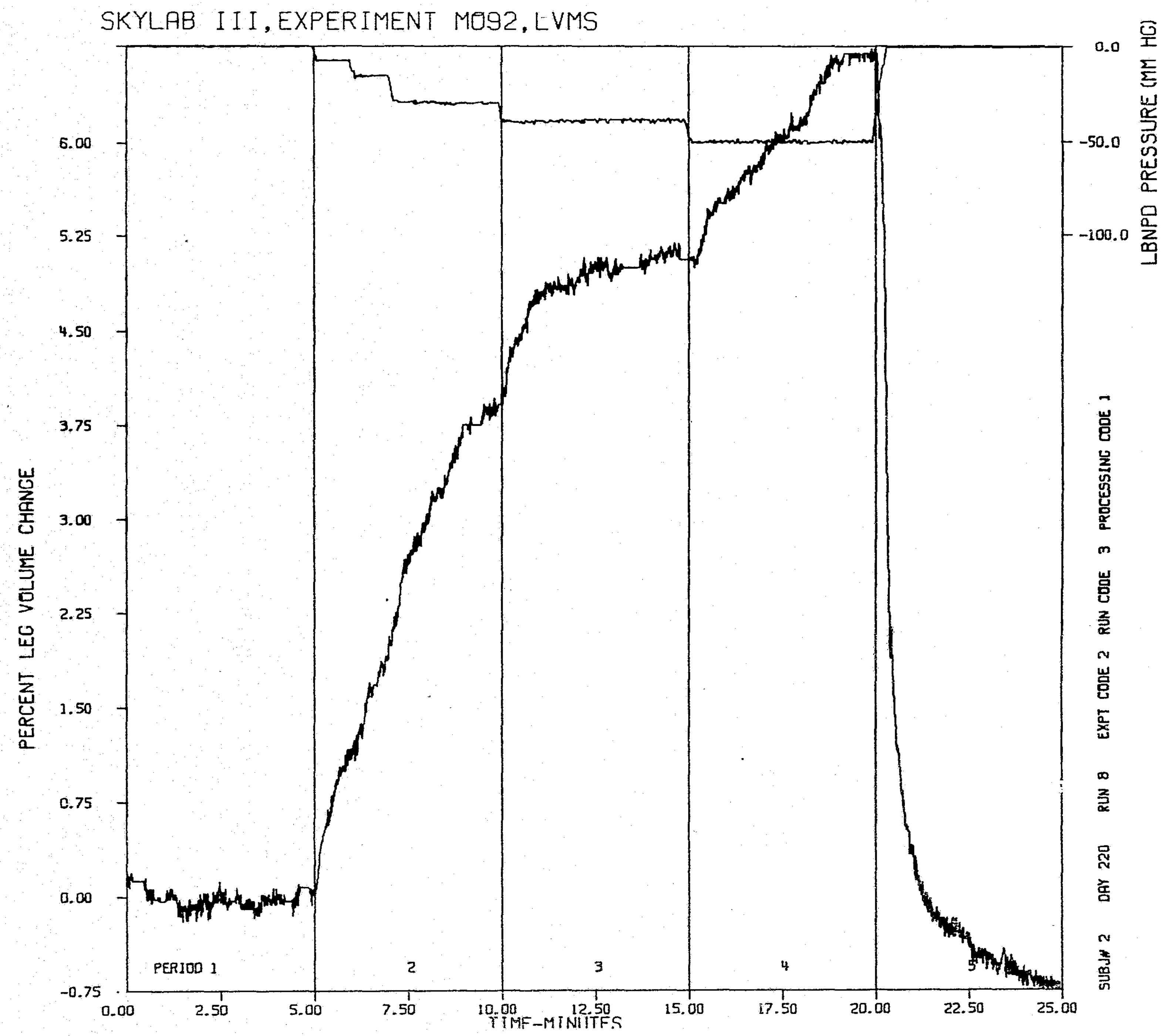

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 2 DAY 193 RUN 4 EXPT CODE 1 RUN CODE 3 PROCESSING CODE 1


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 2 DAY 204 RUN 5 EXPT CODE 1 RUN CODE 8 PROCESSING CODE 1

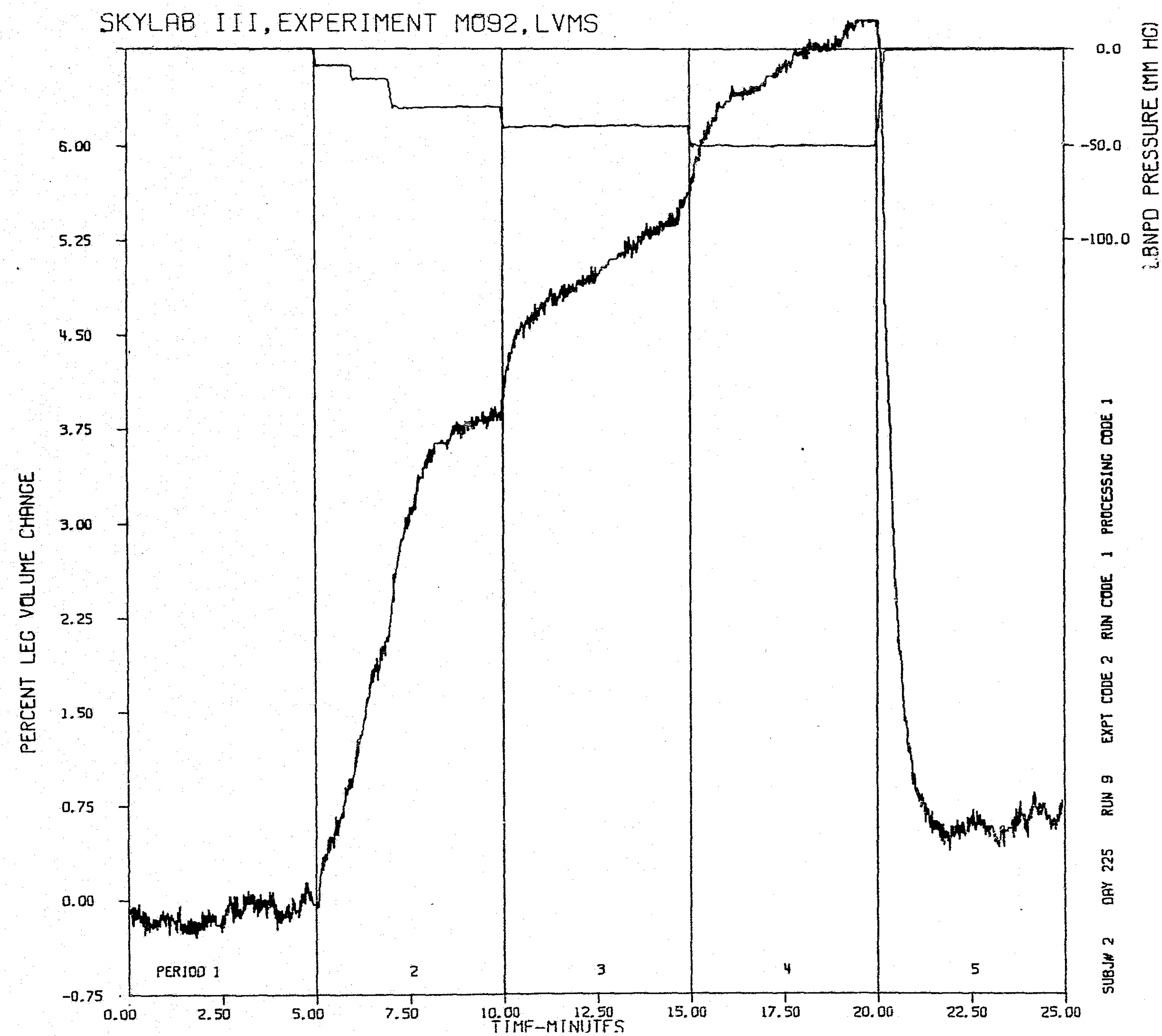

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
LBNPD PRESSURE (MM HG)
SUBJ# 2 DAY 213 RUN 6 EXPT CODE 2 RUN CODE 47 PROCESSING CODE 1

D-36

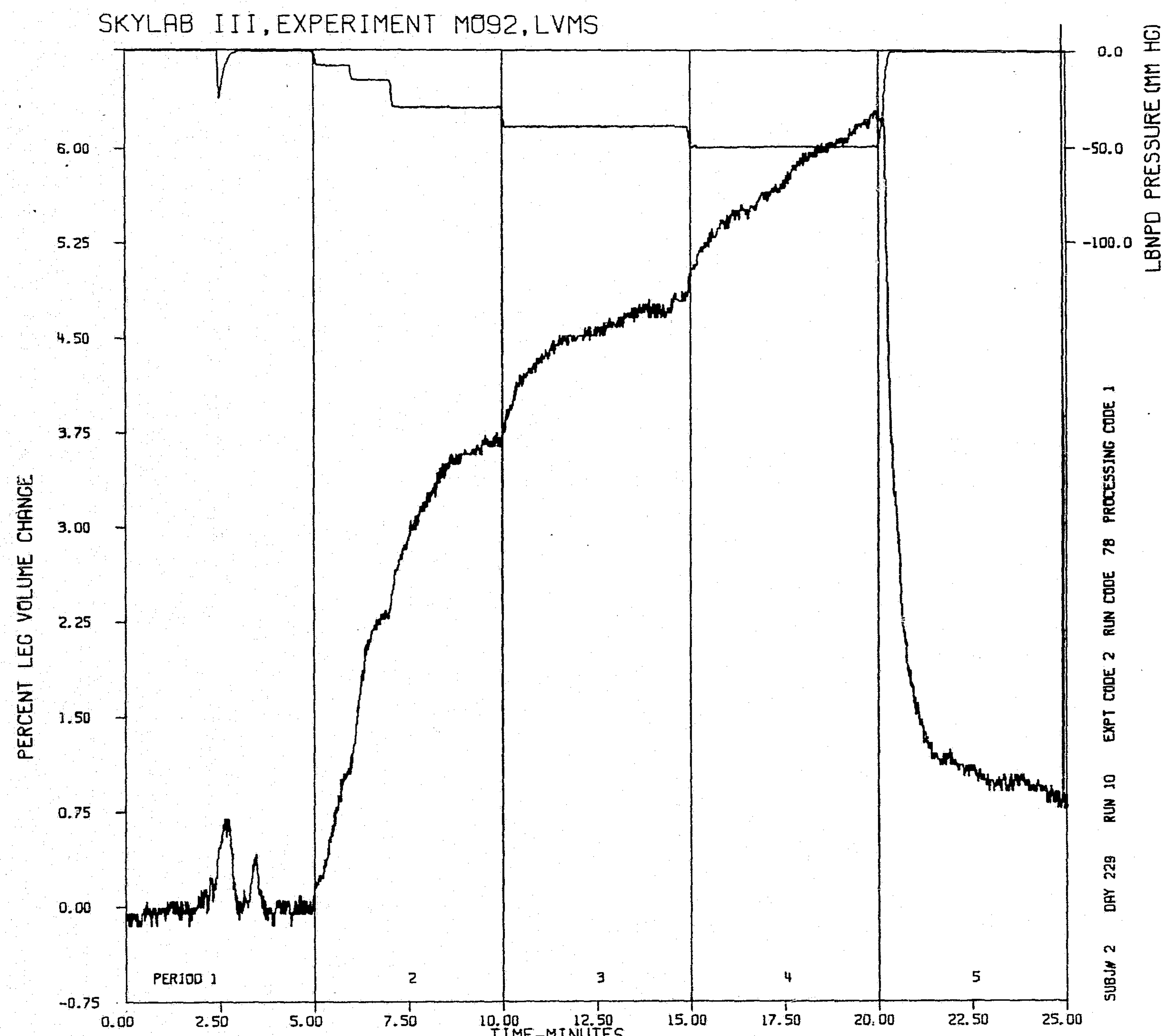

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 216 RUN 7 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
-0.75
0.00
0.75
1.50
2.25
3.00
3.75
4.50
5.25
6.00
0.0
-50.0
-100.0
SUBJ# 2 DAY 220 RUN 8 EXPT CODE 2 RUN CODE 3 PROCESSING CODE 1

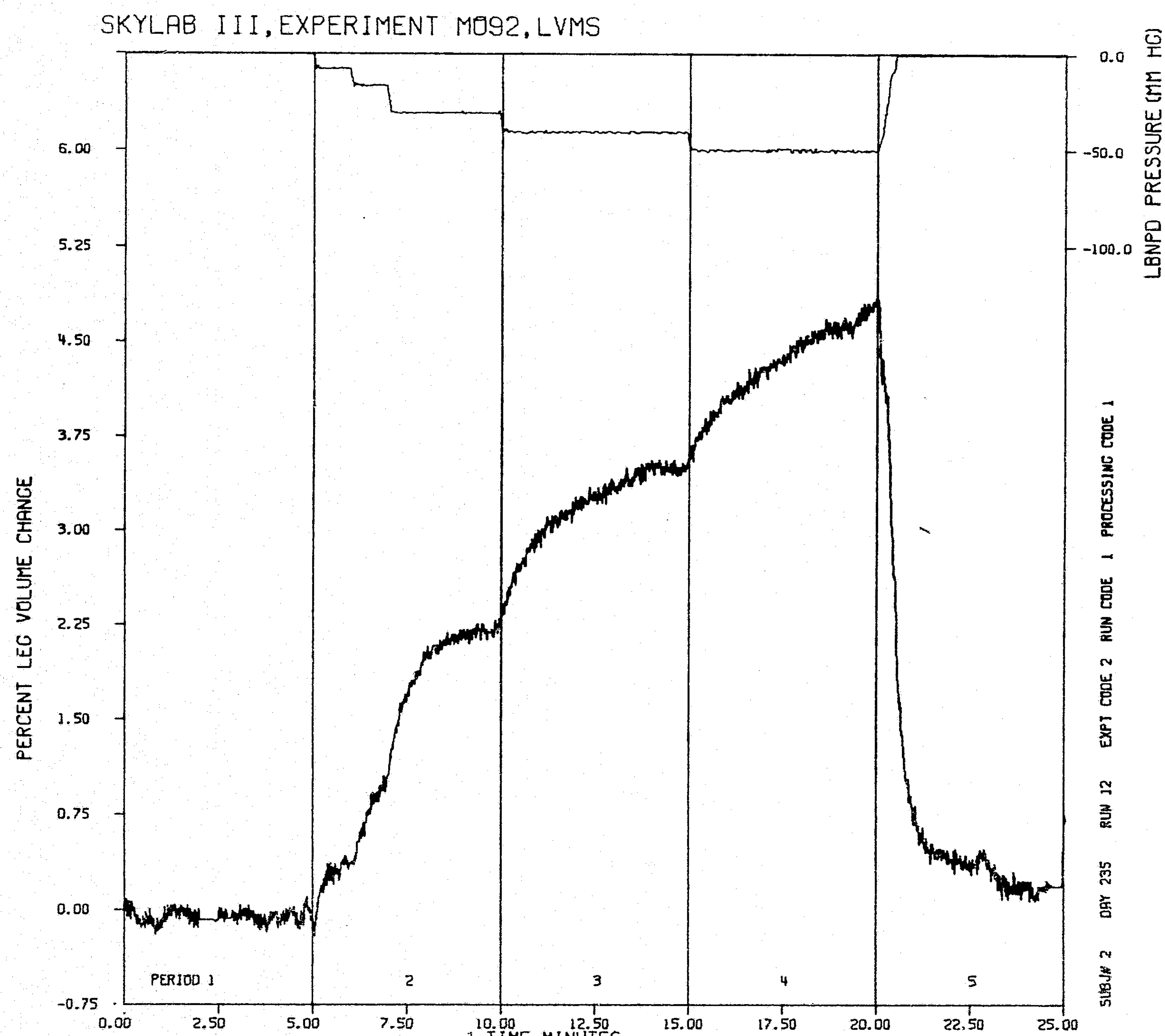


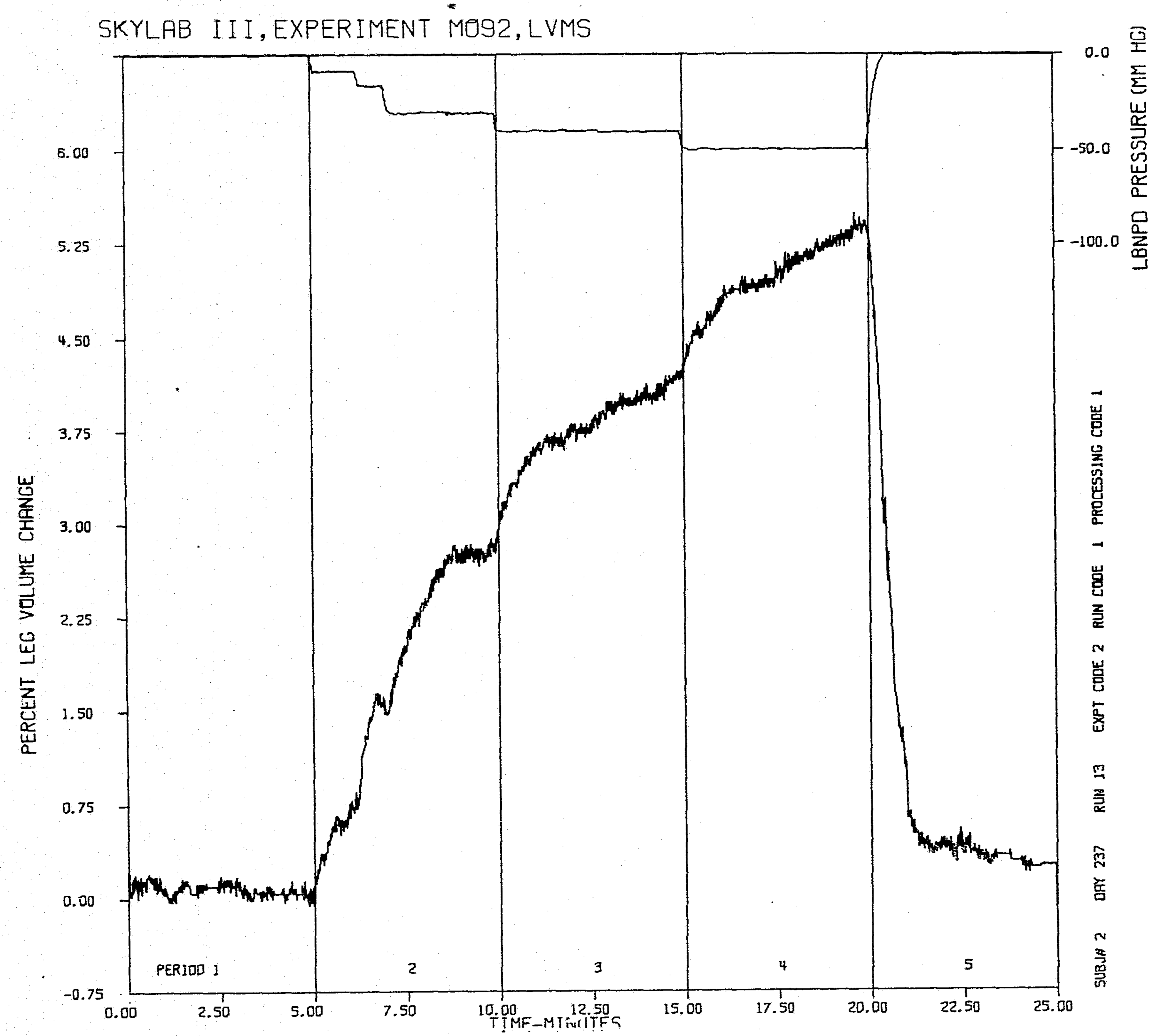
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
-0.75
0.75
1.50
2.25
3.00
3.75
4.50
5.25
6.00
0.0
-50.0
-100.0
SUBJ# 2 DAY 225 RUN 9 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1



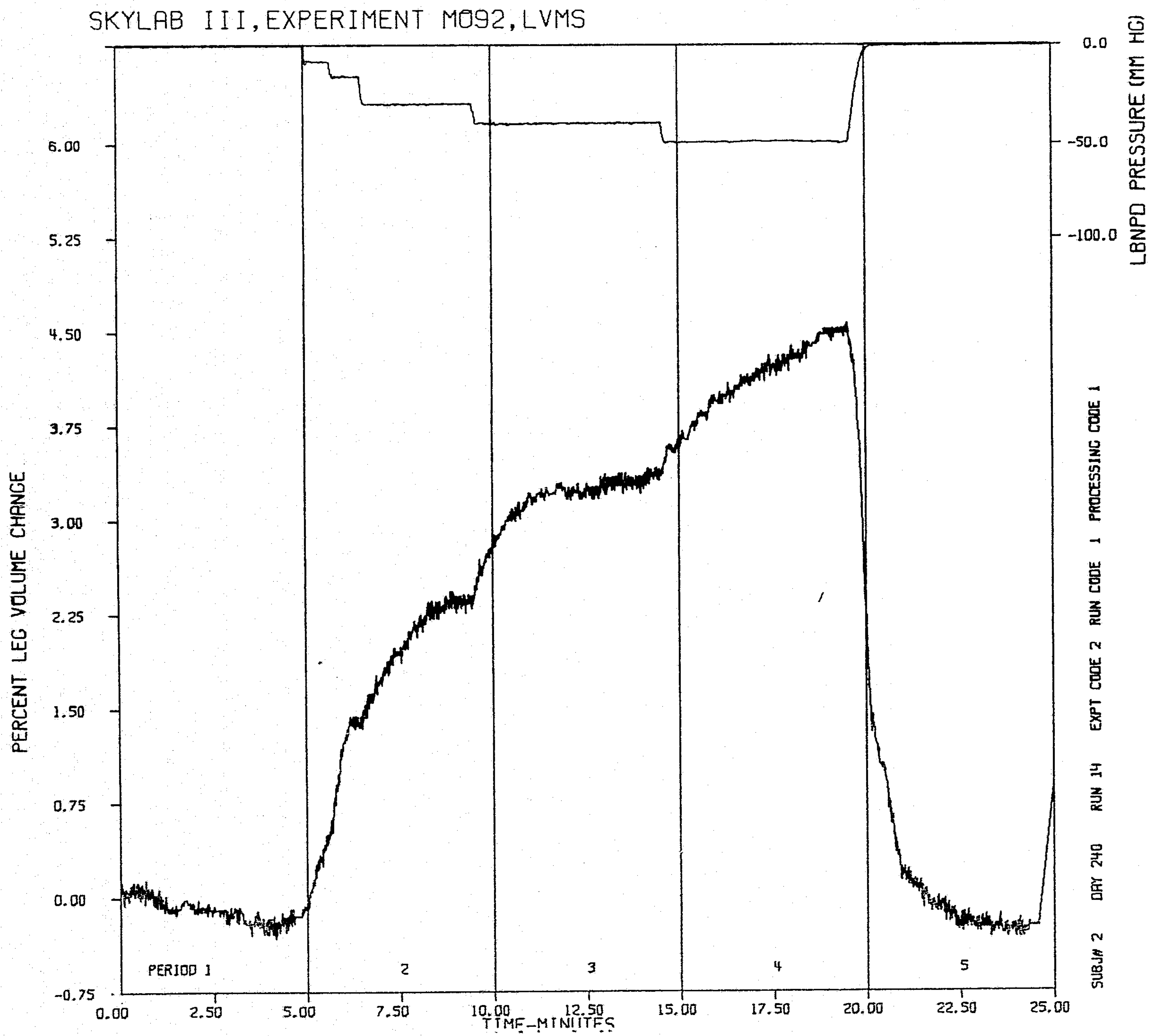
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 2 DAY 229 RUN 10 EXPT CODE 2 RUN CODE 78 PROCESSING CODE 1

