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LING-TEMCO-VOUGHT, INC.

TEST PLAN

UNMANNED EXTRAVEHICULAR ENVIRONMENTS OPERATION QUALIFICATION TEST OF THE GEMINI EXTRAVEHICULAR SUPPORT PACKAGE AND EXTENDED UMBILICAL

Report No. 00.724

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Contract: NAS 9-3414

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1.0 INTRODUCTION

This test plan describes the unmanned portion of the extravehicular environments operation qualification test program, for the Gemini Extravehicular Support Package (ESP) and Extended Umbilical. This test will be performed for the NASA Manned Spacecraft Center by LTV Astronautics under Contract NAS 9-3414 as amended. This series of tests is designed to qualify the ESP and extended umbilical for proper operation in the extravehicular environment. The test program will include two unmanned tests of the ESP during simulated Gemini near earth day and night orbital conditions.

This test plan is submitted for the approval of the NASA Manned Spacecraft Center in accordance with test requirements outlined by the NASA-MSC. The plan may be modified at any time prior to or during the test through mutual concurrence of cognizant NASA-MSC personnel and LTV.

2.0 SUMMARY

The Gemini Extravehicular Support Package (ESP) series of tests described in this report is the unmanned portion of the extravehicular environments operation qualification test program which leads to the qualification of the unit and its extended umbilical for space flight.

The ESP will be attached to a thermal dummy wearing a Gemini extravehicular suit assembly. During the two days of unmanned thermal vacuum qualification testing the suited dummy, extended umbilical, and ESP will be suspended from a maneuverable remotely controlled overhead mechanism located in the space environment simulator (SES). During pump down and stabilization to pretest conditions the temperature of the ESP, suit and extended umbilical will be controlled with infra-red (IR) lamps and the earth thermal. Suit measurements will not constitute part of the qualification. The extended umbilical will be attached to the ESP and suspended in the test plane.

Depletion of the ESP oxygen bottle will be accomplished by venting the O_2 outside the chamber through a flowmeter and an adjustable control valve. The ESP Freon bottle will be vented through the chamber wall to the hand held maneuvering unit (HHMU) which will be operated manually outside the chamber, for a series of pulses simulating typical orbital duty cycles.

During both test days the ESP, suited dummy and extended umbilical will be operated for five minutes of simulated night orbit (egress 5 min. before sunup), 50 minutes of simulated orbital day and with 40 minutes of simulated night orbit. During the simulated daylight portion of the test the suited dummy and ESP will be rotated 270° from the maximum ESP solar position (back to the sun) in a horizontal plane. The various oxygen withdrawal rates imposed on the ESP are as follows:

5.1 ± .4 lbs/hr, 7.8 ± .4 lbs/hr, and 13.5 ± 1 lbs/hr.

Simulation of the extravehicular earth orbit environments will include:

1. Vacuum (5×10^{-4} mm Hg or less).
2. Solar radiation at 1 solar constant.
3. Heat sink of deep space (liquid nitrogen cooled chamber walls).
4. Attachment to thermally simulated suited dummy.

3.0 TEST OBJECTIVES

The objectives of this series of tests is to qualify the ESP and the extended umbilical for operation in the extravehicular environments of earth orbit. The following modes of operation will be performed during the expected mission profile simulation:

1. Depletion of the Extravehicular Life Support System (ELSS) oxygen supply at 5.1 ± .4 lb/hr flow rate (Test Day 1).

2. Evaluation of the HHMU propellant supply during a simulated solar day with no HHMU actuation and minimum O_2 flow of 5.1 ± .4 lb/hr (Test Day 1).

3. Depletion of the ELSS O_2 supply at flow rates of 7.8 ± .4 lb/hr and 13.5 ± 1 lb/hr (Test Day 2).

4. Depletion of the HHMU propellant supply at expected HHMU actuation rates (Test Day 2).

5. Maintenance of continuity in the extended umbilical (Test Day 1 and 2).

All data pertinent to the above modes shall be recorded and/or logged and submitted in report form to NASA-MSC.