D-40

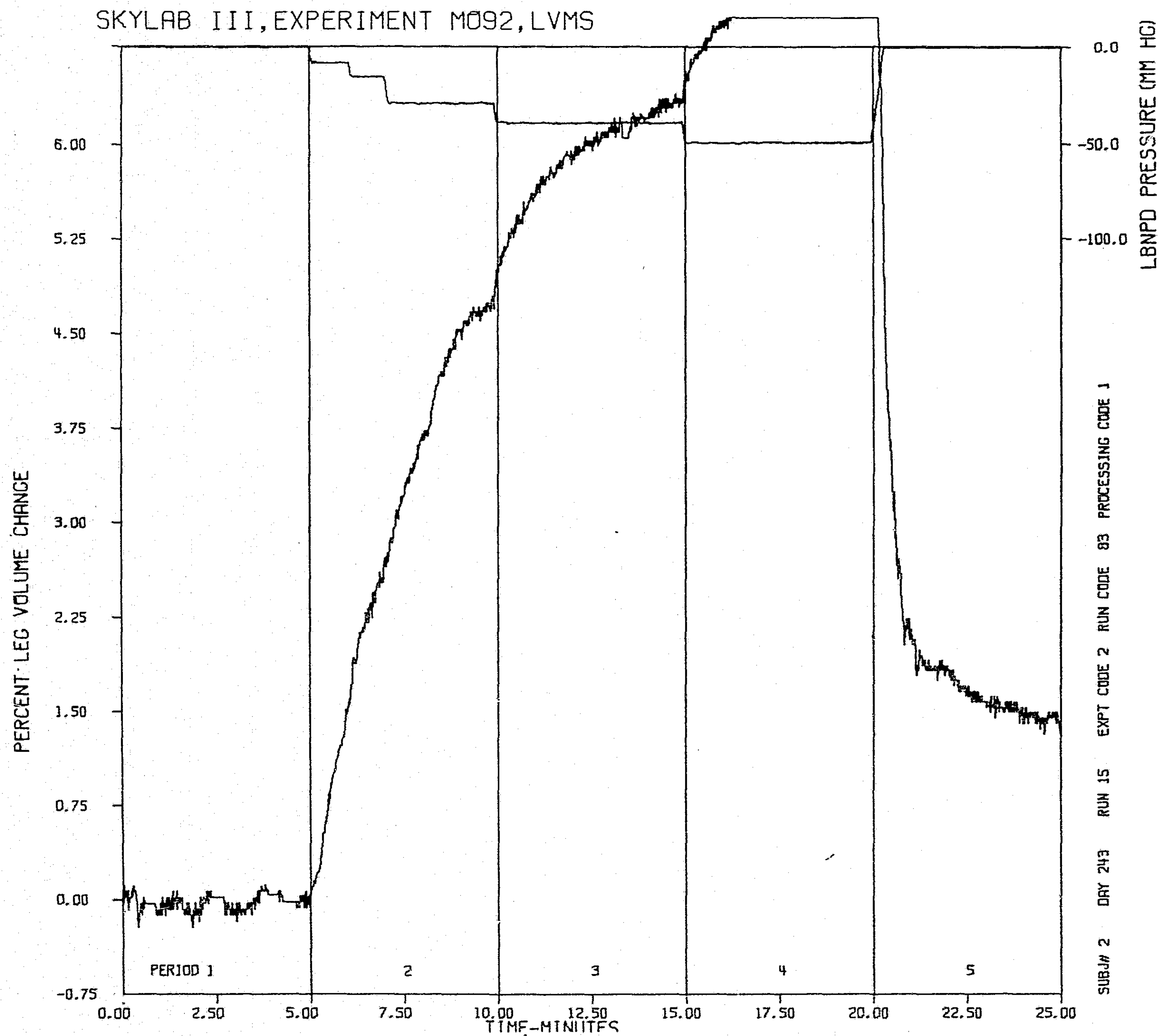

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 235 RUN 12 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1



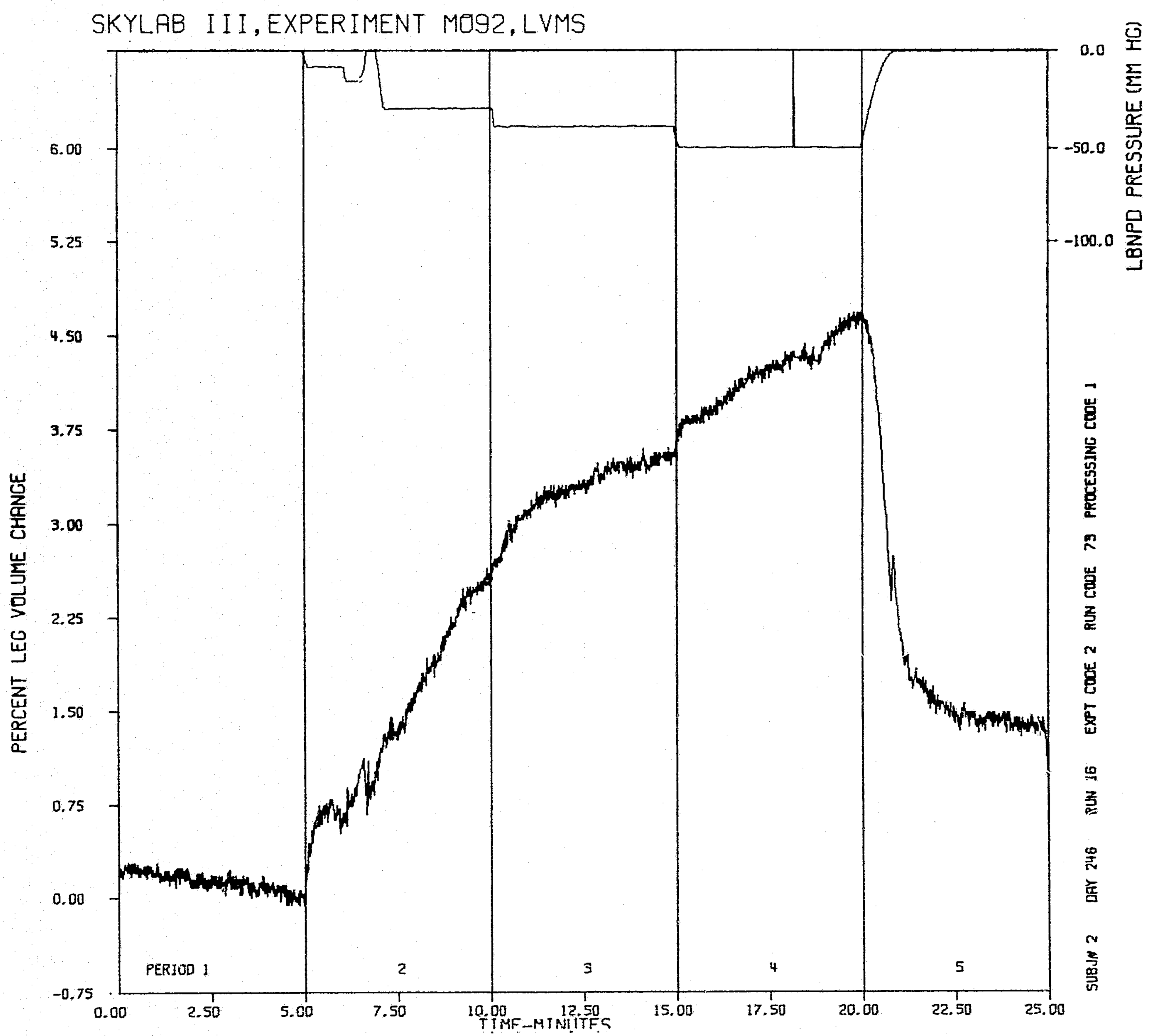
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 2 DAY 237 RUN 13 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1



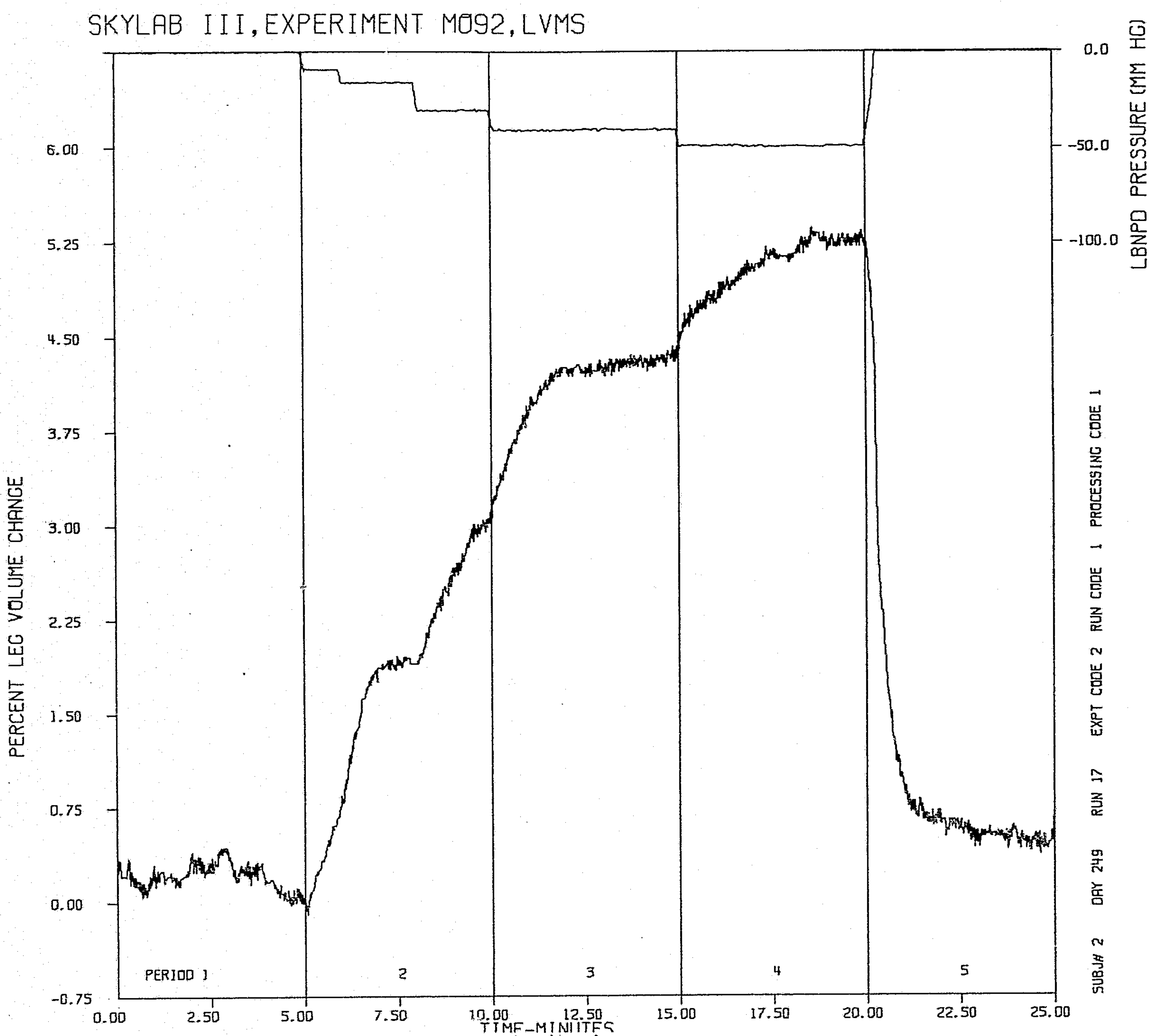
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 240 RUN 14 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1

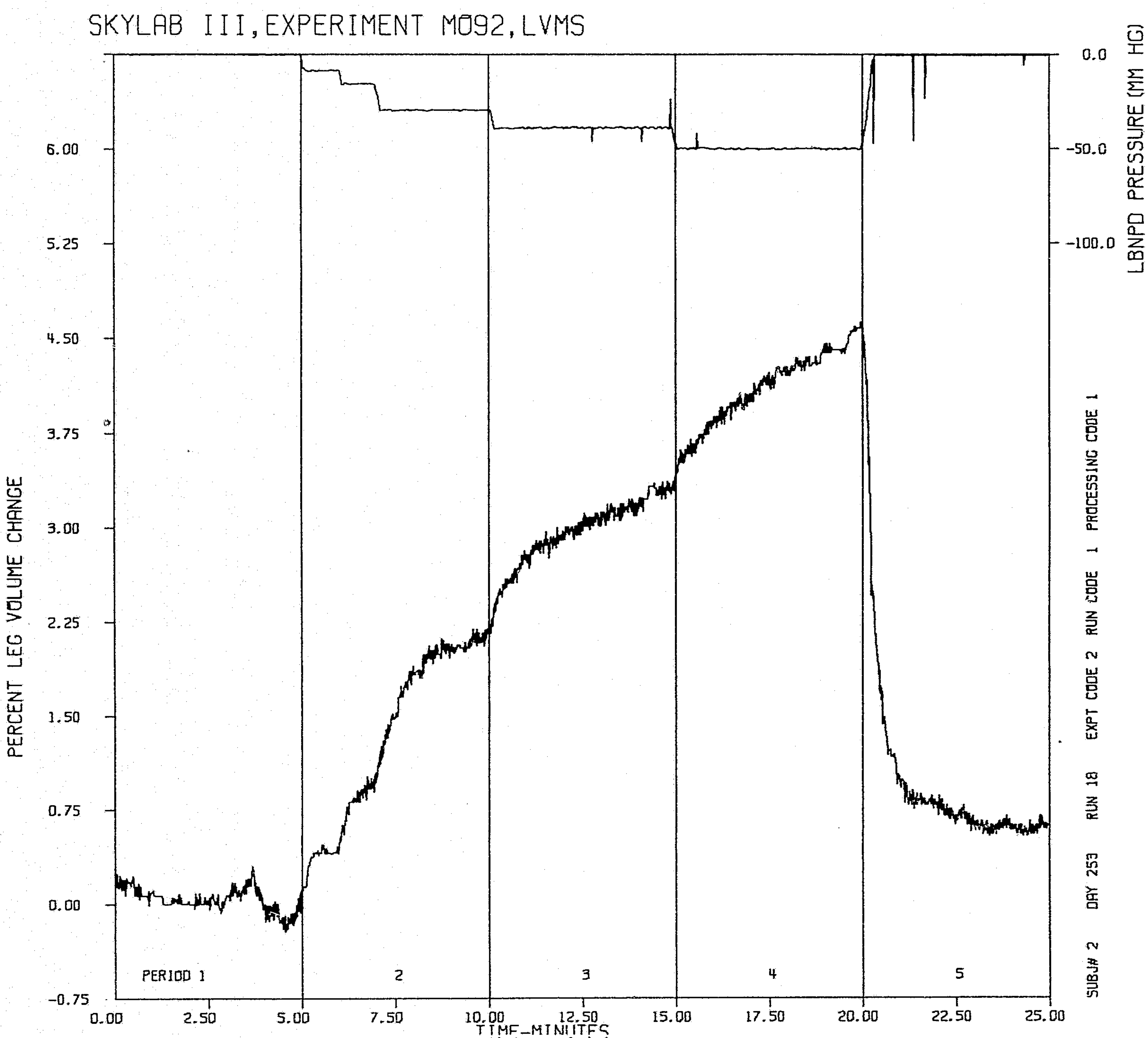


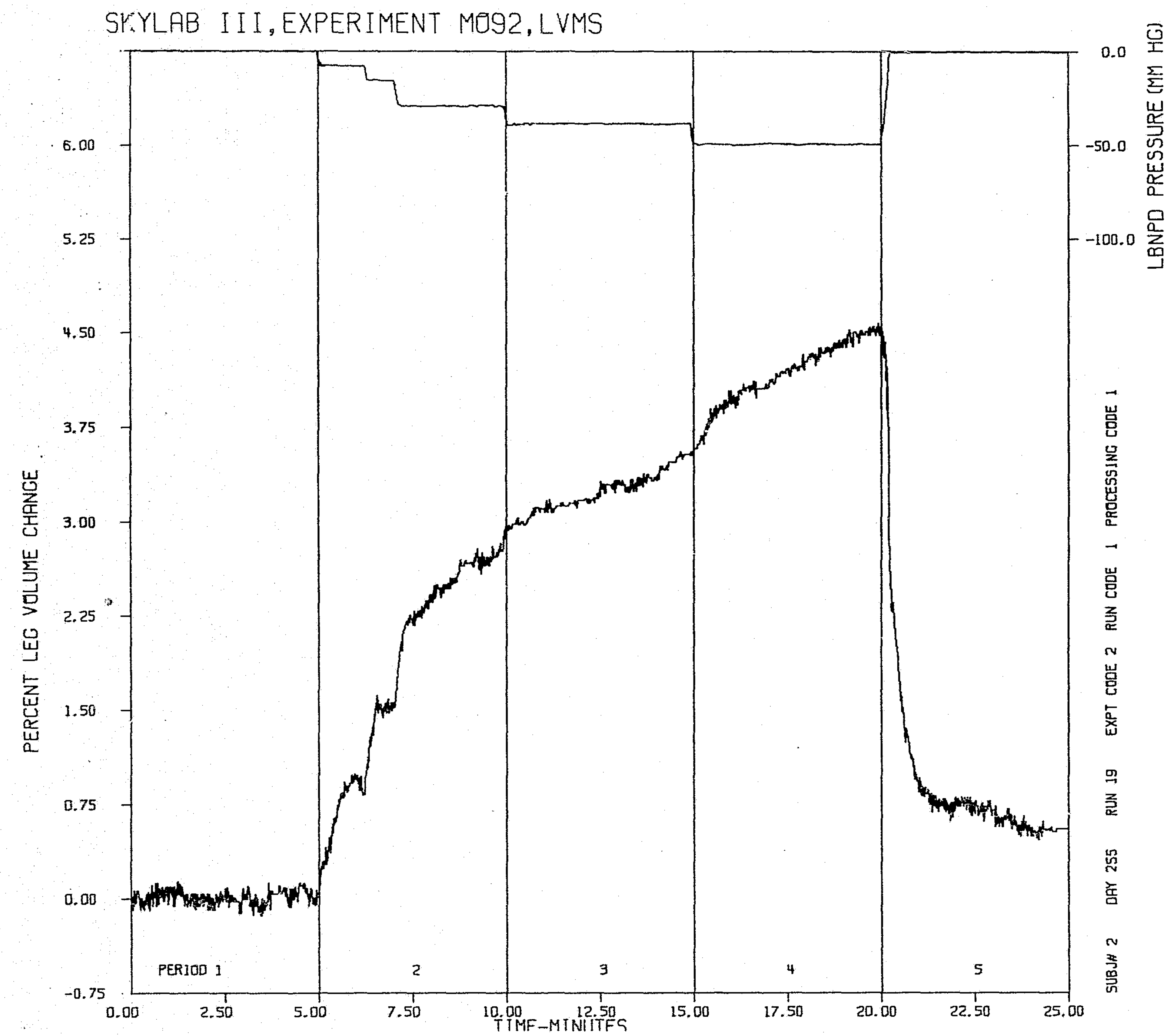
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 2 DAY 243 RUN 15 EXPT CODE 2 RUN CODE 83 PROCESSING CODE 1

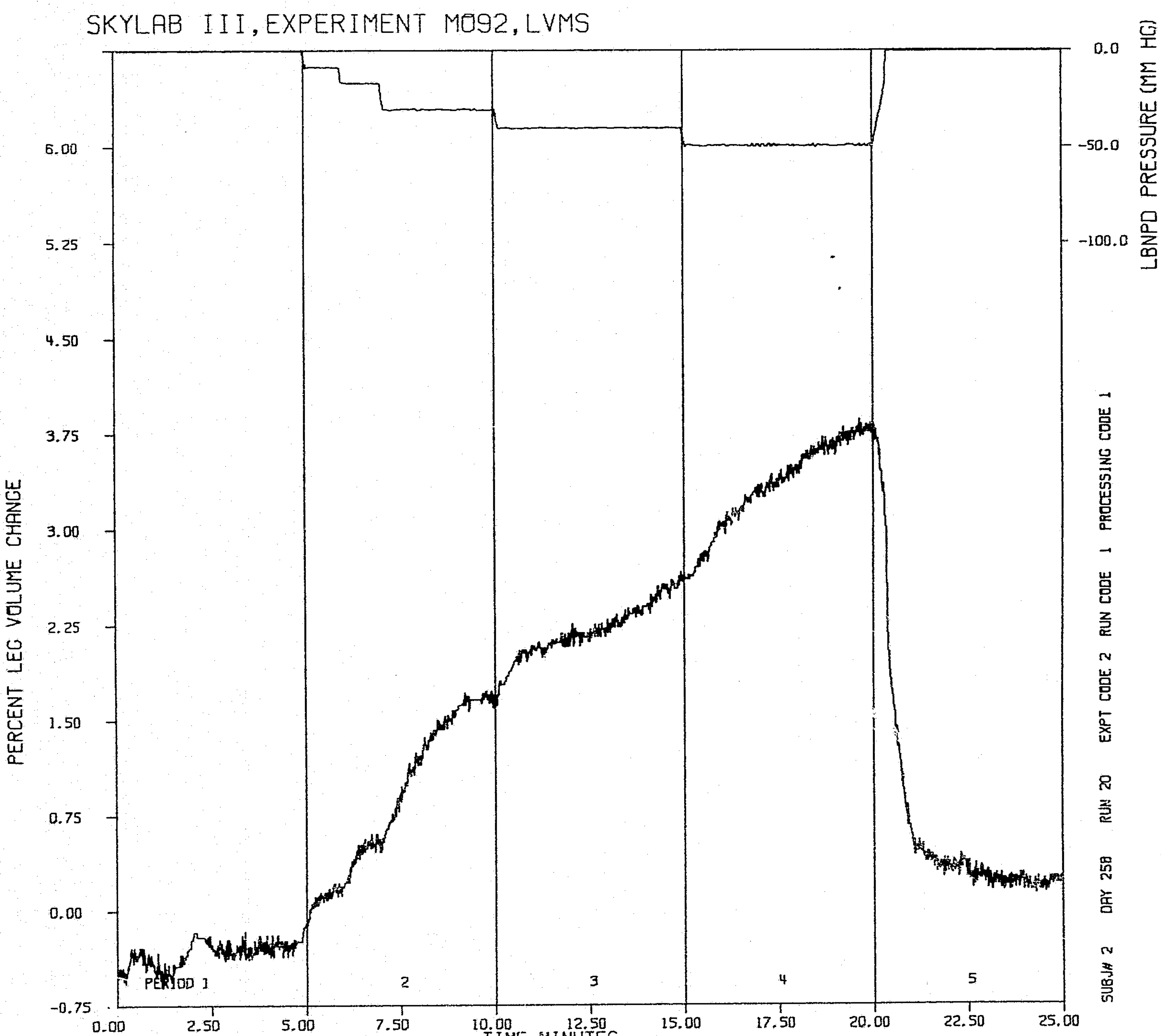


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 246 RUN 16 EXPT CODE 2 RUN CODE 73 PROCESSING CODE 1

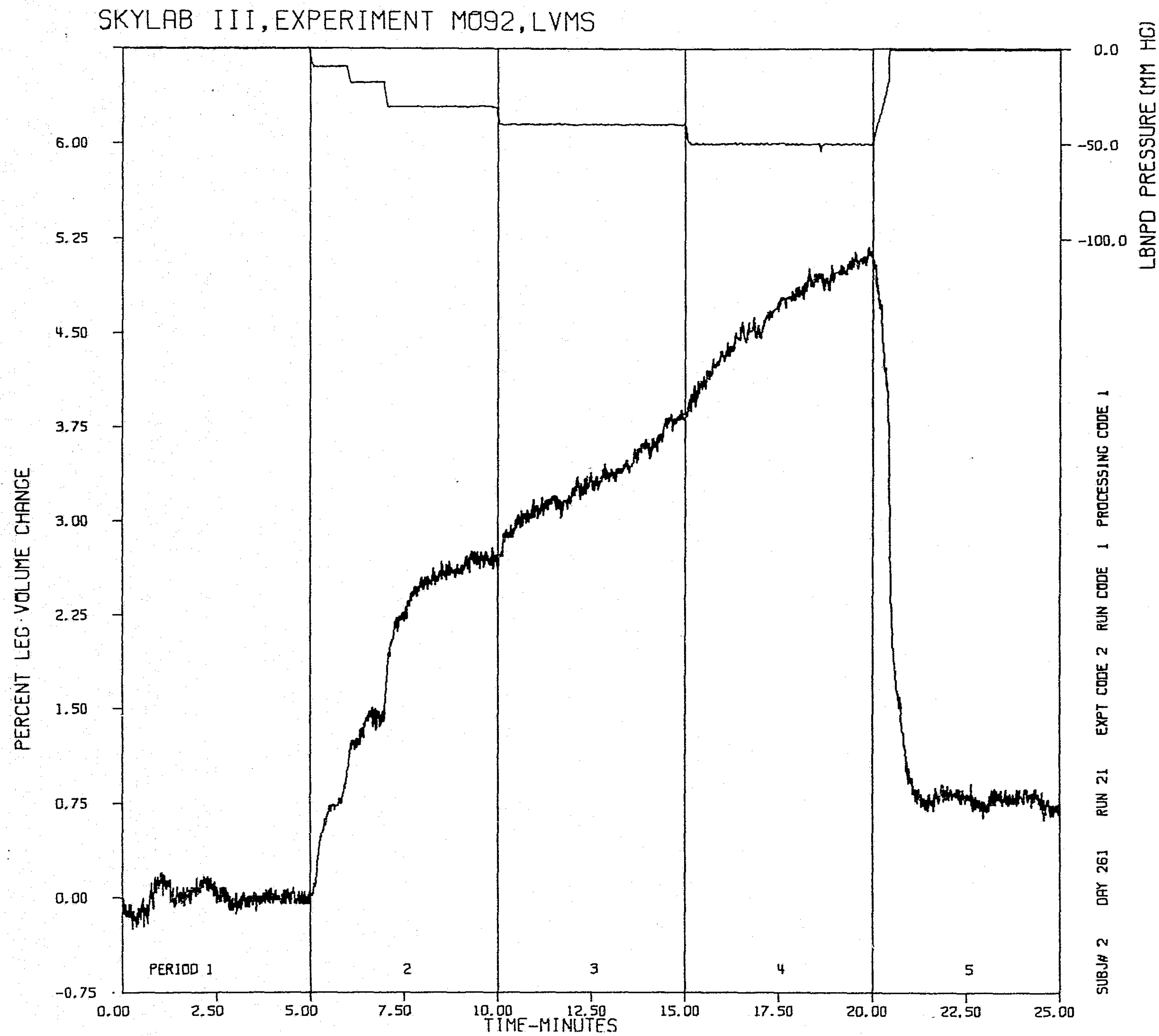

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
LBNPD PRESSURE (MM HG)
SUBJ# 2 DAY 249 RUN 17 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 253 RUN 18 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1