4.0 FACILITY AND TEST EQUIPMENT

4.1 TEST FACILITY

The Gemini ESP unmanned extravehicular environments operation qualification test will be conducted in the LTV Aerospace Corp. Space Environment Simulator (SES). The SES is a horizontal cylindrical test chamber which simulates the thermal and pressure environments of space. The test chamber dimensions are 10 feet in diameter by 10 feet in length. The ESP will be attached to a suited thermal dummy and suspended in the chamber. Special test equipment (described in paragraph 4.2) has been designed for installation in the chamber to meet test requirements not possible by the basic chamber equipment.

The vacuum of space is simulated in the SES through evacuation by three 32 inch diffusion pumps with an ejector and mechanical fore-pumping system. The ultimate capability of the SES is approximately 10^{-7} mm Hg absolute (with minimum outgassing of installed components). The tests outlined in this report require pressures of 5×10^{-4} mm Hg absolute maximum which can be adequately maintained during the course of the tests.

The thermal heat sink of space is provided by absorbing walls ($\alpha = 0.98$) that are cooled to liquid nitrogen temperature (-320°F). The absorbing walls or "cryowall" completely enclose the test area except for the openings to admit simulated solar energy. The total area of the opening is approximately 4.4% of the wall area. The maximum average cold wall temperature during tests shall not exceed -290°F.

Simulated solar energy is provided by a bank of collimated, horizontally directed Mercury-Xenon arc lamps. The spectral and flux distribution of the lamps is described in references 2 and 3. The simulated solar flux is variable over the range of approximately .60 to 1.0 solar constant* in the test area. A water-cooled, mechanical shutter located in front of the lamps provides rapid "on-off" action of the solar flux.

4.2 SPECIAL TEST EQUIPMENT

The equipment discussed in the following paragraphs is required for mechanically supporting the test and supplying the function listed.

Pressure Servicing Equipment - The ESP requires servicing of the high pressure oxygen bottle prior to each day of testing. The 5000 psi oxygen bottle will be serviced with equipment that is utilized for MMU servicing. Oxygen conforming to MIL-O-27210A shall be supplied by LTV and

*Due to a slight delay in the reflectors, infra-red lamps will supplement the arc lamps to insure one solar constant.

TABLE I

ESP EQUIPMENT REQUIREMENTS

QTY.	NOMENCLATURE & IDENT.	PARAMETER	RANGE	CALIBRATION AND CHECKOFF
1	Cylindrical bank of I R lamps	Suit and ESP surface temperature	N/A	
1	Earth simulator	Simulated earth thermal flux	N/A	
2	Ignitron power supplies	N/A	0-150 kw	
1	Space suit rotating mechanism	ESP orientation	0^{o} to 270^{o}	
1	Test timer clock	Test time	0 to 24 hours	
1	ESP O_2 bottle servicing system	N/A	N/A	
2	Gas analysis sampling bottle	N/A	N/A	
1	Gemini space suit	N/A	N/A	
1	Space suit ECS	N/A	N/A	
1	Thermal dummy	N/A	N/A	
1	Thermal dummy control panel	N/A	N/A	
1	Hand held manouvering unit	N/A	N/A	

TABLE I (Cont'd)

ESP EQUIPMENT REQUIREMENTS

QTY.	NOMENCLATURE & IDENT.	PARAMETER	RANGE	CALIBRATION AND CHECKOFF
2	Oxygen K-bottle per MIL-O-27210	N/A	2200 psig	
1	3/8 inch manual needle valve	ESP O_2 outlet flow rate control	0 to 13.5 lb. O_2 per hour	
1	Hastings O_2 mass flowmeter	ESP O_2 flow rate	0 to 20 lbs. O_2 per hour	
1	Instrumentation line group	ESP O_2 temperature and regulated pressure	0-120 psia and 0 to 200°F	
1	Instrumentation line group	ESP Freon temperature and regulated pressure	0-140 psia and 0 to 200°F	
1	Gemini 75' electrical umbilical	N/A	N/A	
1	Gemini 25' ELSS Umbilical	N/A	N/A	
1	Heisse Pressure Gauge	ELSS Umbilical pressure	0-100 psig	
1	KEPCO Power Supply Model ABC 30-0.3M Serial No. 22680	Supply Pressure transducer excitation	0-30 VDC	
1	KEPCO Power Supply Model ABC 30-0.3M Serial No. 22655	Regulated Pressure transducer excitation	0-30 VDC	
1	Laboratory Power Supply	Transceiver Thermal Dummy	0-30 VDC	

NASA oxygen sampling bottle will be filled from the MMU servicing cart and submitted to NASA-MSC for analysis. NASA-MSC will provide the oxygen filter. The fill line interface with LTV will be an AMINCO 1/4" female fitting. The Freon bottle will be charged to 5000 PSI with Freon 14 by NASA-MSC prior to delivery of the ESP to LTV. Recharging at LTV is not required.