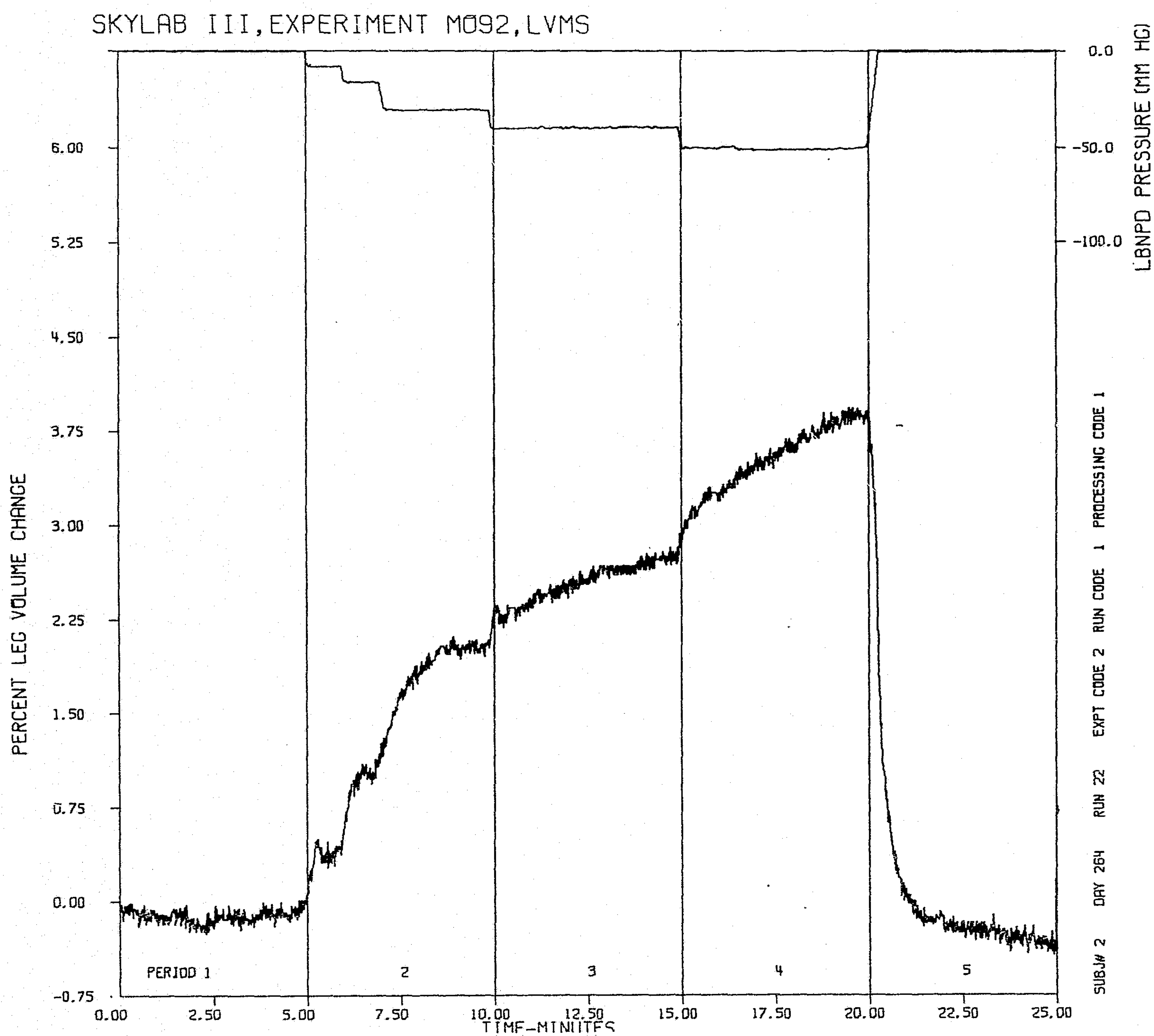

SKYLAB III,EXPERIMENT M092,LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 255 RUN 19 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
-0.75
0.00
0.75
1.50
2.25
3.00
3.75
4.50
5.25
6.00
0.0
-50.0
-100.0
SUBJ# 2 DAY 258 RUN 20 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1

D-49

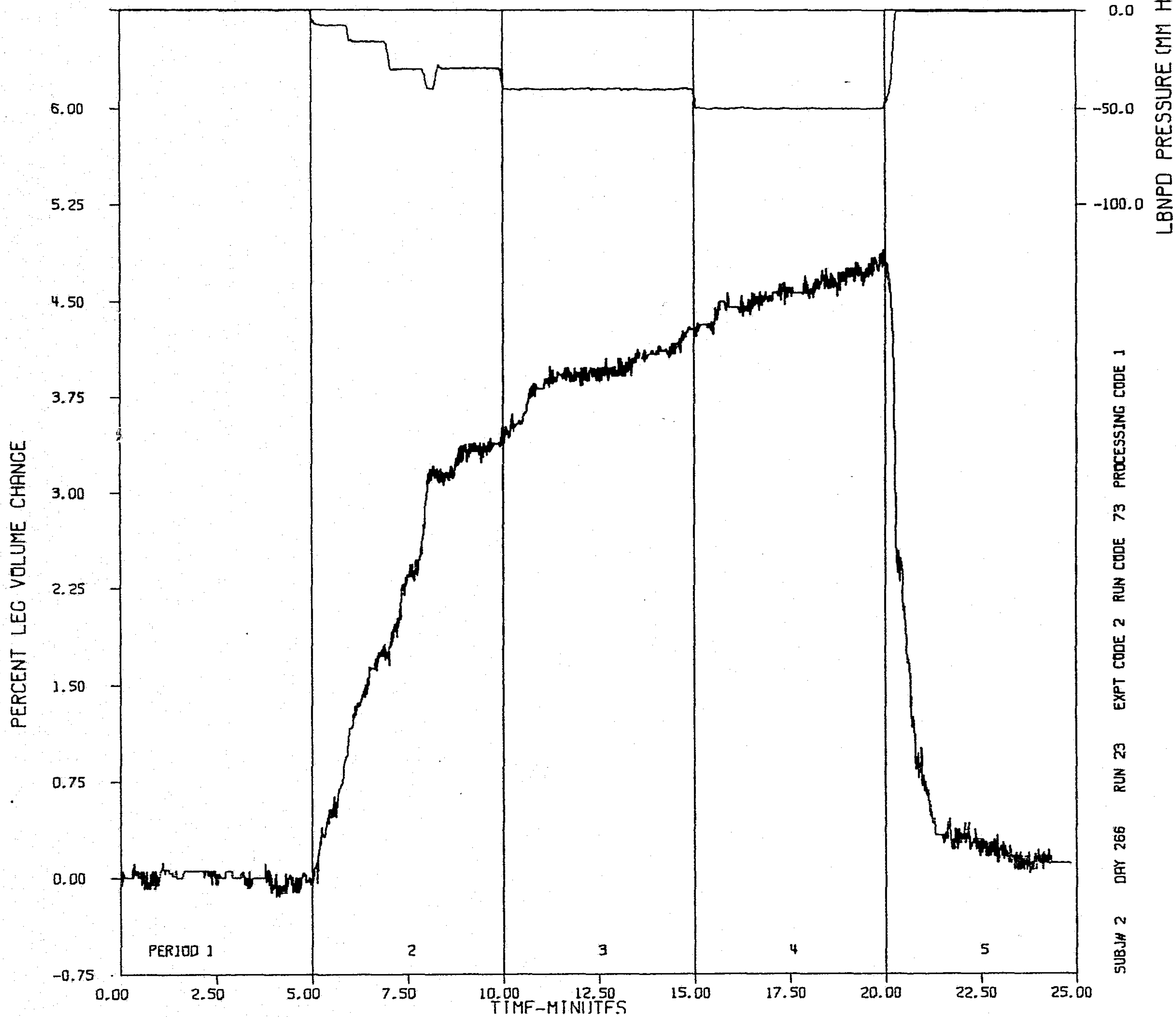

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 261 RUN 21 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1

D-50

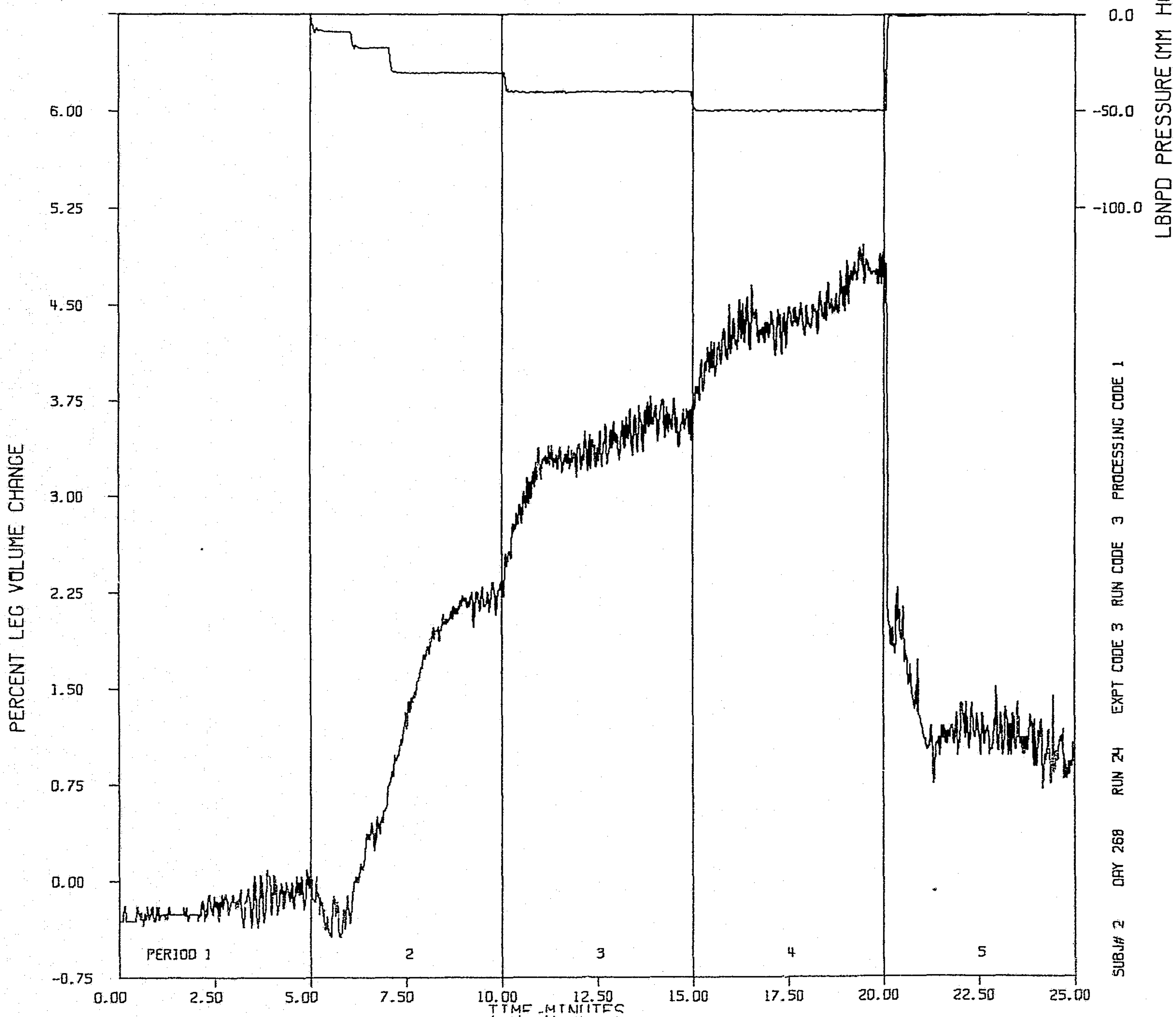


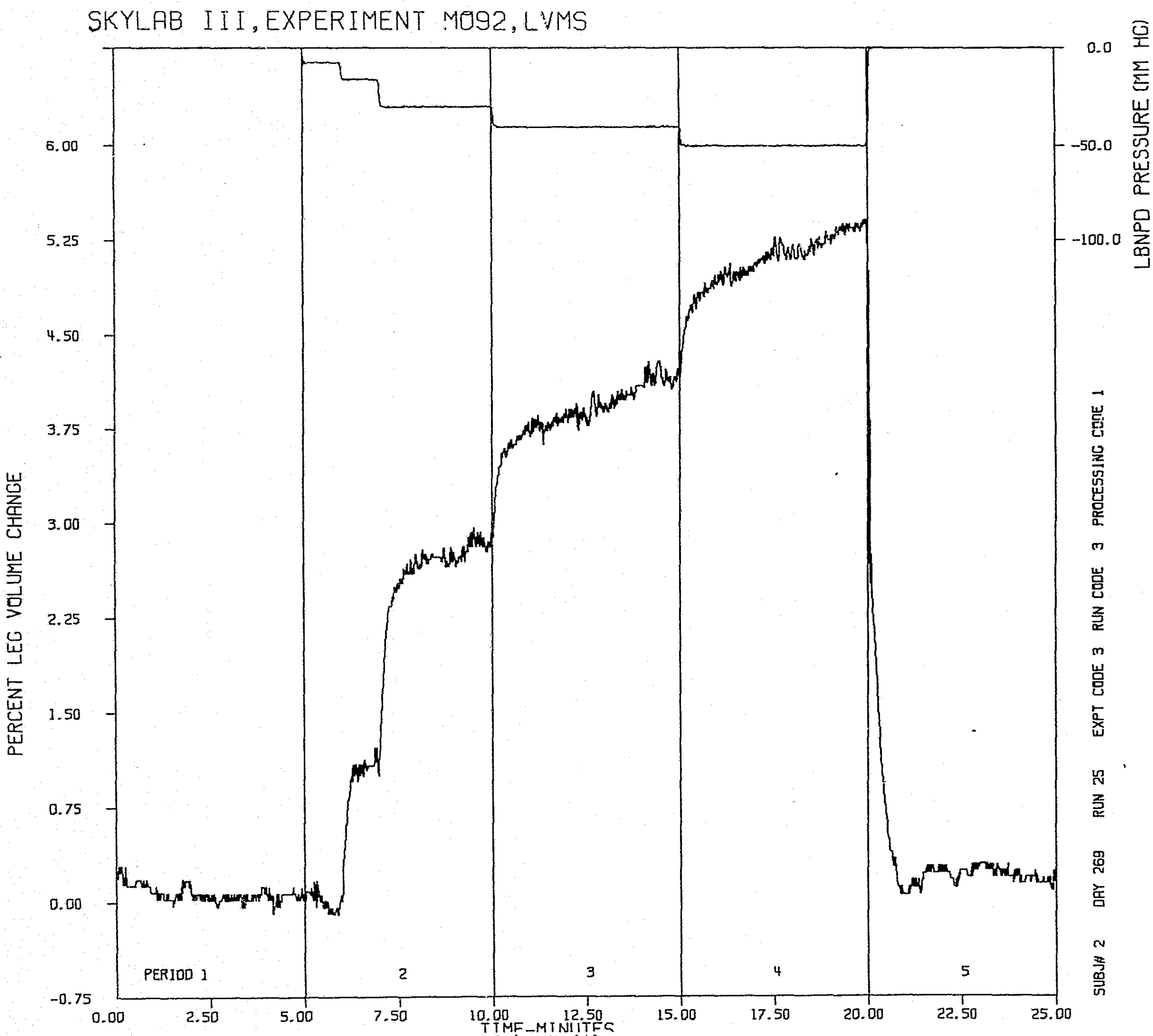
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 264 RUN 22 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1

SKYLAB III, EXPERIMENT M092, LVMS

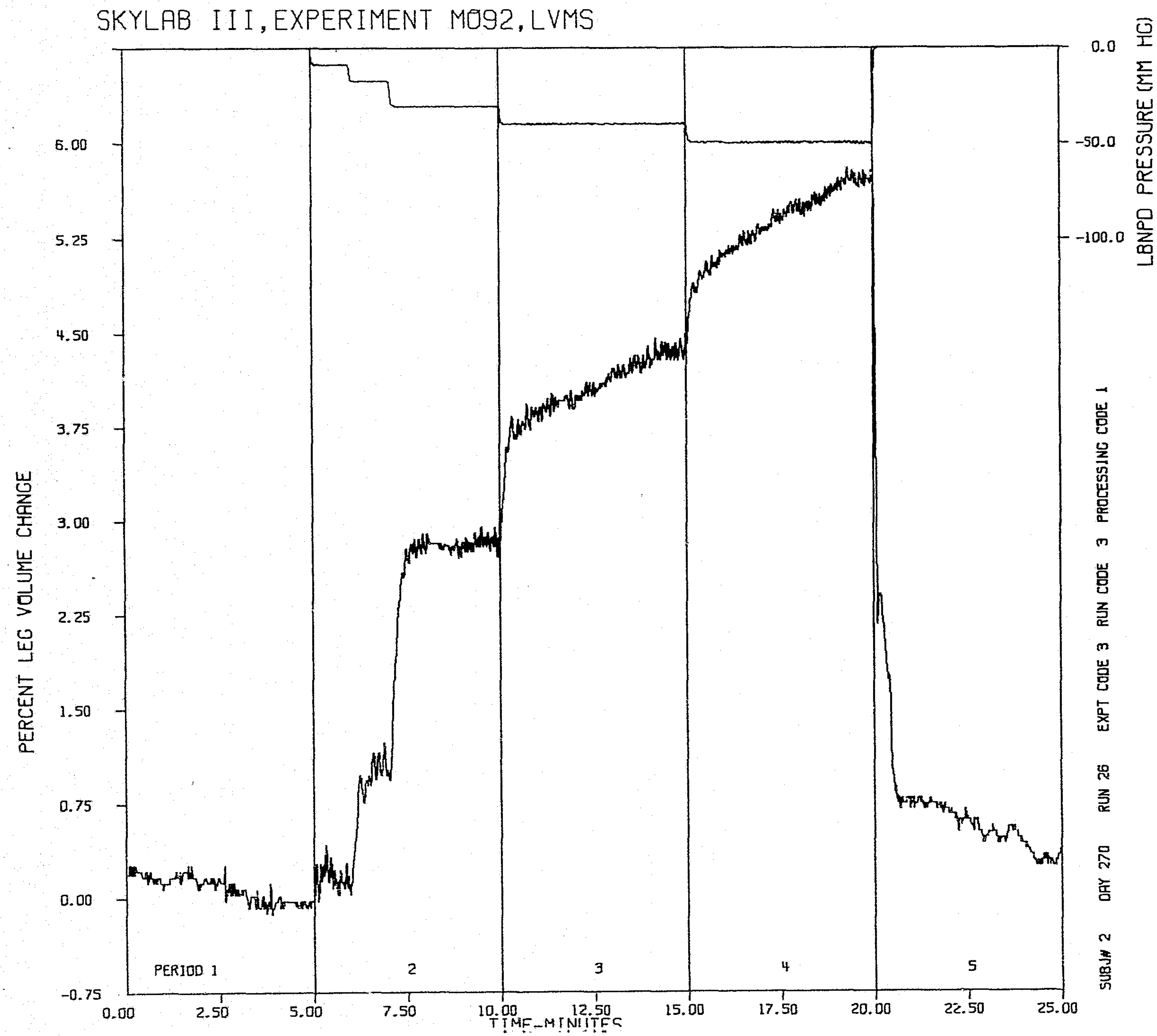


SKYLAB III, EXPERIMENT MØ92, LVMS

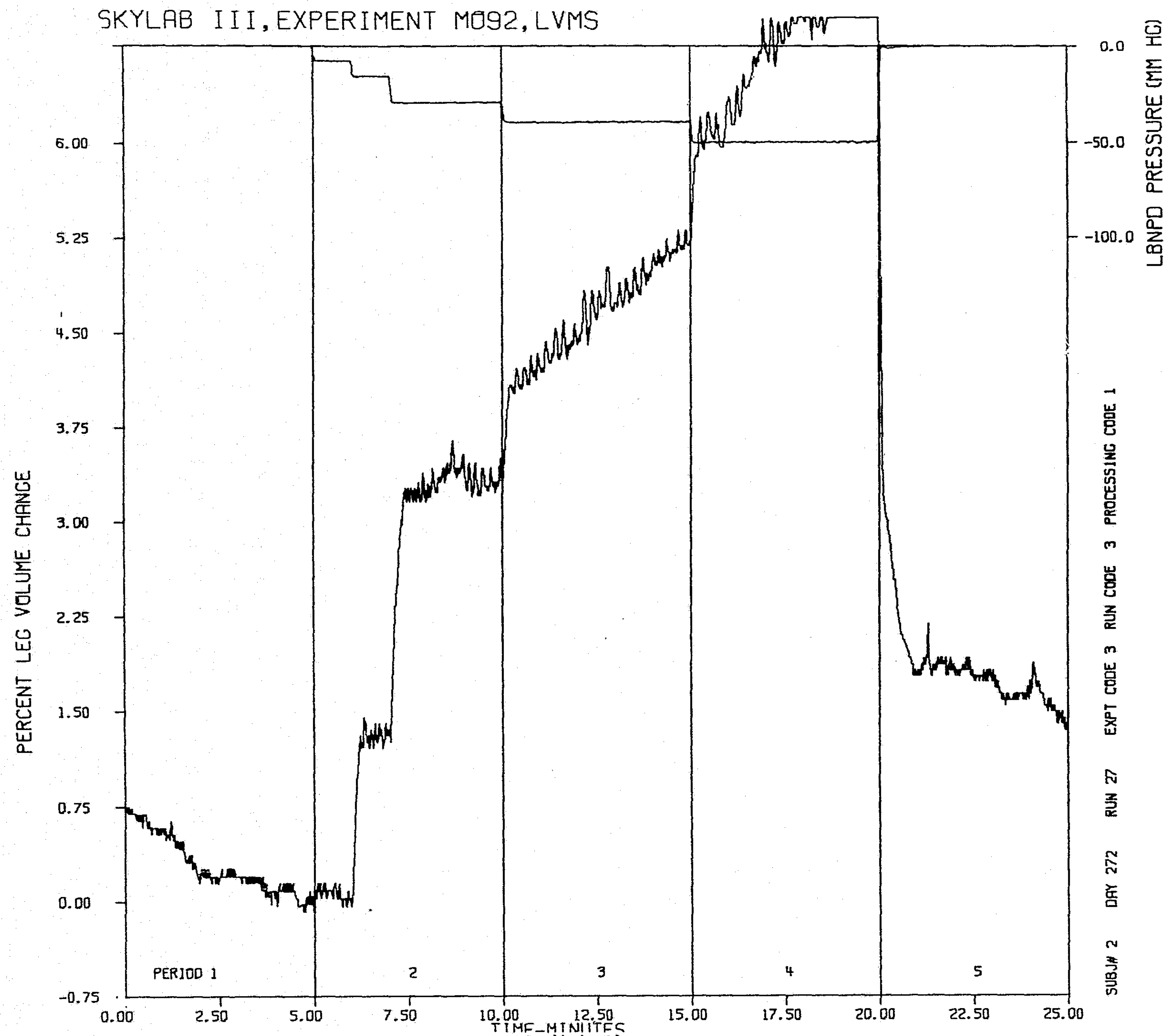




SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 2 DAY 269 RUN 25 EXPT CODE 3 RUN CODE 3 PROCESSING CODE 1

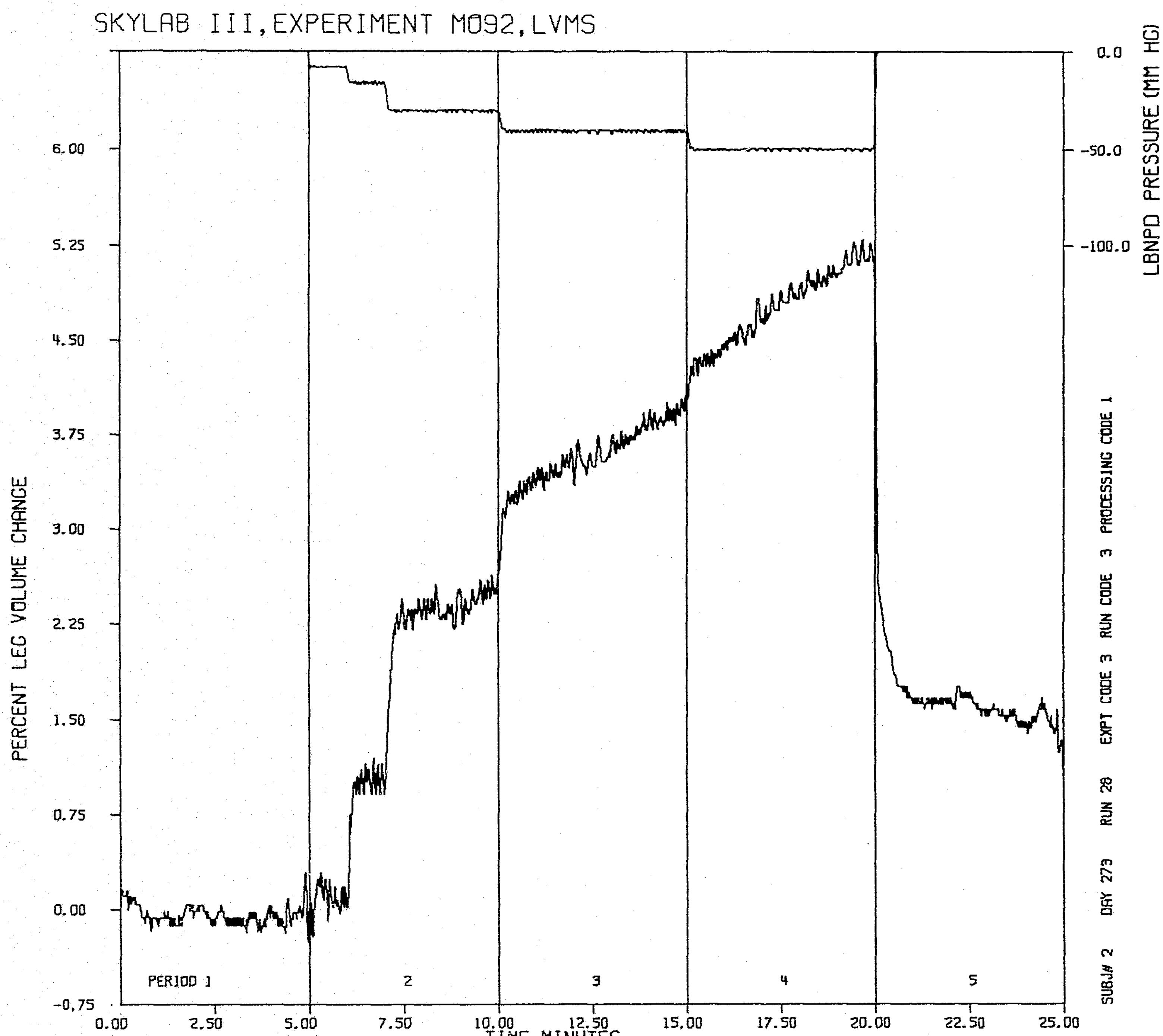


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 270 RUN 26 EXPT CODE 3 RUN CODE 3 PROCESSING CODE 1



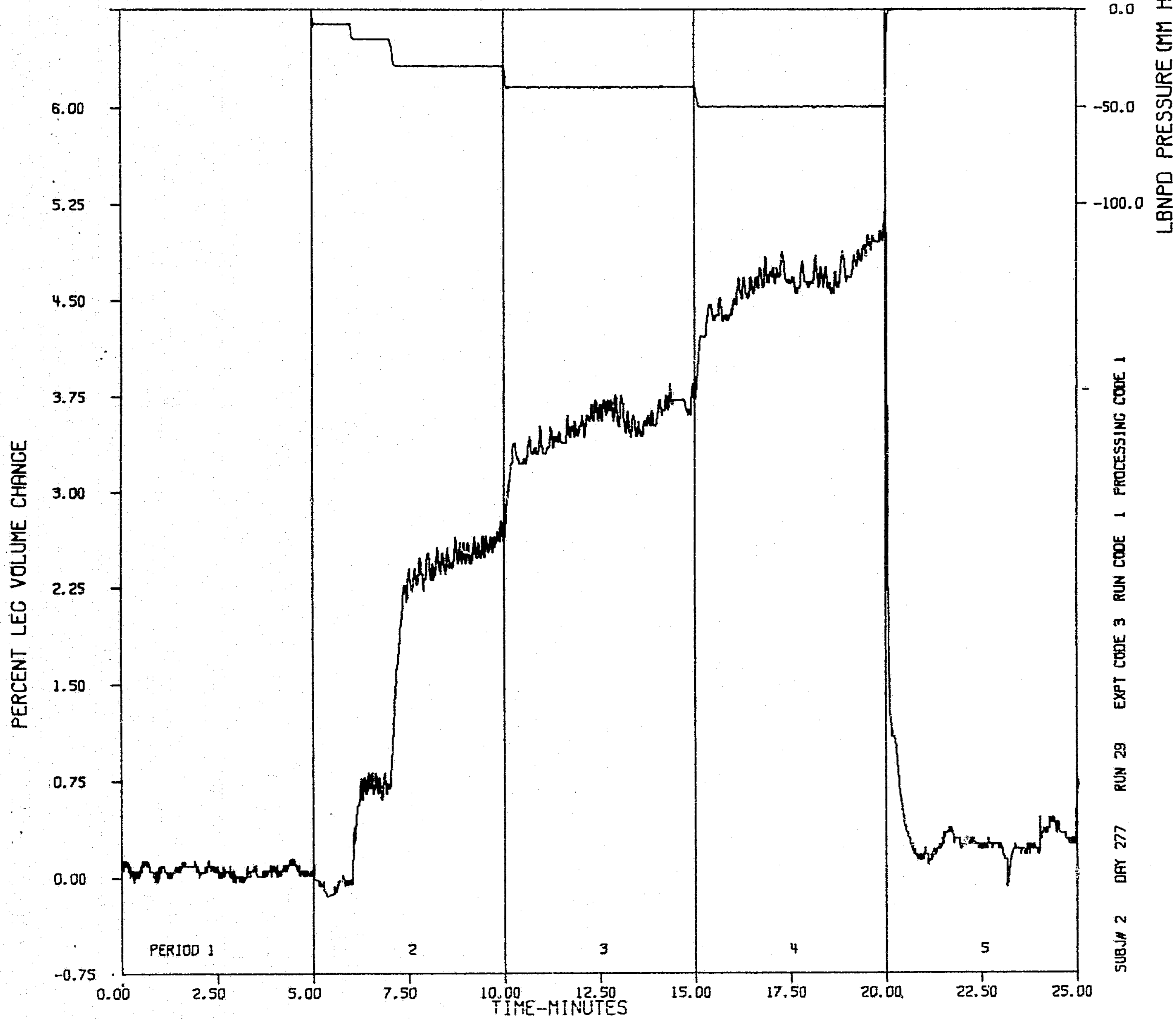
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
LBNPD PRESSURE (MM HG)
SUBJ# 2 DAY 272 RUN 27 EXPT CODE 3 RUN CODE 3 PROCESSING CODE 1

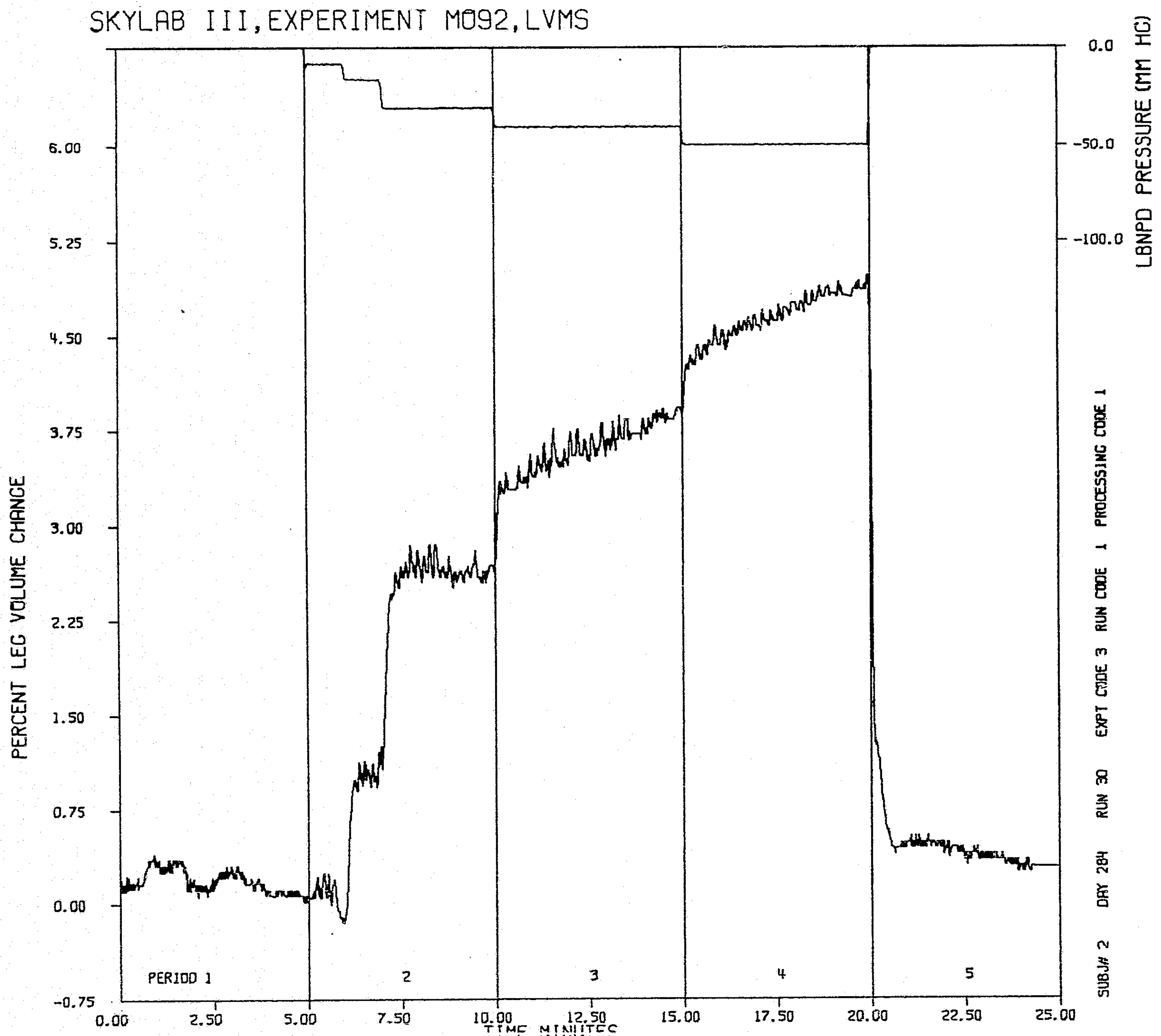
D-56



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
LBNPD PRESSURE (MM HG)
SUBJ# 2 DAY 273 RUN 28 EXPT CODE 3 RUN CODE 3 PROCESSING CODE 1

SKYLAB III, EXPERIMENT M092, LVMS

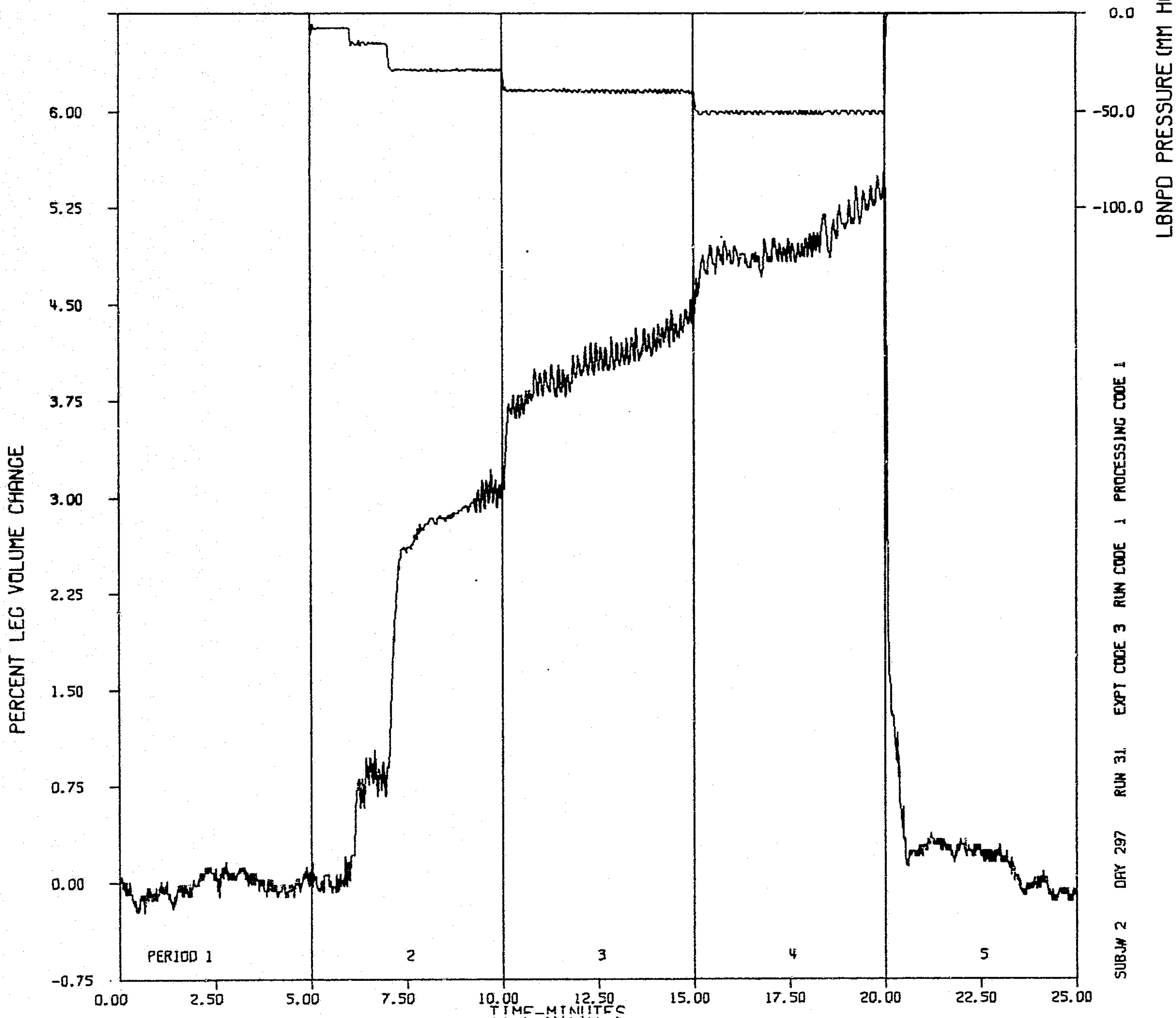


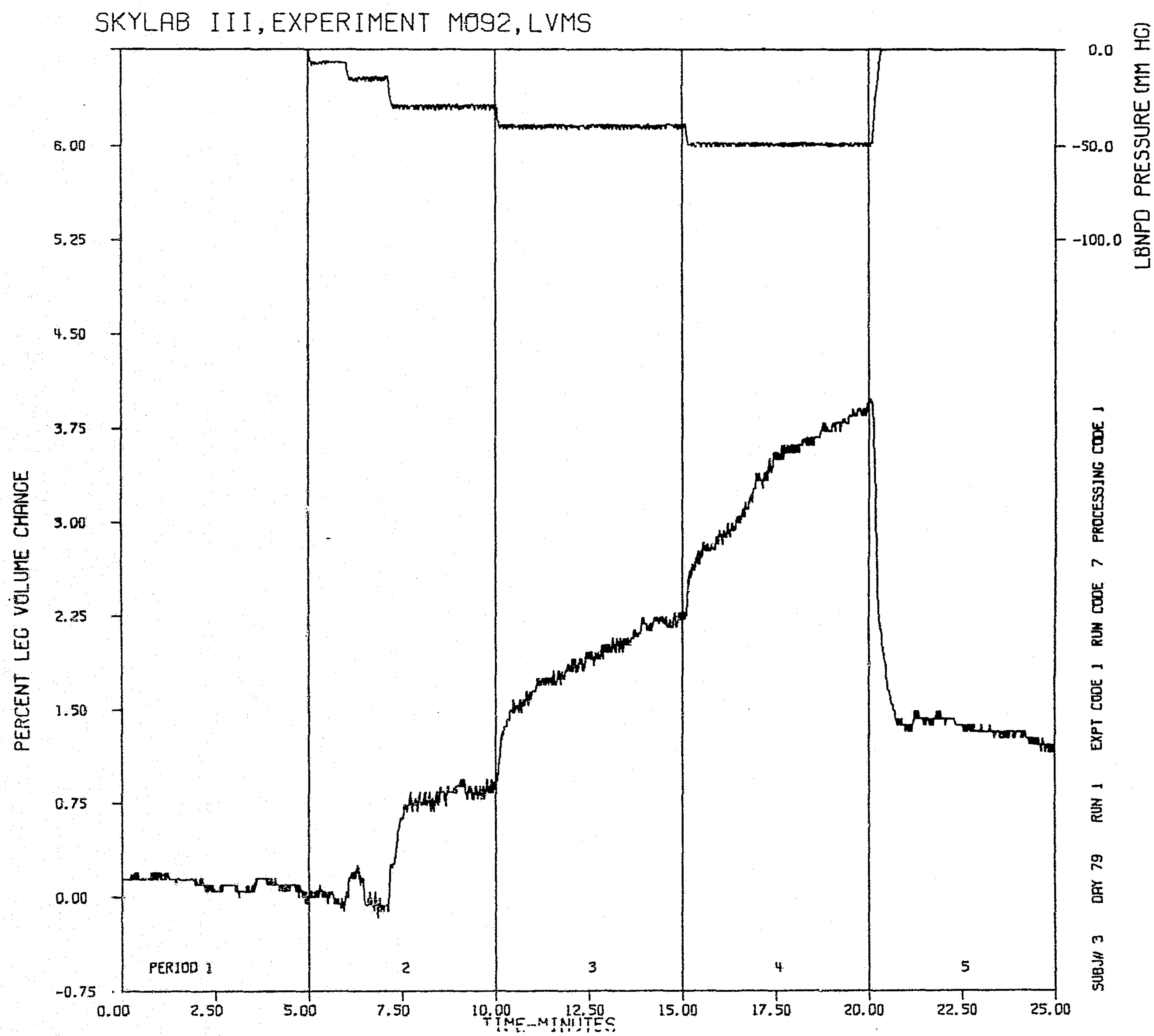


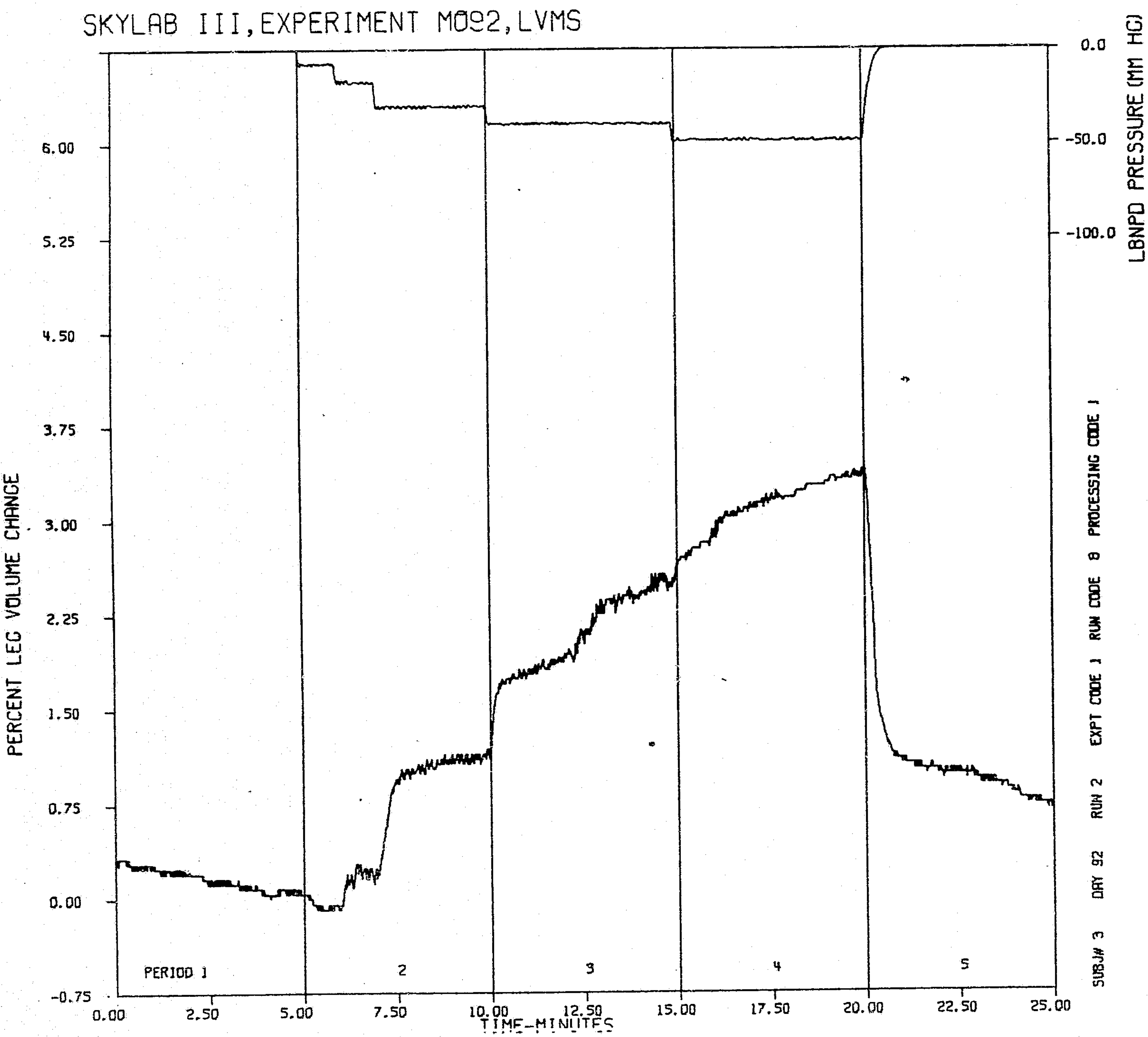
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME MINUTES
PERIOD 1
2
3
4
5
SUBJ# 2 DAY 284 RUN 30 EXPT CODE 3 RUN CODE 1 PROCESSING CODE 1

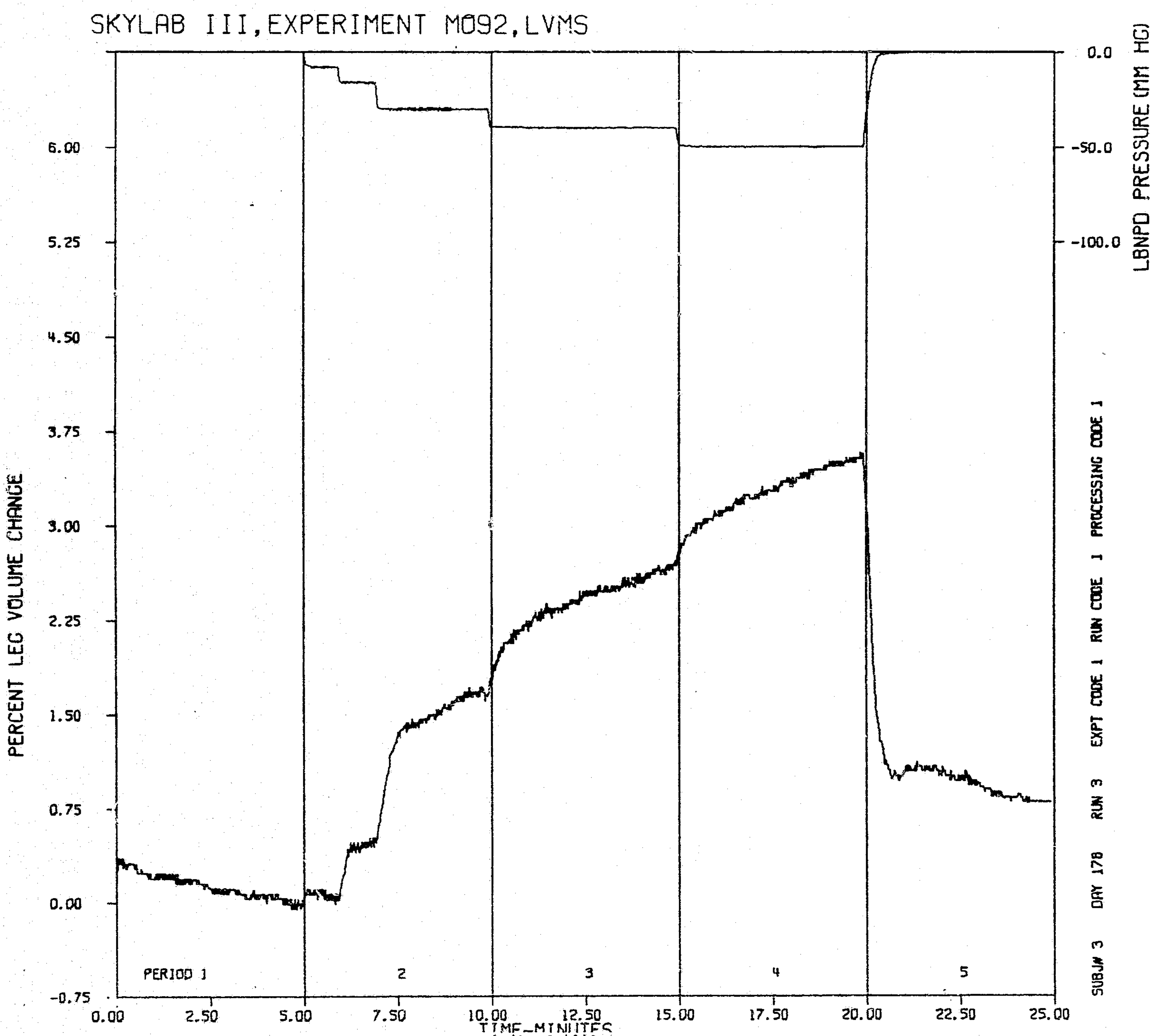
D-59

SKYLAB III, EXPERIMENT M092, LVMS



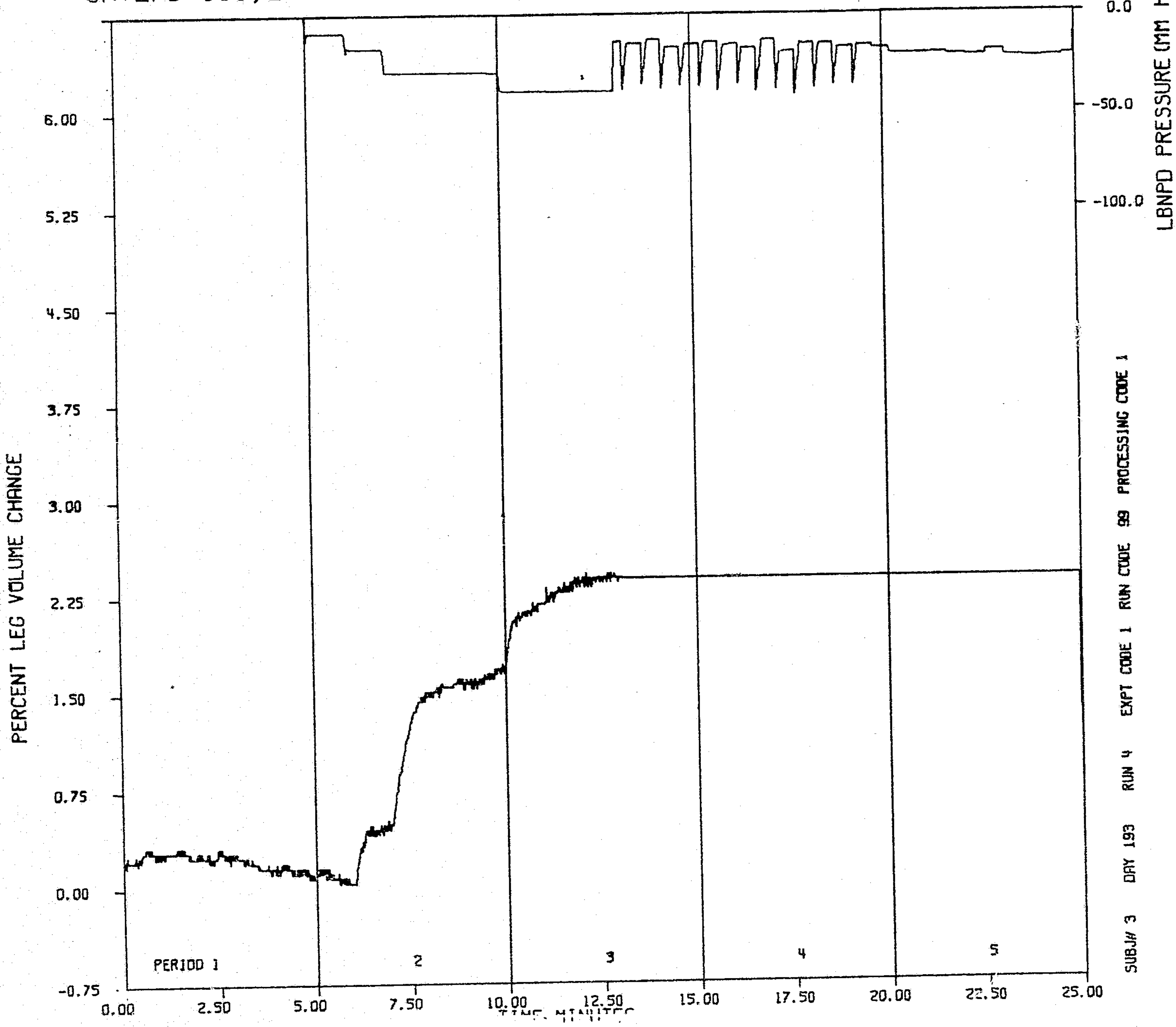

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 79 RUN 1 EXPT CODE 1 RUN CODE 7 PROCESSING CODE 1