Infra-Red Lamps - The vacuum pump down over a period of approximately one hour with liquid nitrogen flowing in the chamber walls would cause an appreciable reduction in the test equipment temperatures. Thus, a bank of infra-red lamps (and the earth thermal) surrounding the entire test setup within the SES is provided to control the test equipment temperature during pump down of the chamber. The infra-red lamps are arranged to permit the maintenance of normal ambient temperatures within the equipment prior to the initiation of the test.

Experimental Rotation - The ESP (and suited dummy) may be rotated 270° from the installed position by a jack screw and gear motor arrangement. The whole apparatus is suspended from a rail installed at the top of the SES chamber. This arrangement permits the ESP to be rotated to permit simulated solar radiation of all four sides of the ESP. Rotation is controlled exterior to the chamber. The rotation rate is approximately 4 degrees per second.

Suited Thermal Dummy - NASA will provide an extravehicular Gemini suit assembly complete with parachute harness, the low pressure umbilicals and one-inch connectors. The suit will be mounted on the thermal dummy procurred by LTV under this contract.

The suited dummy will be suspended by the parachute harness and the claw on the ESP. The suit will be pressurized to 3.7 ± .2 PSI by an automatic suit pressure and flow control system and the dummy maintained at 85°F nominal. Gas flow will be controlled through the pressure suit at a flow rate of 11.5 ± .3 SCFM.

4.3 INSTRUMENTATION

The instrumentation and data recording system for this test is based on the measurement and recording of pertinent parameters produced by the modes of operation outlined in Section 3.0, "Test Objectives". The data collected will provide the basis for the unmanned qualification of the ESP in the extravehicular thermal environment.

4.3.1 Parameters

The data measurements include system temperatures, gas flow pressures and electrical continuity. Table II is a tabular listing of the various parameters to be monitored.

TABLE II

TEST PARAMETERS MONITORED

Measurement Number		Measurement Name	Real Time Readout Required	Tape Record Required
T-1	*	ELSS Oxygen Supply Regulated Gas Temperature	x	x
T-2	*	ELSS Oxygen Supply Regulator Temperature	x	x
T-3	*	ELSS Oxygen Supply Bottle Temperature	x	x
T-4		ELSS Oxygen Supply Bottle Temperature		x
T-5		ELSS Oxygen Supply Bottle Temperature		x
T-6	*	ELSS Oxygen Supply Bottle Temperature	x	x
T-7	*	HHMU Propellant Supply Regulated Gas Temperature	x	x
T-8	*	HHMU Propellant Supply Regulator Temperature	x	x
T-9	*	HHMU Propellant Supply Bottle Temperature	x	x
T-10		HHMU Propellant Supply Bottle Temperature		x
T-11		HHMU Propellant Supply Bottle Temperature		x
T-12	*	HHMU Propellant Supply Bottle Temperature	x	x
T-13	*	Transceiver Temperature	x	x
T-14	*	Transceiver Temperature	x	x
T-15	*	Transceiver Temperature	x	x
T-16	*	Battery Temperature	x	x
T-17	*	Battery Temperature	x	x
T-18	*	Battery Temperature	x	x
T-19	*	ESP Back Panel Temperature	x	x
T-20	*	ESP Back Panel Temperature	x	x
T-21		ESP Back Panel Temperature		x
T-22		ESP Back Panel Temperature		x
T-23	*	ESP Back Panel Temperature	x	x
T-24	*	ESP Back Panel Temperature	x	x
T-25		ESP Back Panel Temperature		x
T-26		ESP Back Panel Temperature		x
T-27		ESP Internal Structure Temperature		x
T-28		ESP Internal Structure Temperature		x
T-29		ESP Internal Structure Temperature		x

* Manually record at 15 minute intervals during test day No. 1. Repeat for test day No. 2 upon request of NASA-MSC representative.