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 92 RUN 2 EXPT CODE 1 RUN CODE 8 PROCESSING CODE 1

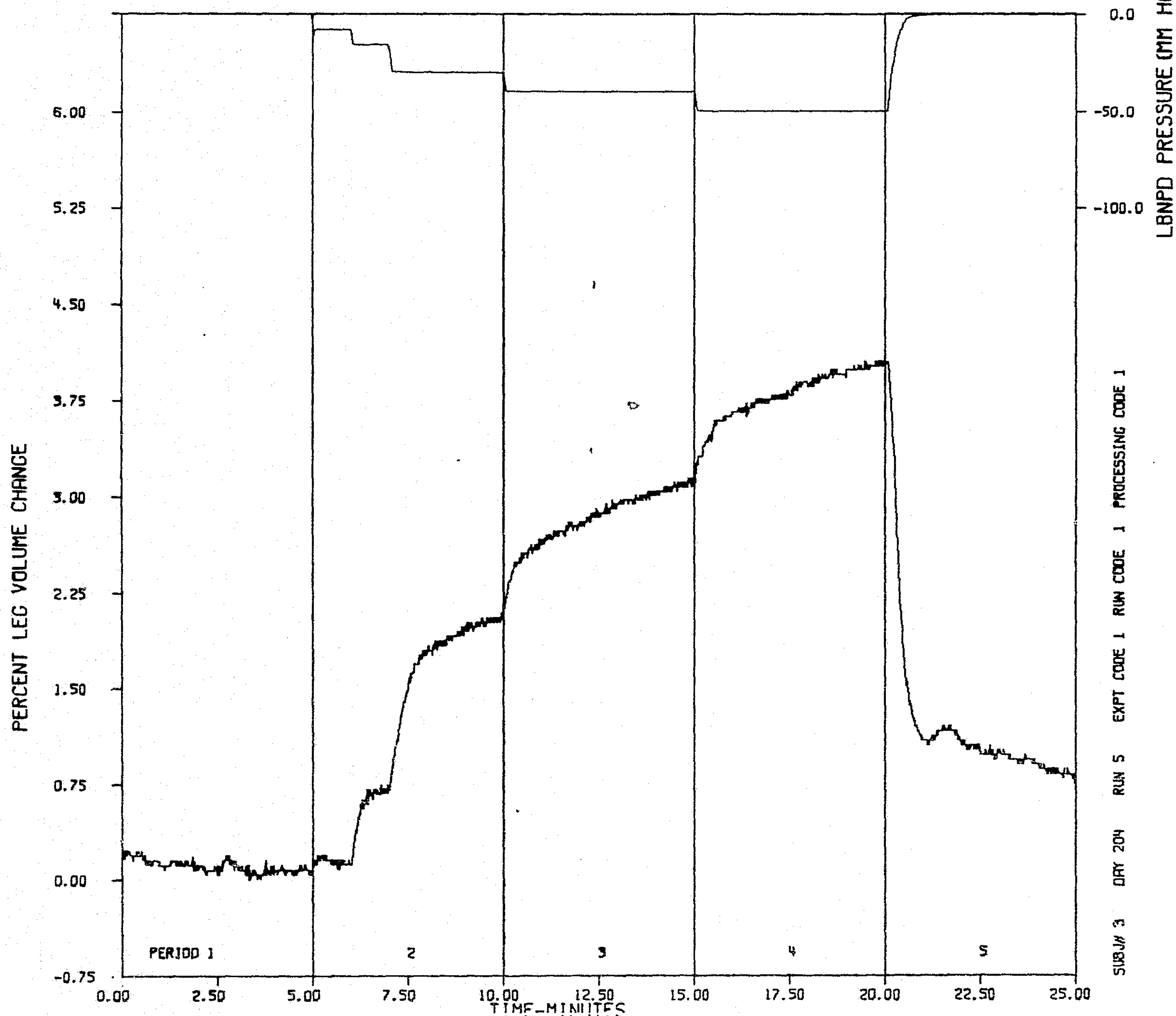


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 178 RUN 3 EXPT CODE 1 RUN CODE 1 PROCESSING CODE 1

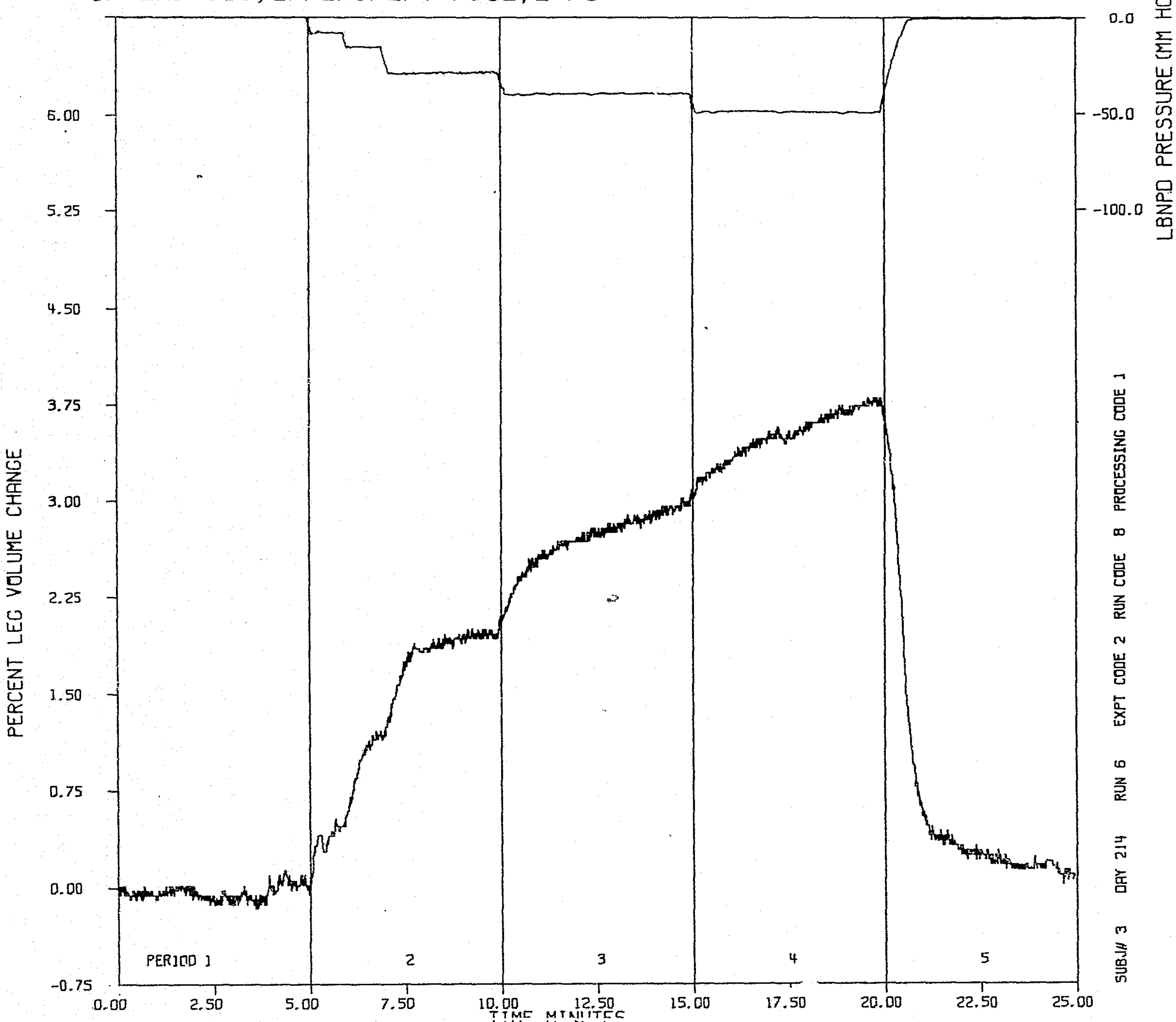
SKYLAB III, EXPERIMENT M092, LVMS



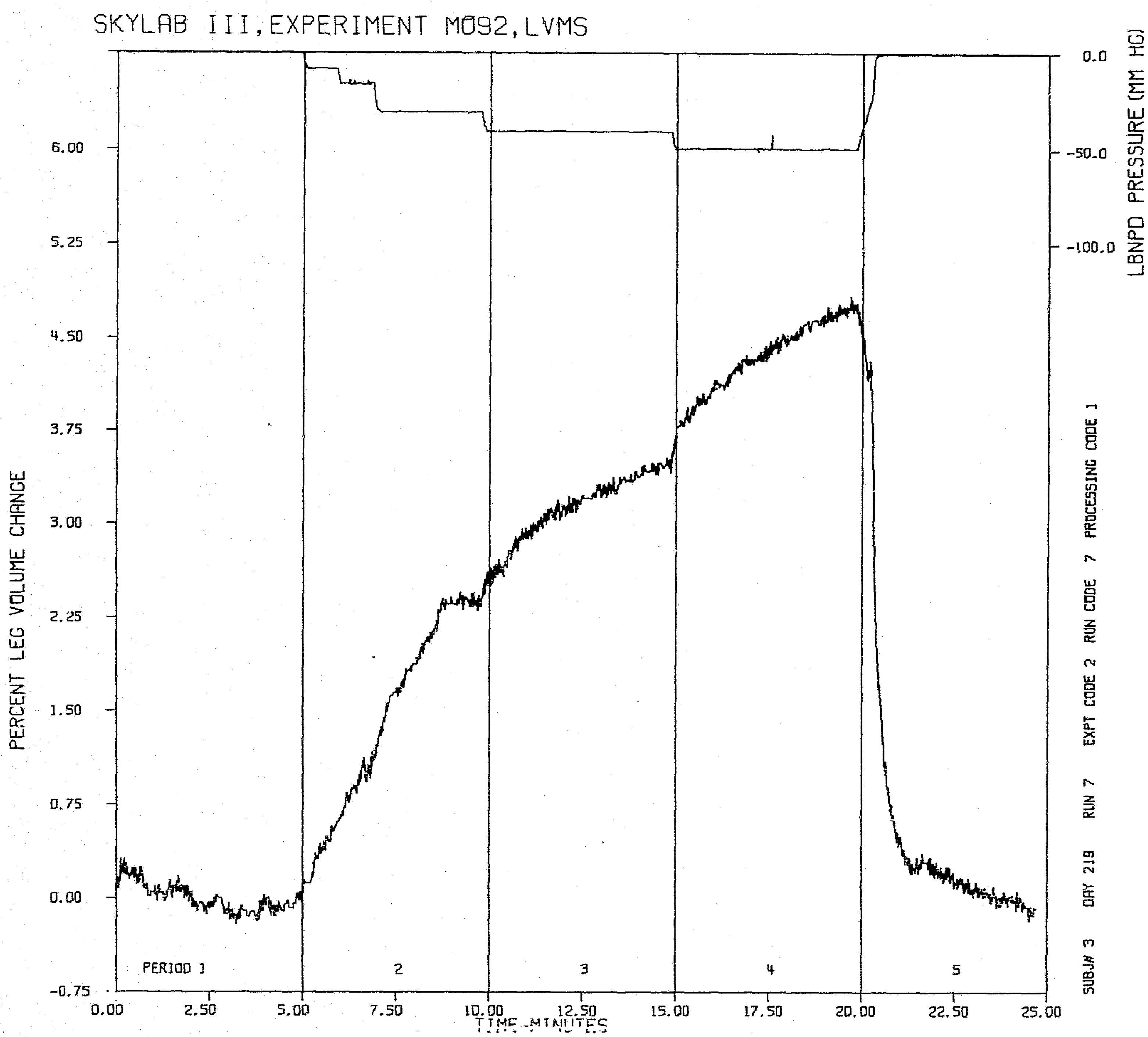
SKYLAB III, EXPERIMENT M092, LVMS



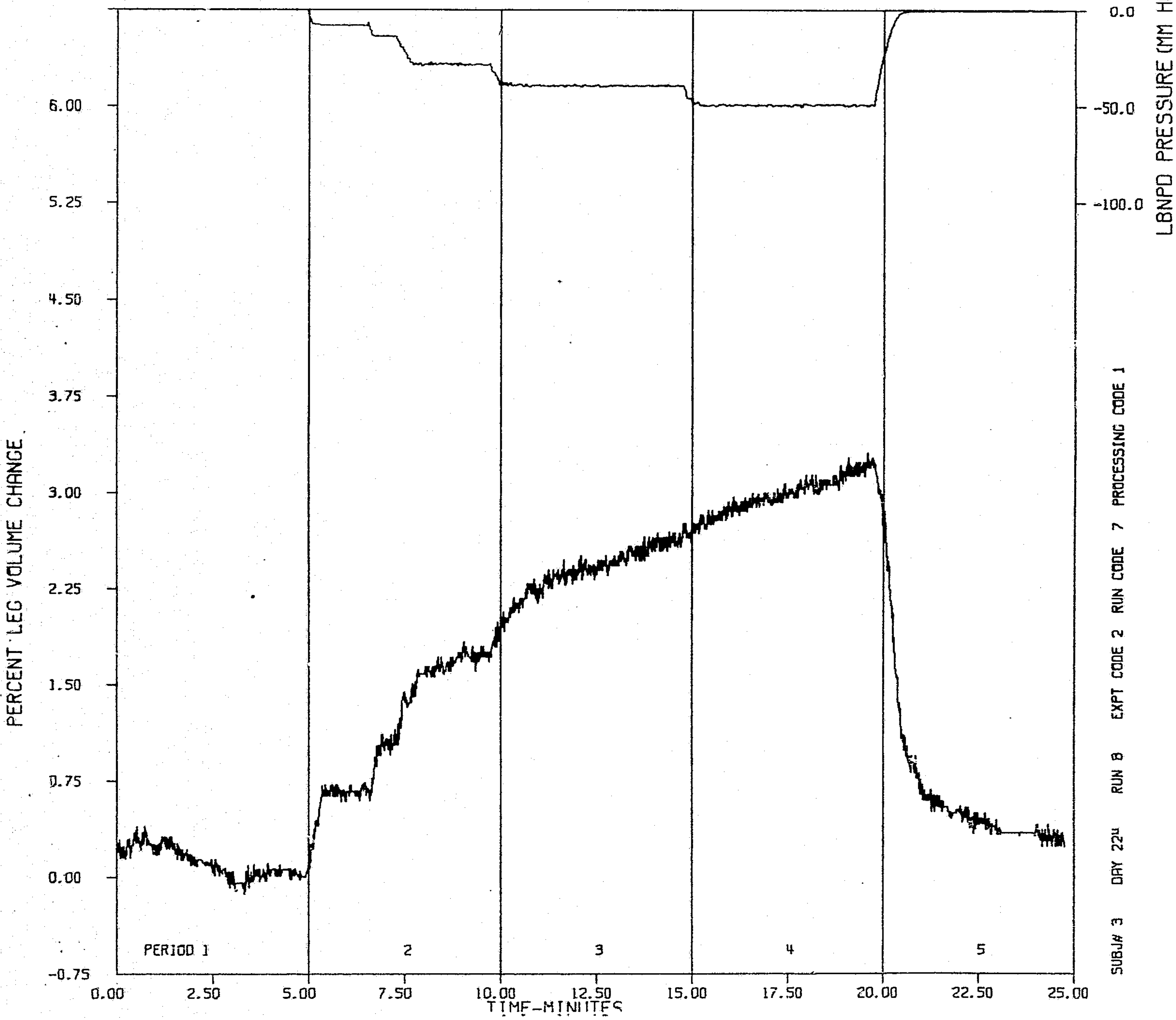
SKYLAB III, EXPERIMENT M092, LVMS



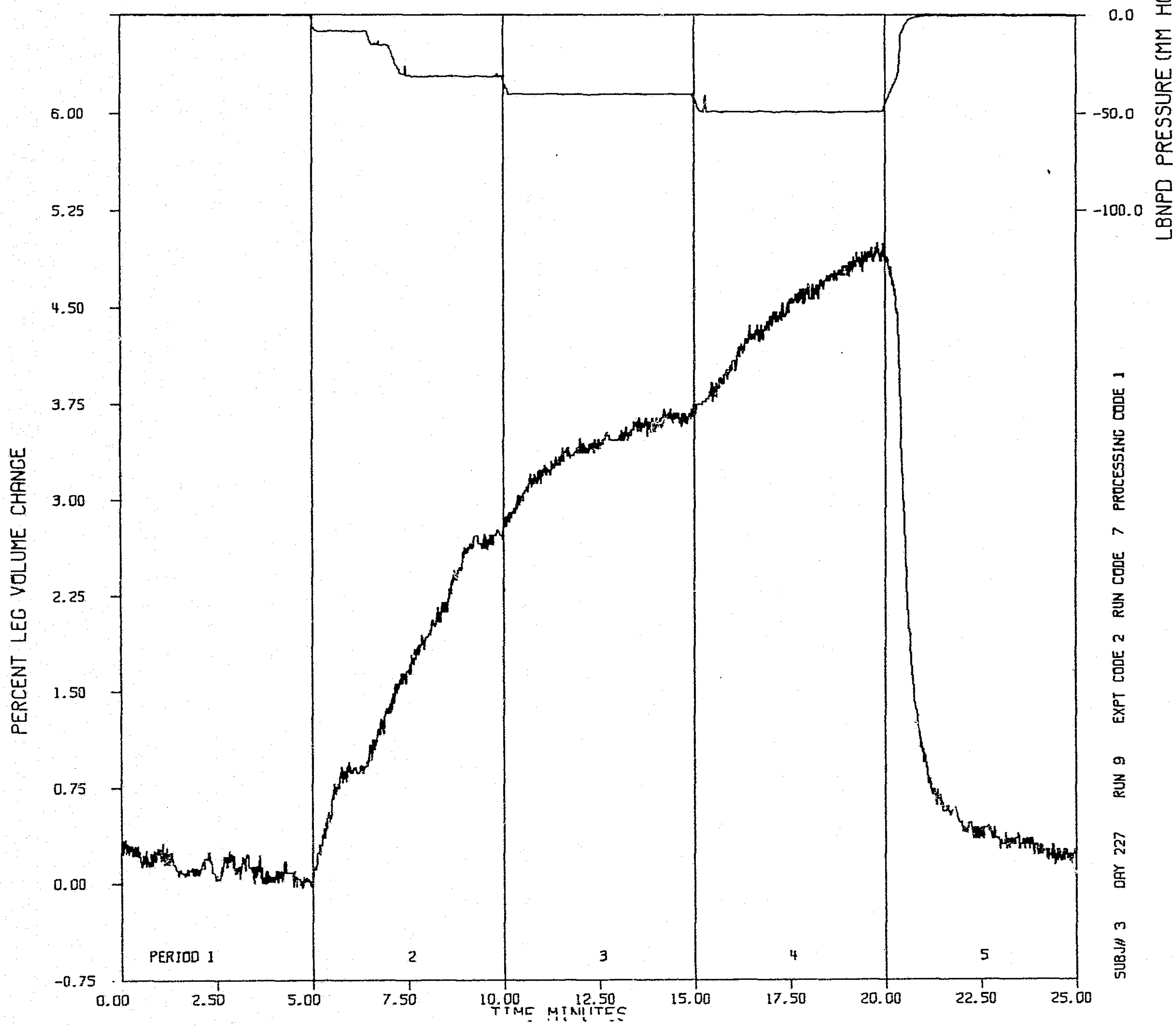
D-66

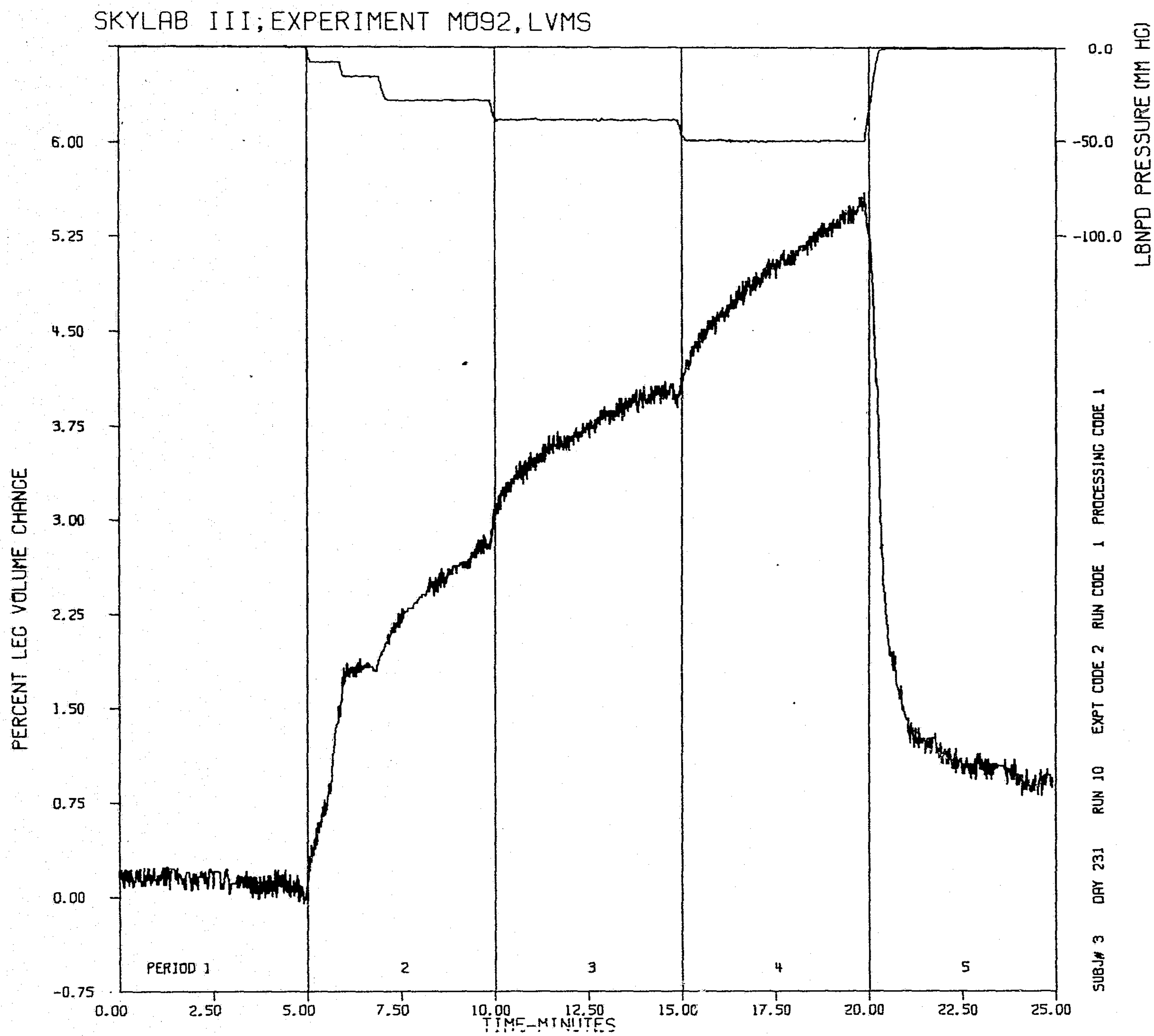

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 219 RUN 7 EXPT CODE 2 RUN CODE 7 PROCESSING CODE 1

SKYLAB III, EXPERIMENT M092, LVMS

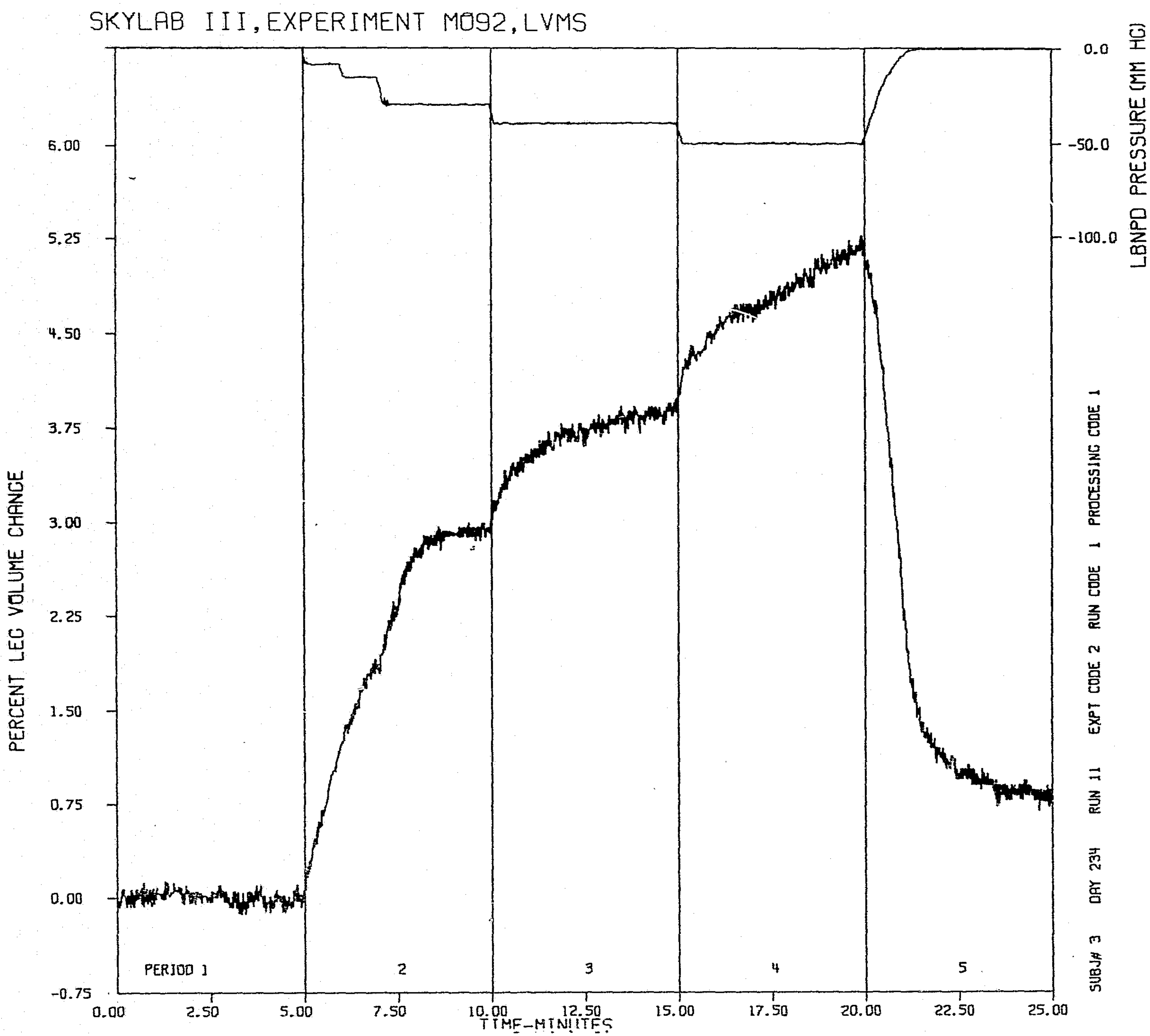


SKYLAB III, EXPERIMENT M092, LVMS

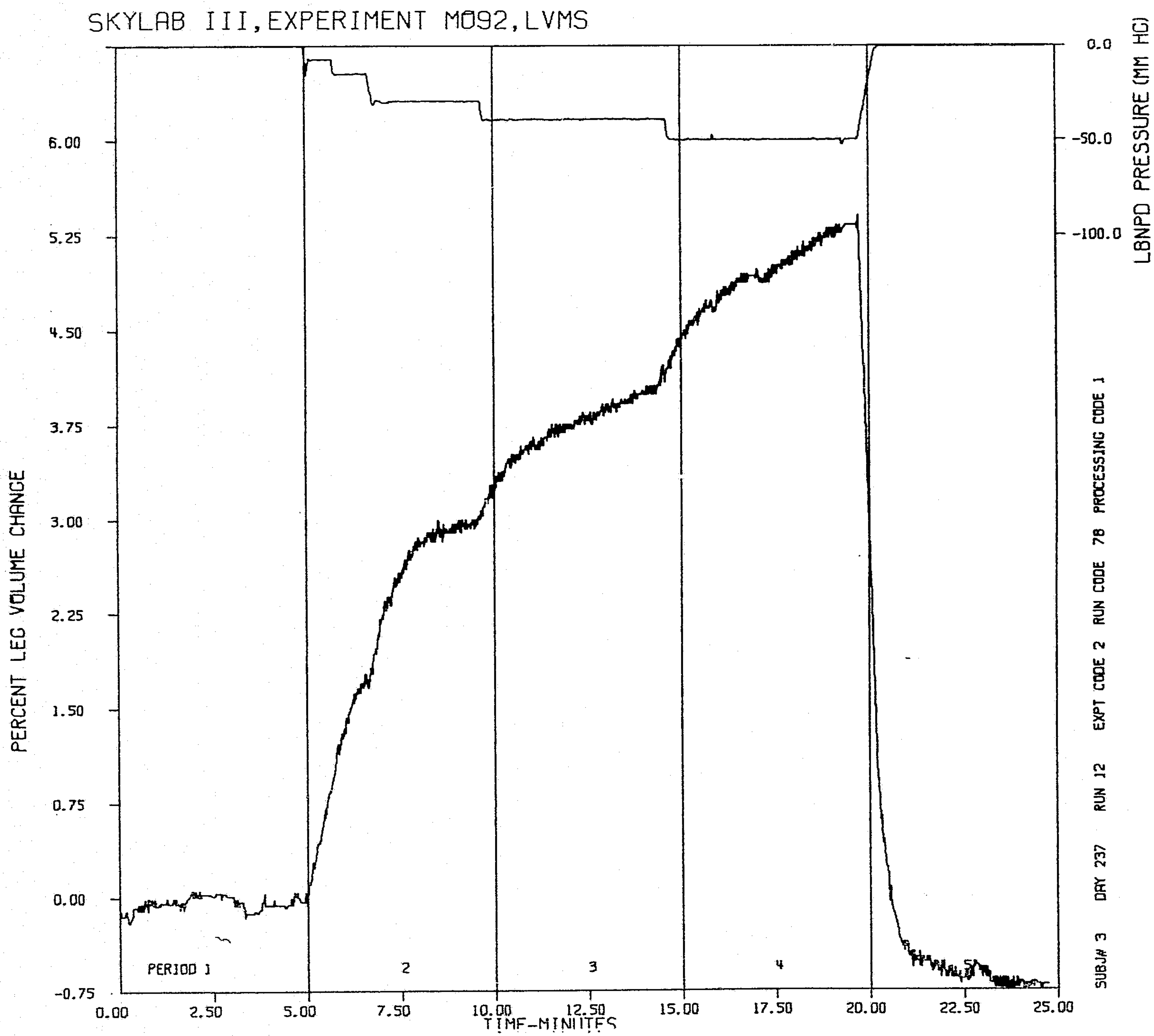


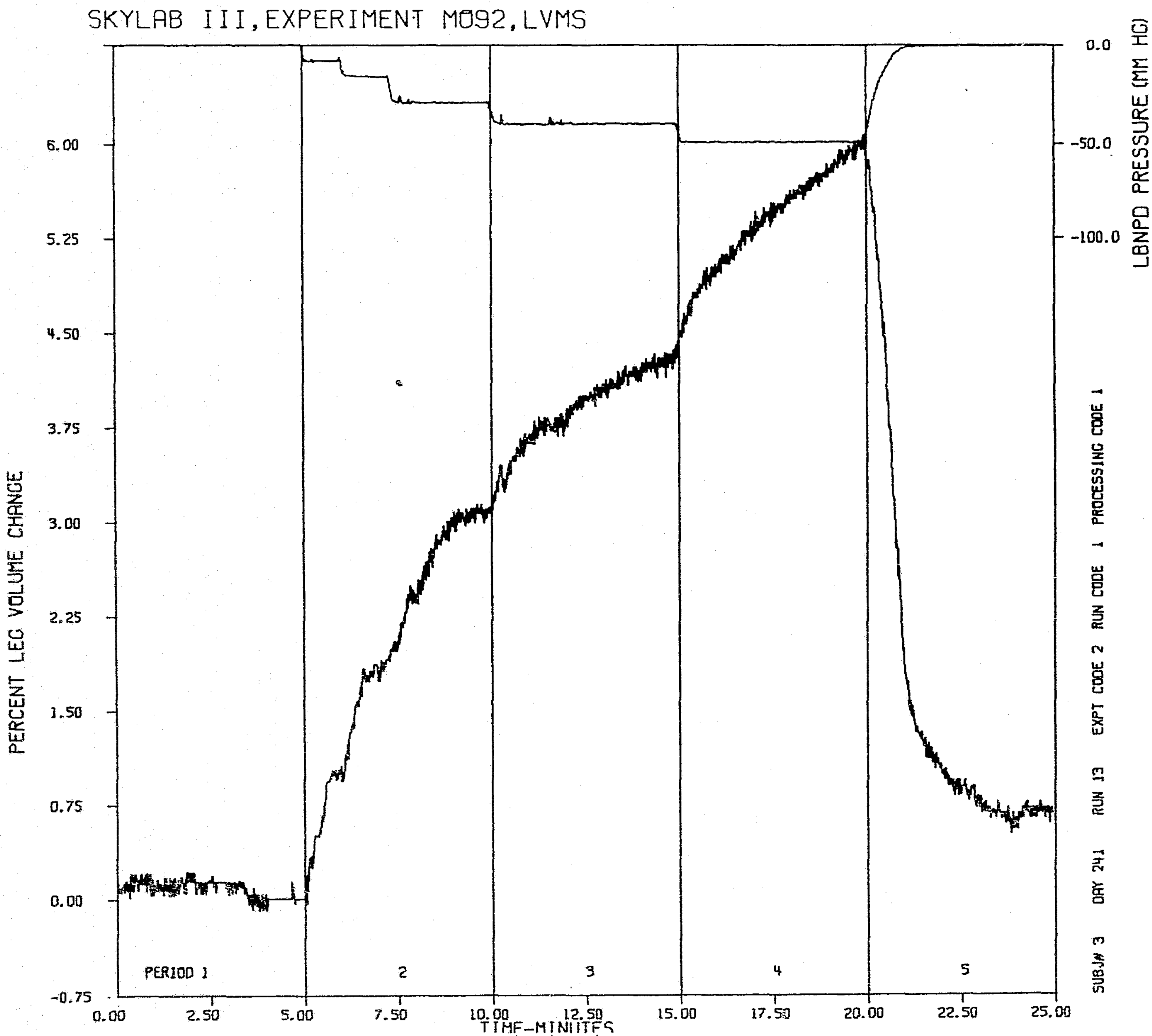


SKYLAB III; EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 3 DAY 231 RUN 10 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1



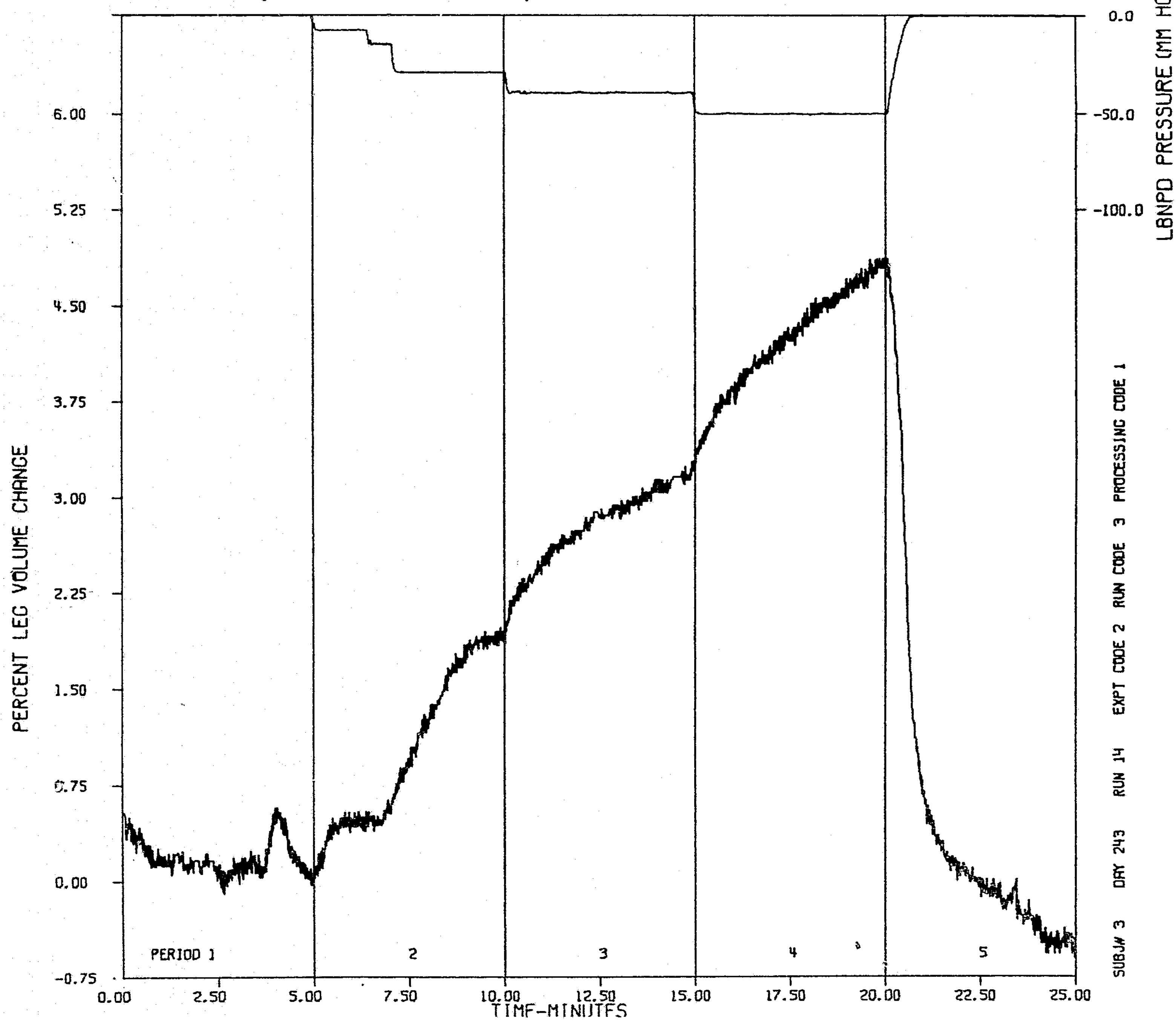
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 234 RUN 11 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1

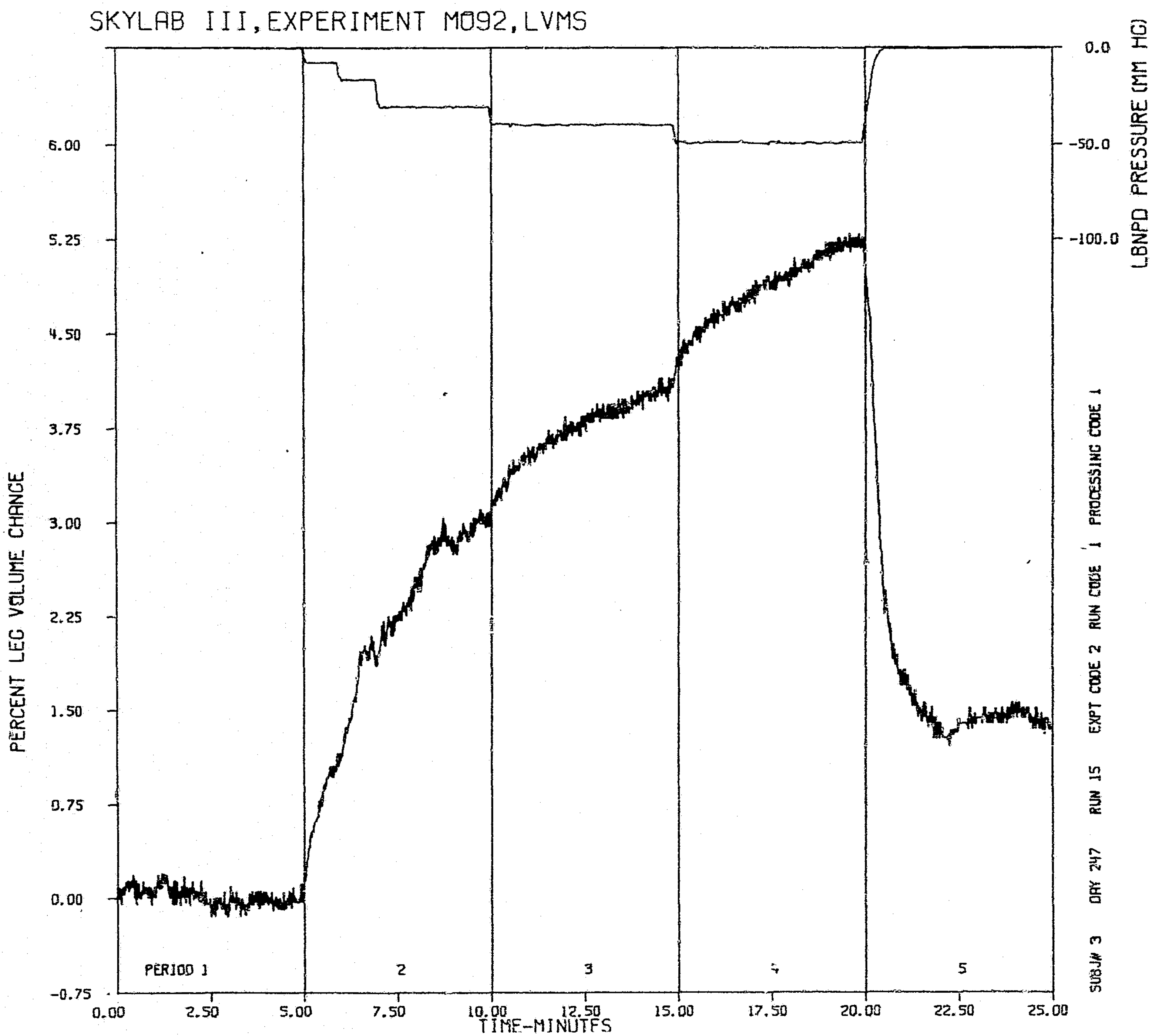

SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
TIME-MINUTES
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 237 RUN 12 EXPT CODE 2 RUN CODE 78 PROCESSING CODE 1



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 3 DAY 241 RUN 13 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1

SKYLAB III, EXPERIMENT M092, LVMS

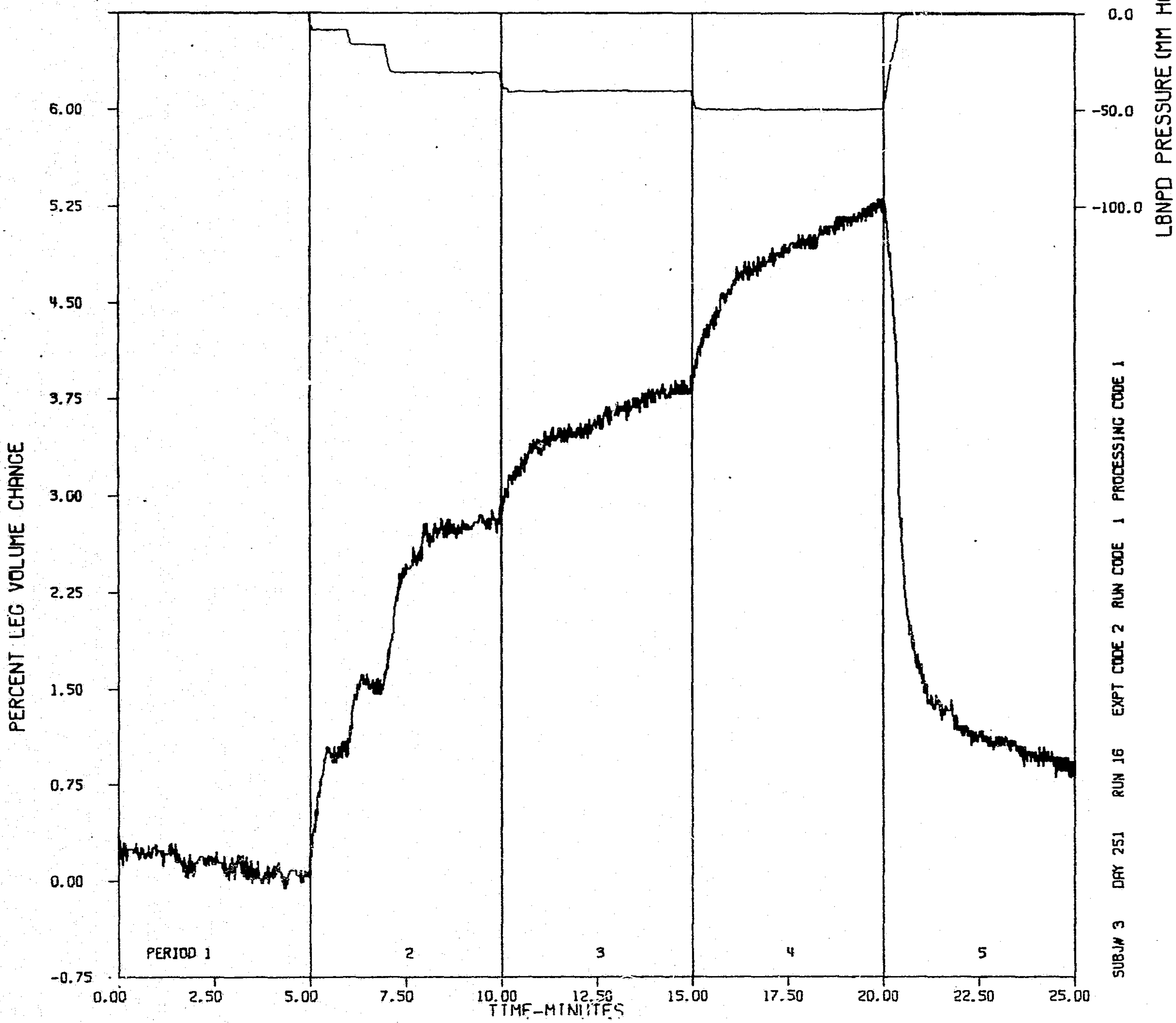




SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 247 RUN 15 EXPT CODE 2 RUN CODE 1 PROCESSING CODE 1

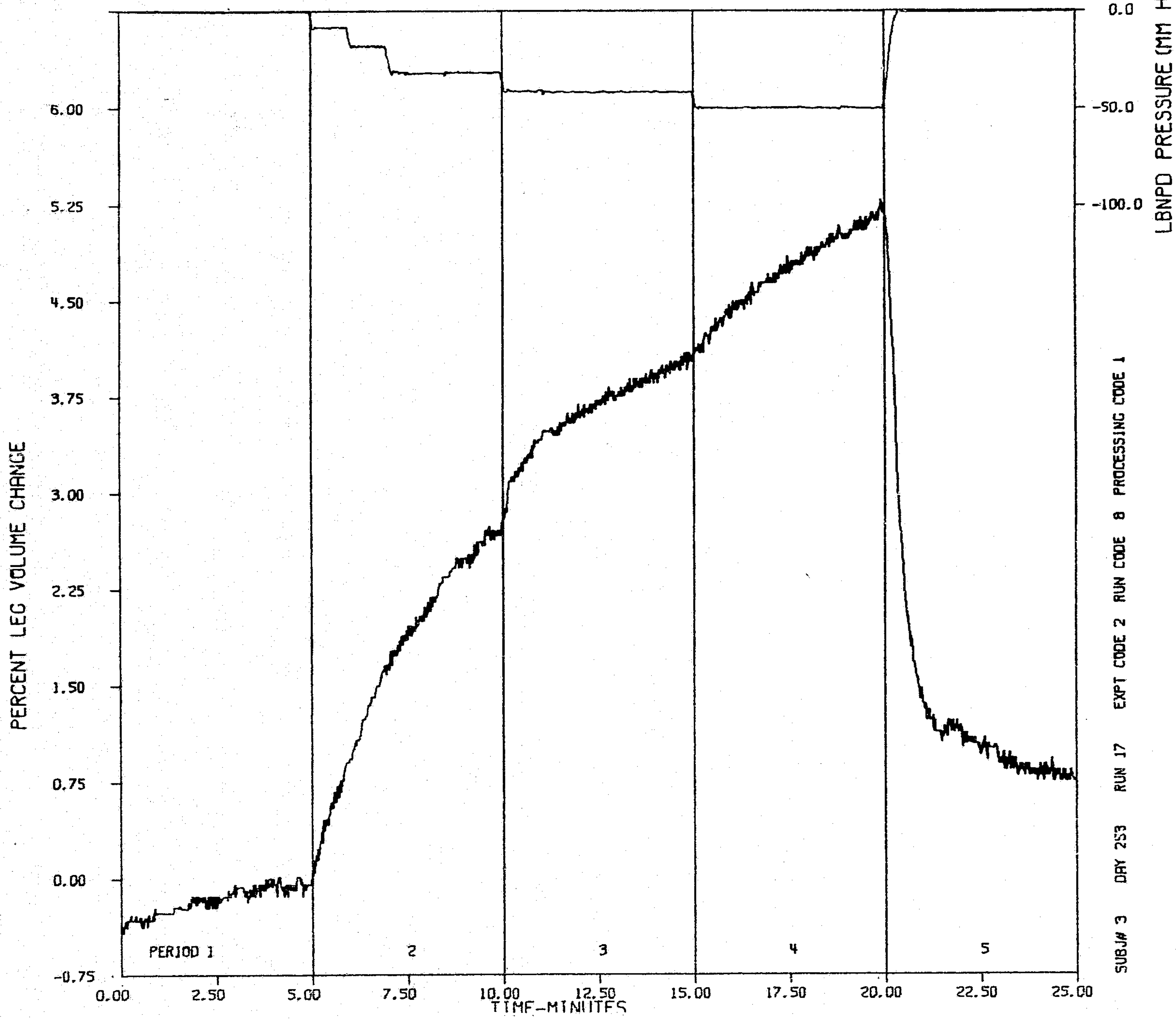
D-75

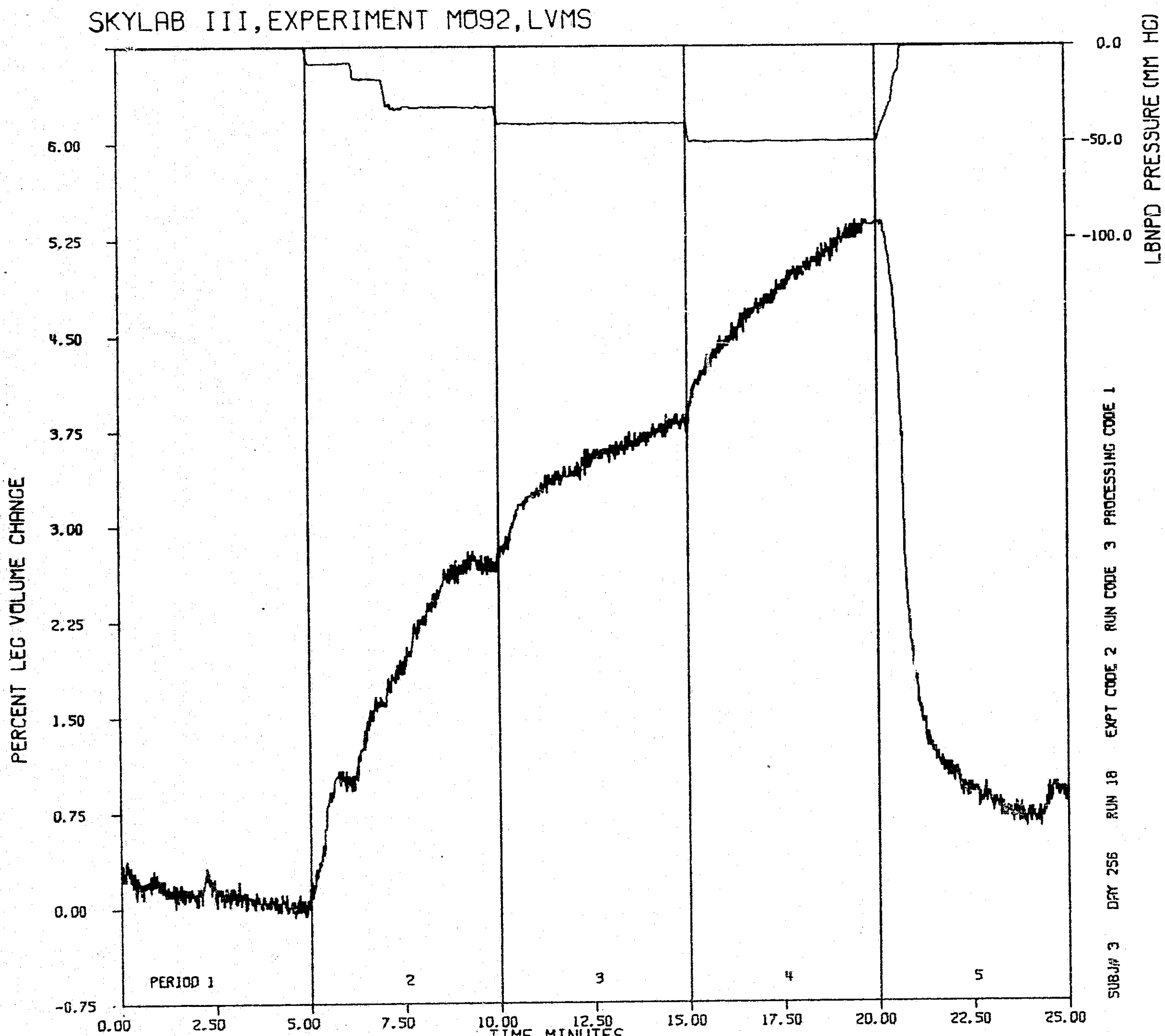
SKYLAB III, EXPERIMENT M092, LVMS



(C-4)

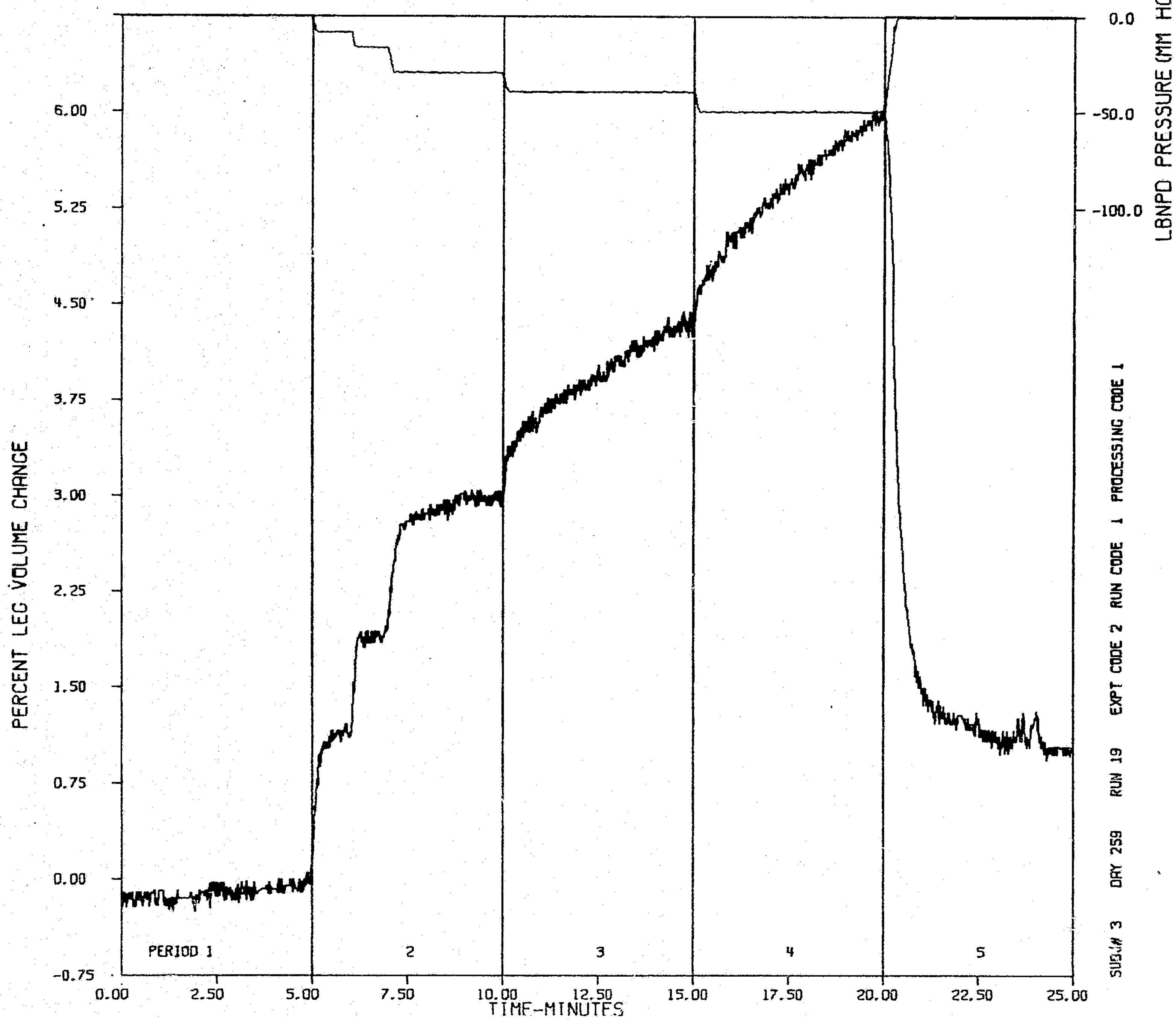
SKYLAB III, EXPERIMENT M092, LVMS

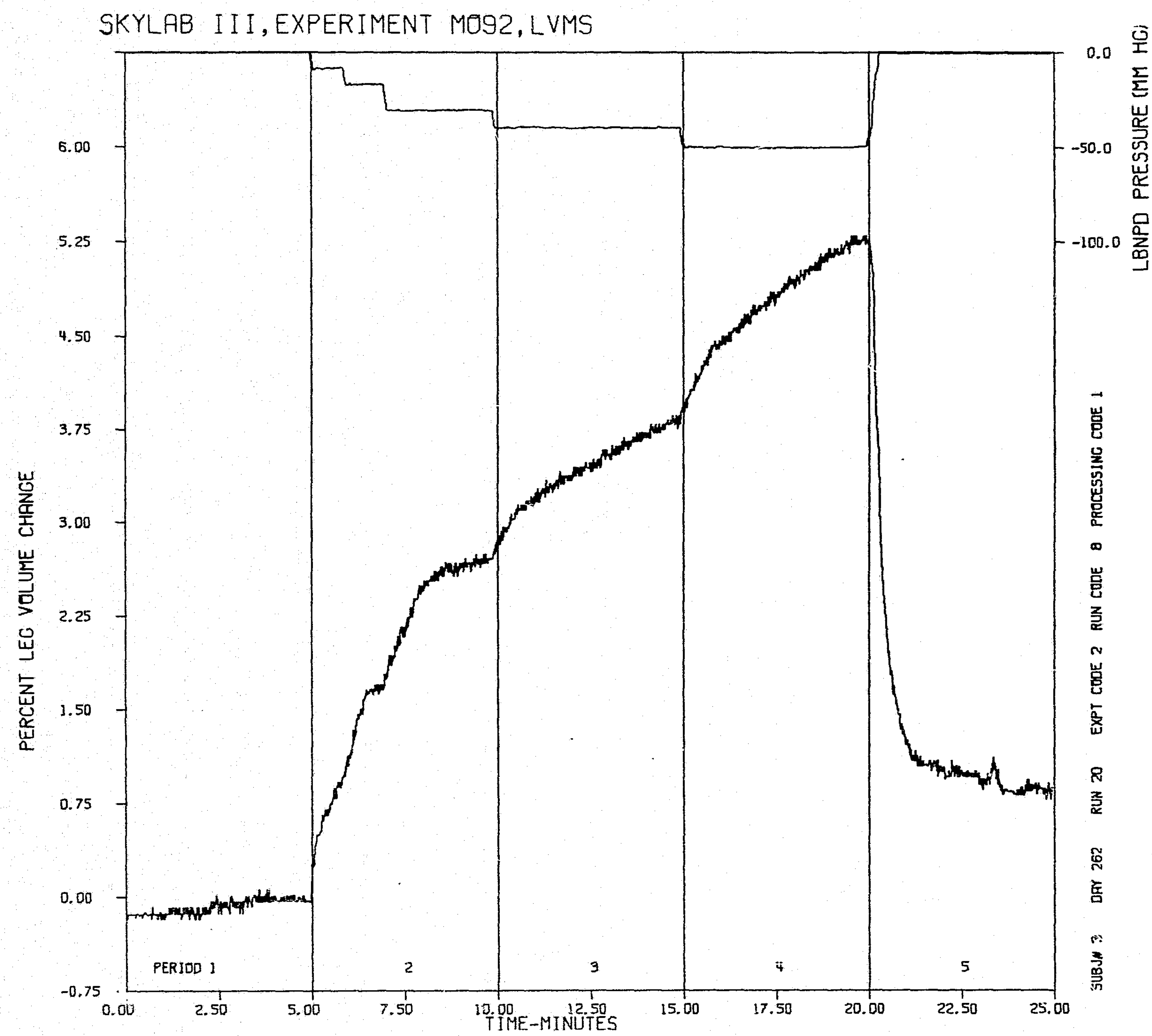


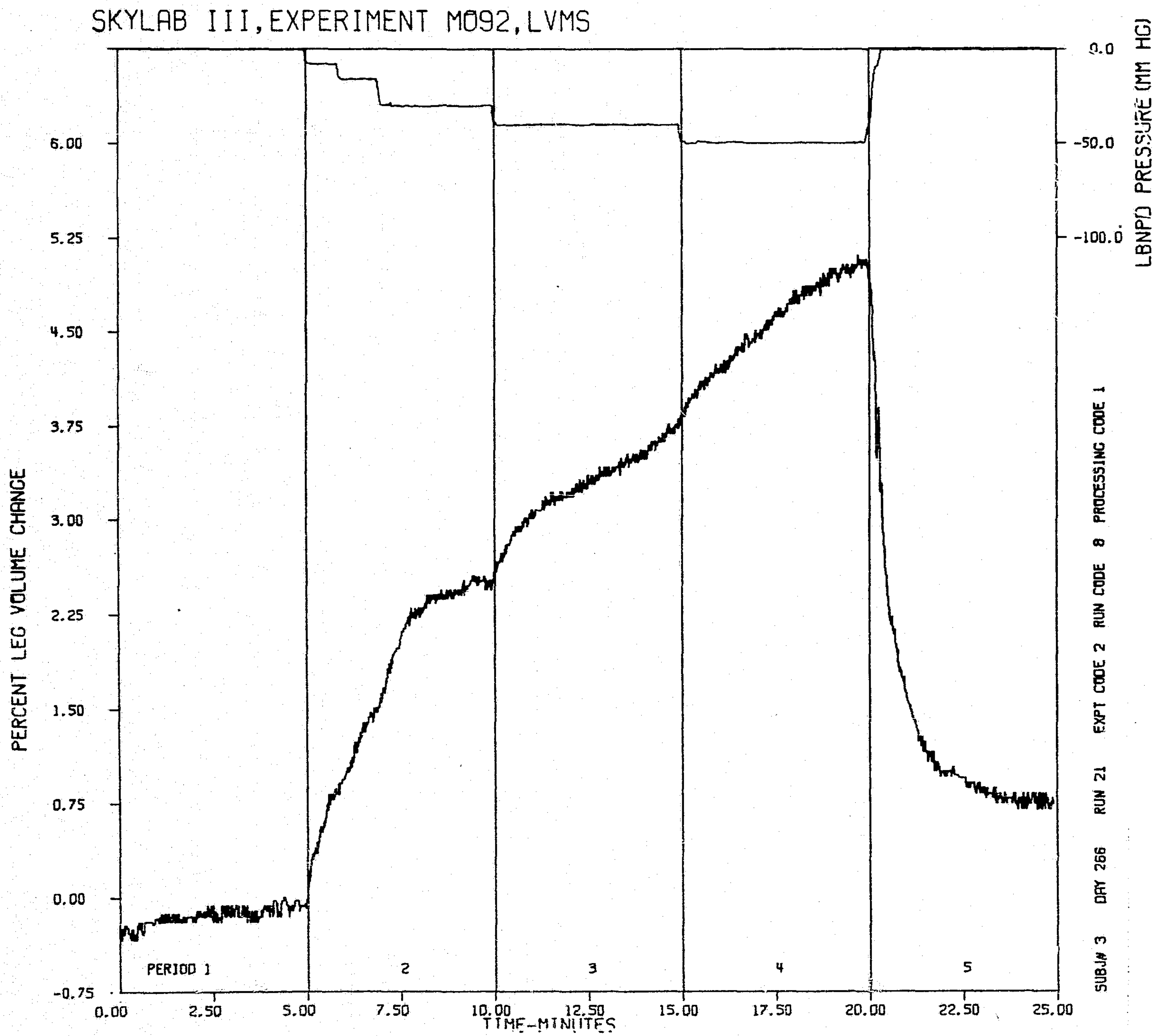


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 3 DAY 256 RUN 18 EXPT CODE 2 RUN CODE 3 PROCESSING CODE 1

SKYLAB III, EXPERIMENT M092, LVMS

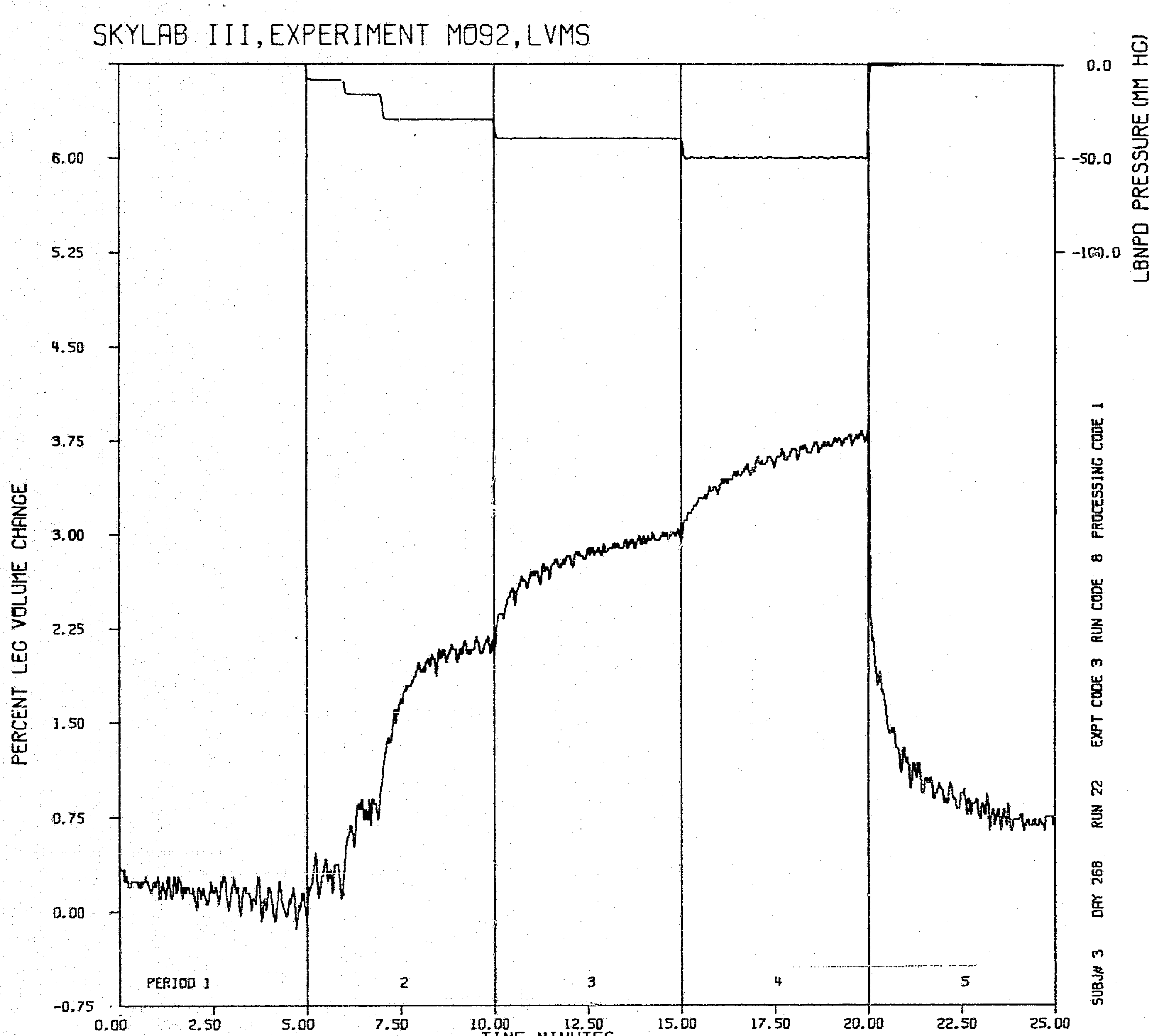



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 262 RUN 20 EXPT CODE 2 RUN CODE 8 PROCESSING CODE 1

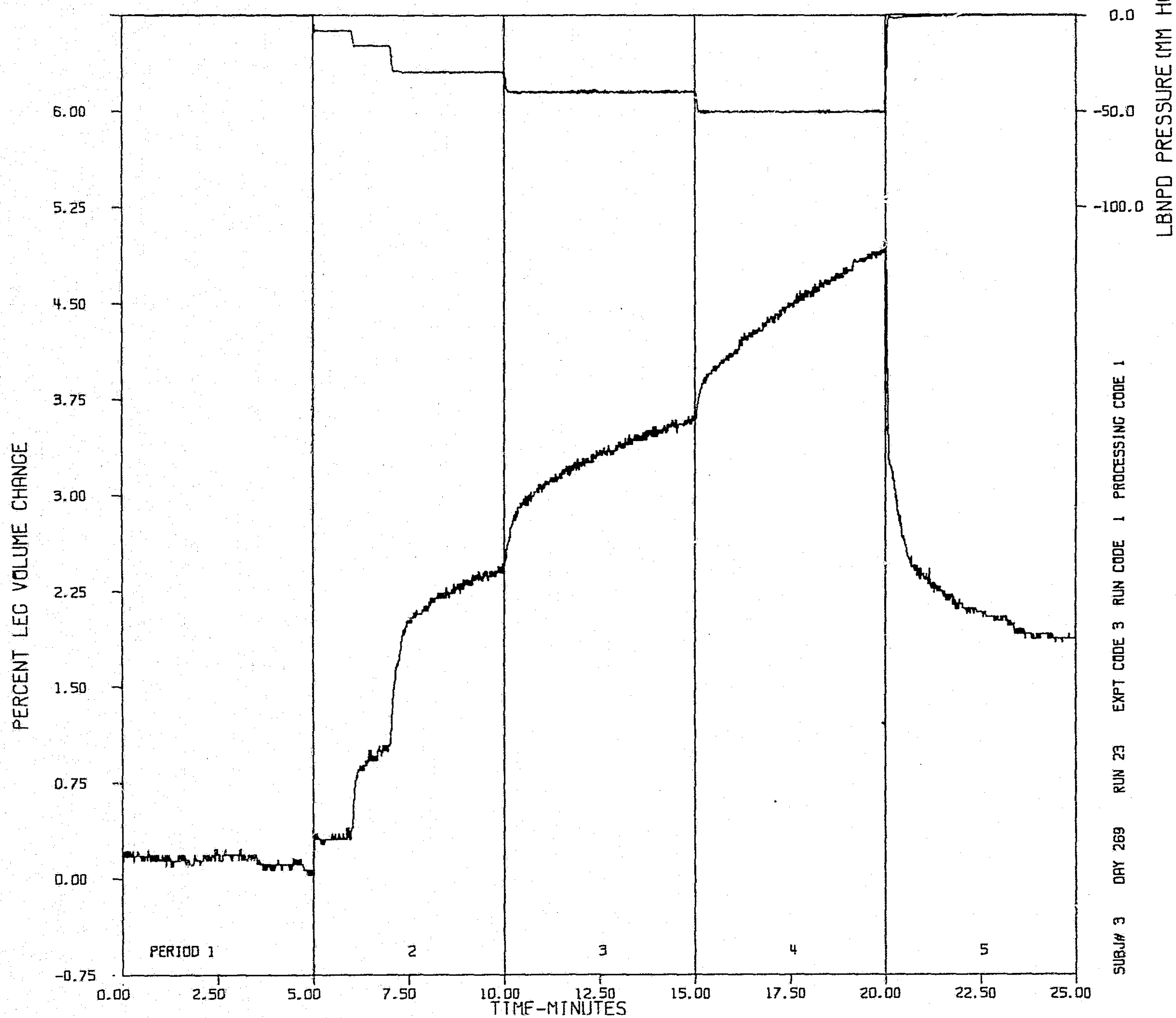


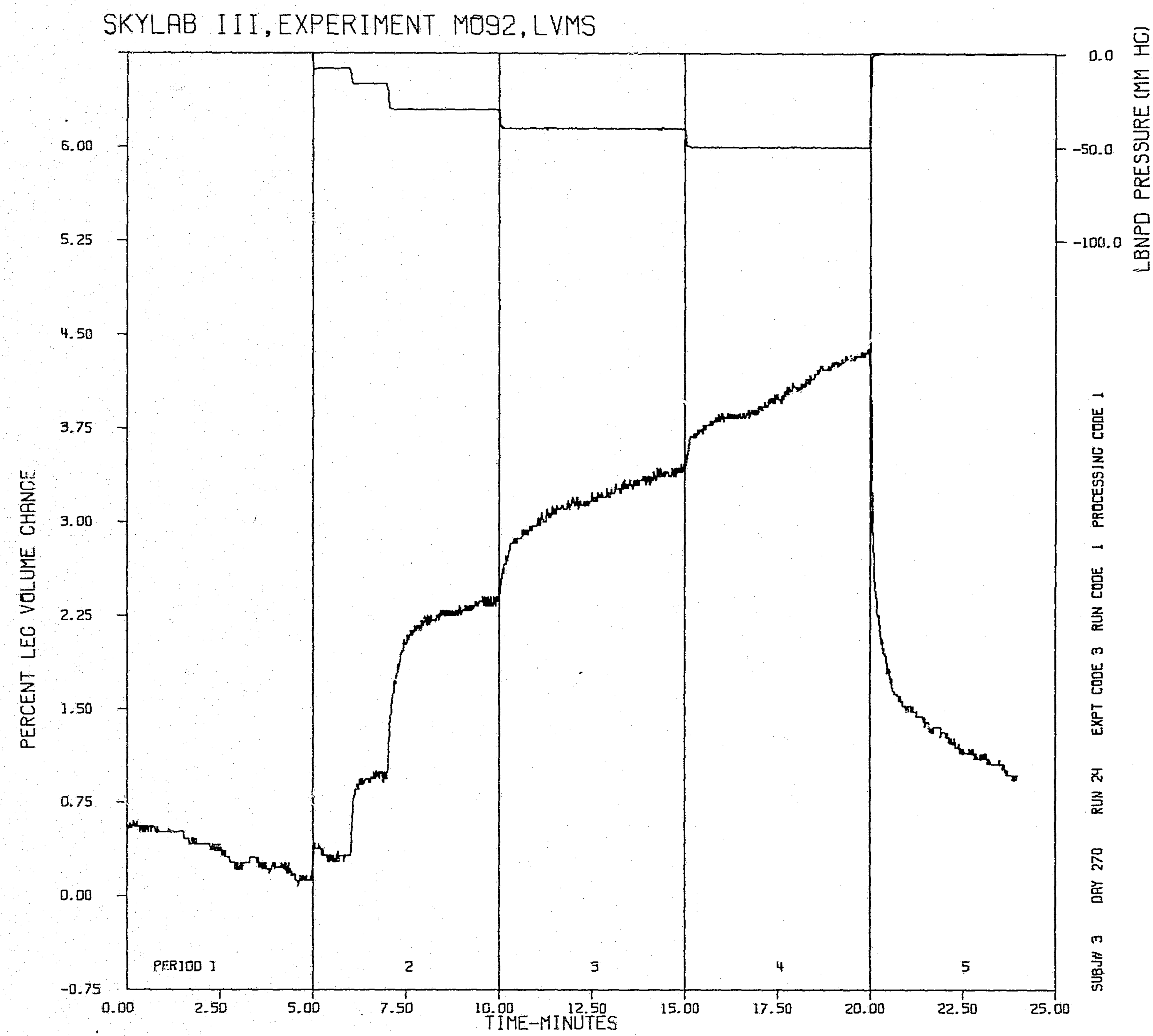
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 266 RUN 21 EXPT CODE 2 RUN CODE 8 PROCESSING CODE 1

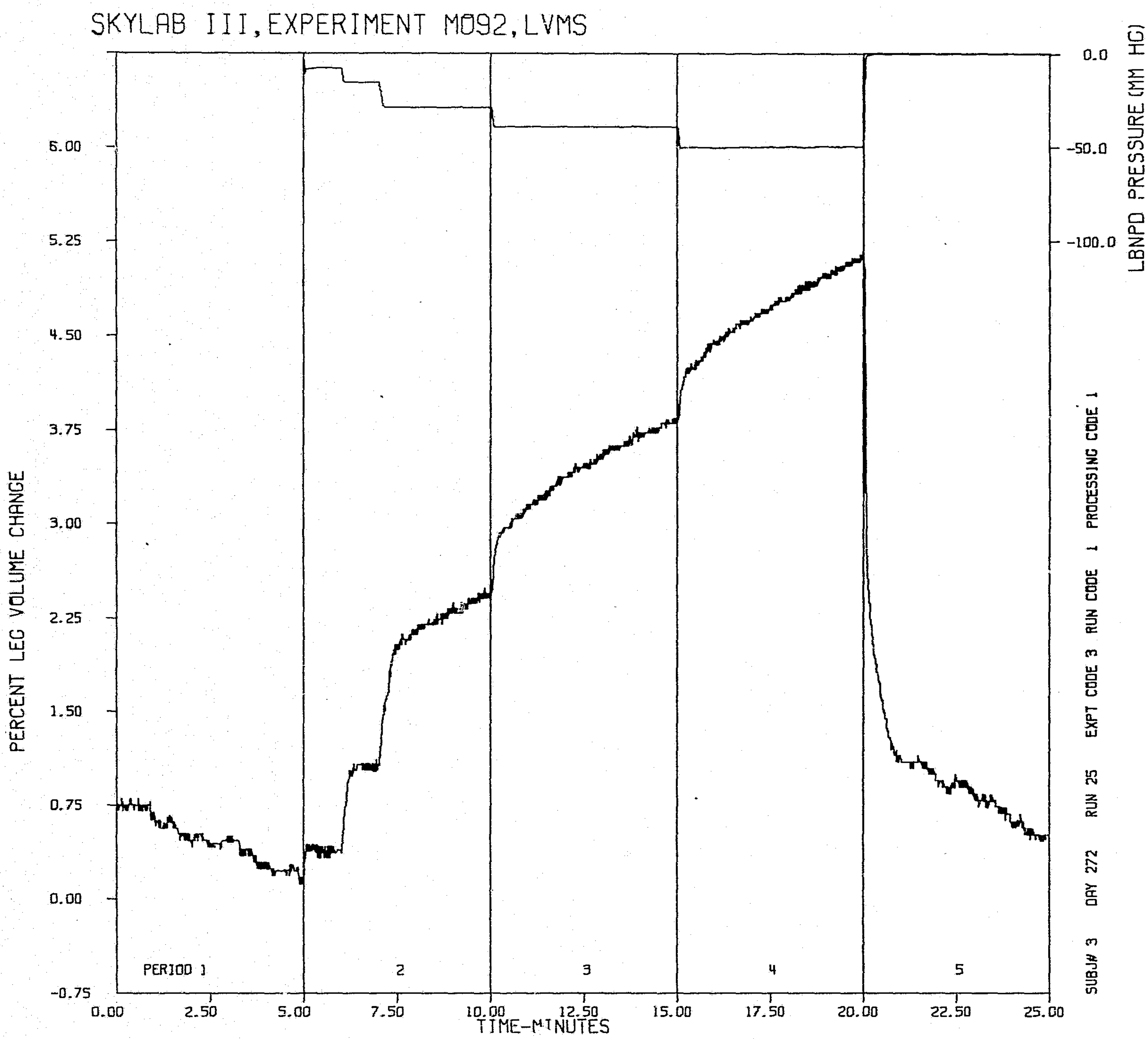
D-81


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 3 DAY 268 RUN 22 EXPT CODE 3 RUN CODE 8 PROCESSING CODE 1

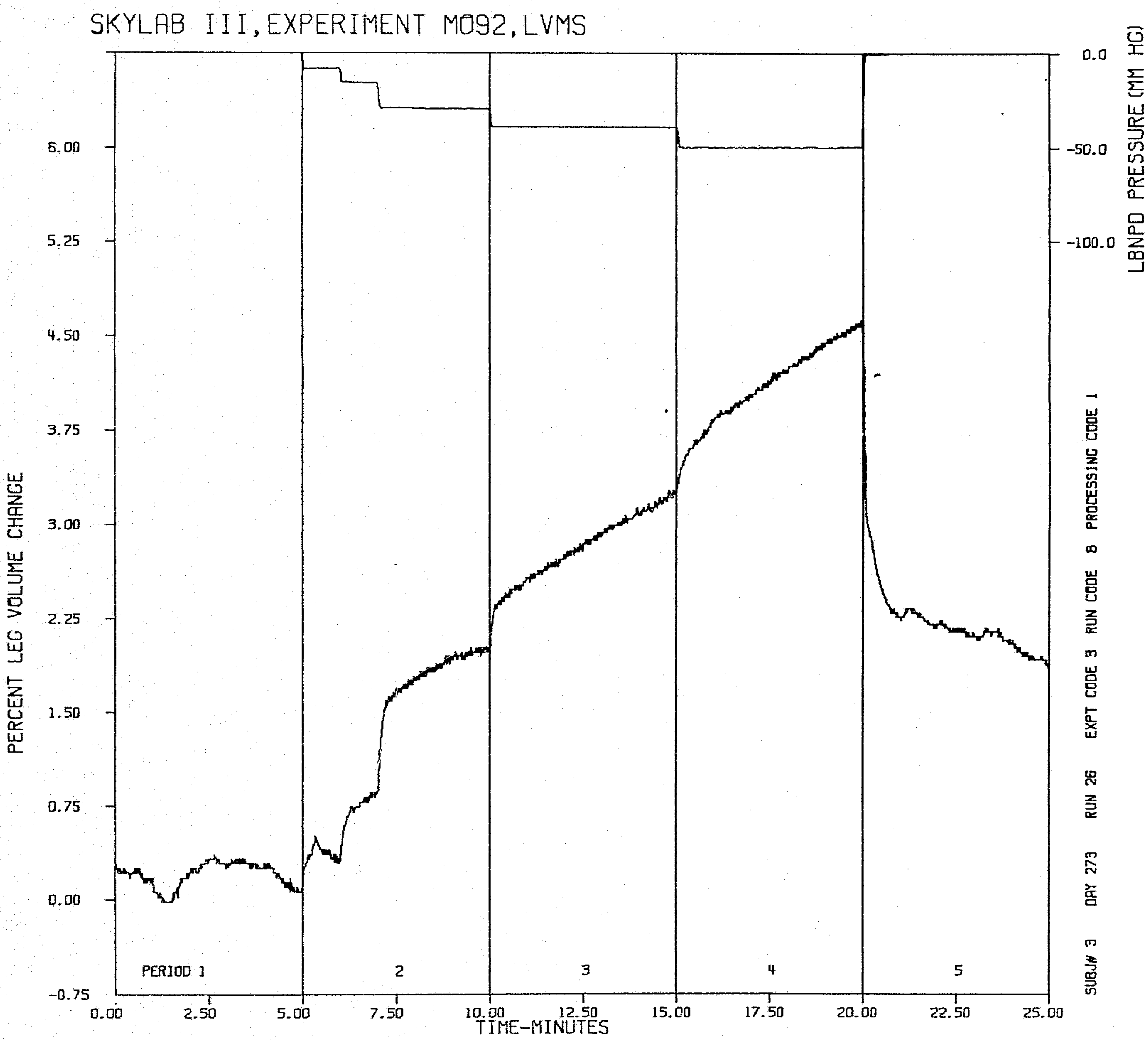
SKYLAB III, EXPERIMENT M092, LVMS

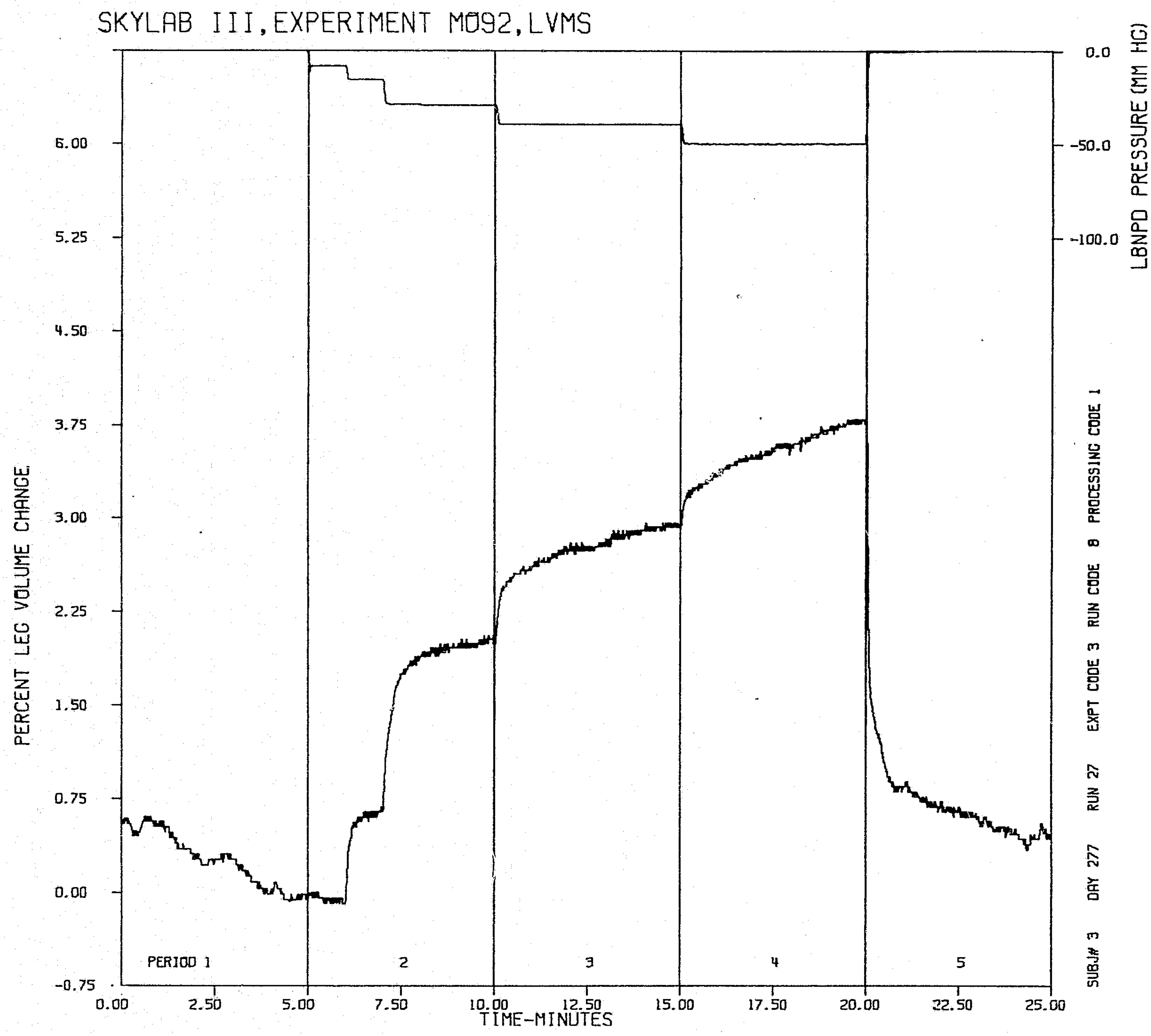



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 3 DAY 270 RUN 24 EXPT CODE 3 RUN CODE 1 PROCESSING CODE 1



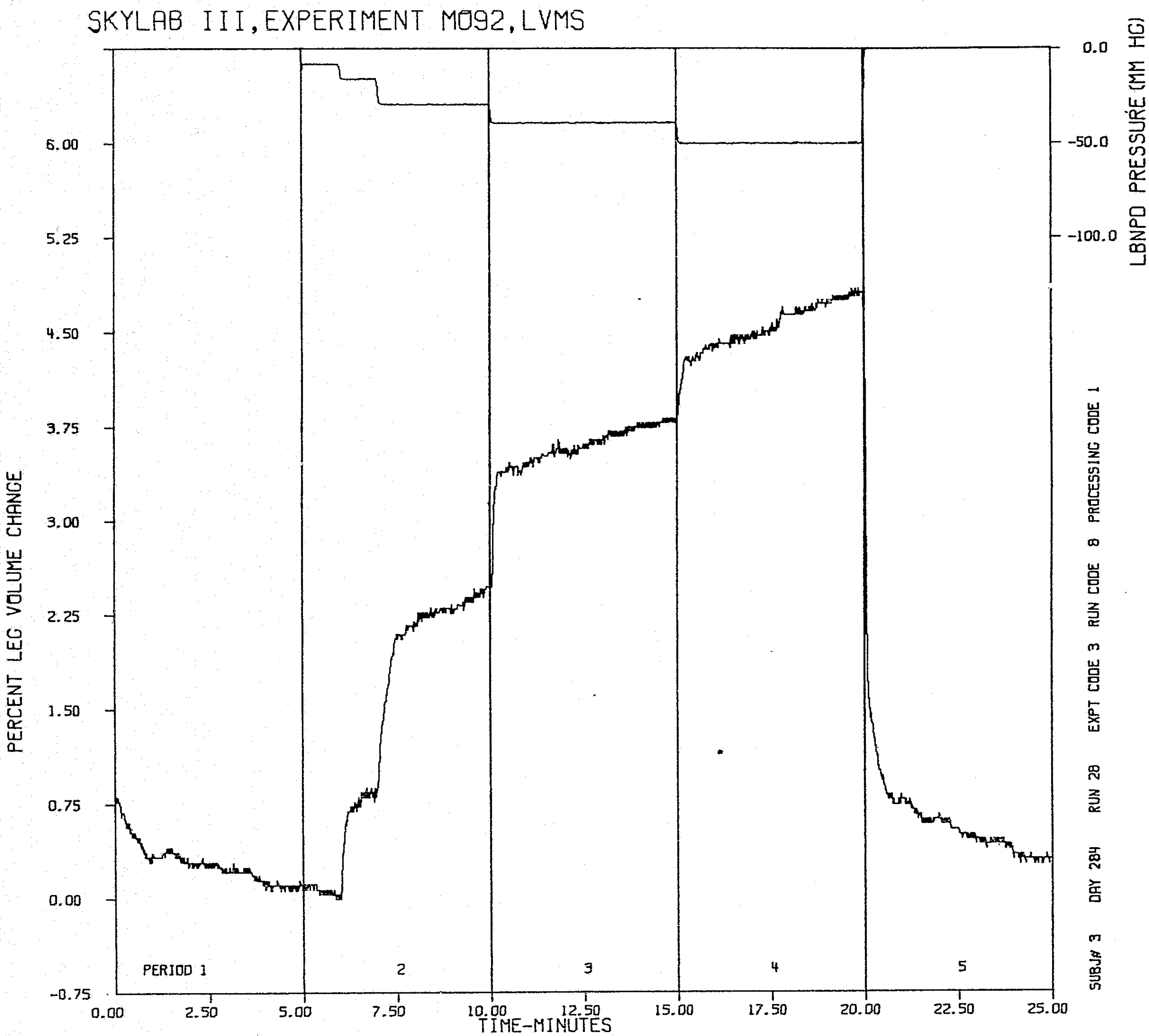
SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 272 RUN 25 EXPT CODE 3 RUN CODE 1 PROCESSING CODE 1


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 3 DAY 273 RUN 26 EXPT CODE 3 RUN CODE 8 PROCESSING CODE 1

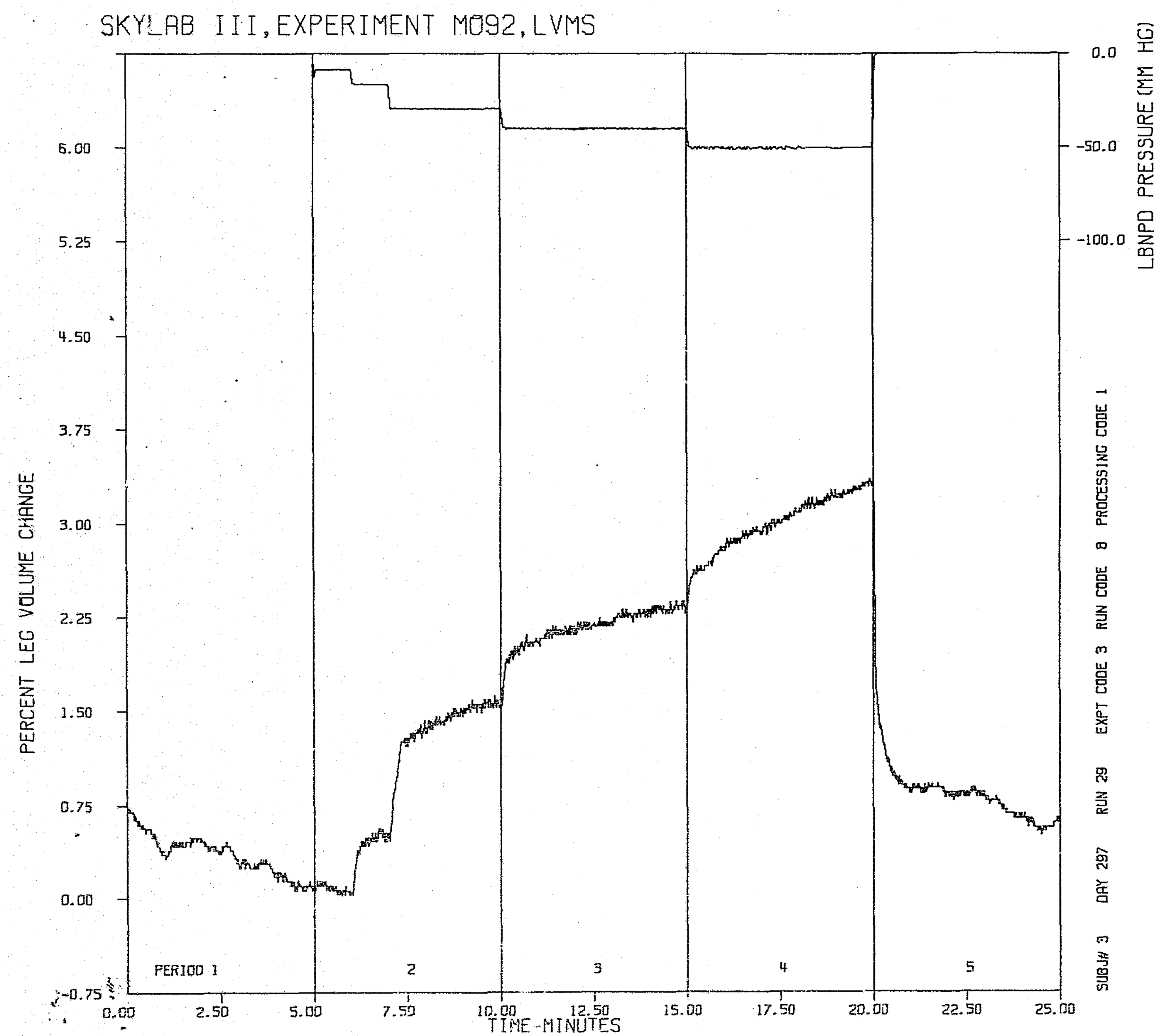


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.0
-50.0
-100.0
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
PERIOD 1
2
3
4
5
SUBJ# 3 DAY 277 RUN 27 EXPT CODE 3 RUN CODE 8 PROCESSING CODE 1

D-87



SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
LBNPD PRESSURE (MM HG)
TIME-MINUTES
PERIOD 1
2
3
4
5
0.0
-50.0
-100.0
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
SUBJ# 3 DAY 284 RUN 28 EXPT CODE 3 RUN CODE 8 PROCESSING CODE 1


SKYLAB III, EXPERIMENT M092, LVMS
PERCENT LEG VOLUME CHANGE
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
-0.75
LBNPD PRESSURE (MM HG)
0.0
-50.0
-100.0
PERIOD 1
2
3
4
5
0.00
2.50
5.00
7.50
10.00
12.50
15.00
17.50
20.00
22.50
25.00
TIME-MINUTES
SUBJ# 3 DAY 297 RUN 29 EXPT CODE 3 RUN CODE 8 PROCESSING CODE 1