TABLE II (cont'd)

Measurement Number	Measurement Name	Real Time Readout Required	Tape Record Required
T-30	ESP Internal Structure Temperature		x
T-31	ESP Internal Structure Temperature		x
T-32	ESP Side Panel Temperature		x
T-33	ESP Front Panel Temperature		x
T-34	ESP Front Panel Temperature		x
T-35	ESP Front Panel Temperature		x
T-36	Extended Umbilical Surface Temperature		x
T-37	Extended Umbilical Surface Temperature		x
T-38	Extended Umbilical Surface Temperature		x
T-39	Extended Umbilical Surface Temperature		x
T-40	Extended Umbilical Internal Temperature		x
T-53	Transceiver Temperature	x	x
T-54	Transceiver Temperature	x	x
T-55	Transceiver Temperature	x	x
T-56	Inlet ELSS Umbilical Gas Temperature	x	x
T-57	Outlet ELSS Umbilical Gas Temperature	x	x
P-1	ELSS Oxygen Supply Regulated Pressure	x	x
P-2	ELSS Oxygen Supply Pressure	x	x
P-3	HHMU Propellant Supply Regulated Pressure	x	x
P-4	HHMU Propellant Supply Pressure	x	x
F_1	ELSS Oxygen Supply Gas Flow	x	x
F_2	ELSS Umbilical Flow Rate	Manual Record	
R	Electrical Resistance Check	Manual Record	

Temperature

- ESP - The ESP will be instrumented by NASA-MSC with approximately 38 copper-constantan thermocouples terminating in 5 feet bundled wire with bare ended leads. The ends will be connected in the SES by soldered joints to the appropriate instrument lead wires.

- Extended Umbilical - The extended umbilical will be instrumented by NASA-MSC with approximately 5 copper constantan thermocouples terminating in 5 feet bundled wires with bare ended leads. The ends will be connected in the SES by soldered joints to the appropriate instrument leads.

- Suited Dummy - Thermocouples are to be installed on the suit by LTV as described by "Unmanned Thermal Performance Evaluation of a Gemini Extravehicular Space Suit," Report No. 00.683, July 15, 1965, Volume I. Thermocouples to be installed are indicated on Table III with discrepancies from Report No. 00.683 noted.

- ELSS Umbilical - Thermocouples (2) will be installed in the inlet and outlet gas flow line.

TABLE III

SUIT THERMOCOUPLE LOCATIONS

Measurement Number	Report Code Number	Discrepancy
T-41	020-IV	Centered
T-42	021-IV	
T-43	093-EAF	
T-44	094-EAF	
T-45	098-ETF	
T-46	105-ELF	
T-47	106-ELF	
T-48	109-EHB	
T-49	115-ELB	
T-50	116-ELB	
T-51	086-EV	Center EV Sunvisor
T-52	087-EV	Center Low Emittance Visor

- o SES Cryowall Temperatures - To be instrumented at 6 random points to verify averaged temperature of less than -290°F.

- o Suit Gas Inlet - One thermocouple will be placed to sense gas temperature going into the suit. The temperature will be recorded on a strip chart and displayed on the DVM.

- o Dummy - The thermal dummy will be instrumented with 13 thermocouples for thermal control. All 13 will be displayed on a Brown recorder and the DVM system.

Pressure

- o ESP - ESP supply pressures (P_2 and P_4, Figure 1) will be measured with pressure transducers which are an integral part of the ESP (reference MSC Drawing SE-AE-005709). The 15 K ohms resistance transducers require a 5 VDC excitation and indicate 0-6000 PSI.

- o The ESP outlet gas pressures will also be monitored with Pace CP60A pressure transducers attached by NASA-MSC to each (oxygen and Freon) discharge line. The oxygen transducer is calibrated for a range of 0-120 PSI and the Freon transducer for a 0-140 PSI range. The Pace transducers require a 28 VDC excitation. Power to all pressure transducers will be supplied by LTV.

- o SES Chamber Pressure - To be monitored and recorded to insure test pressures of less than 5×10^{-4} mm Hg absolute.

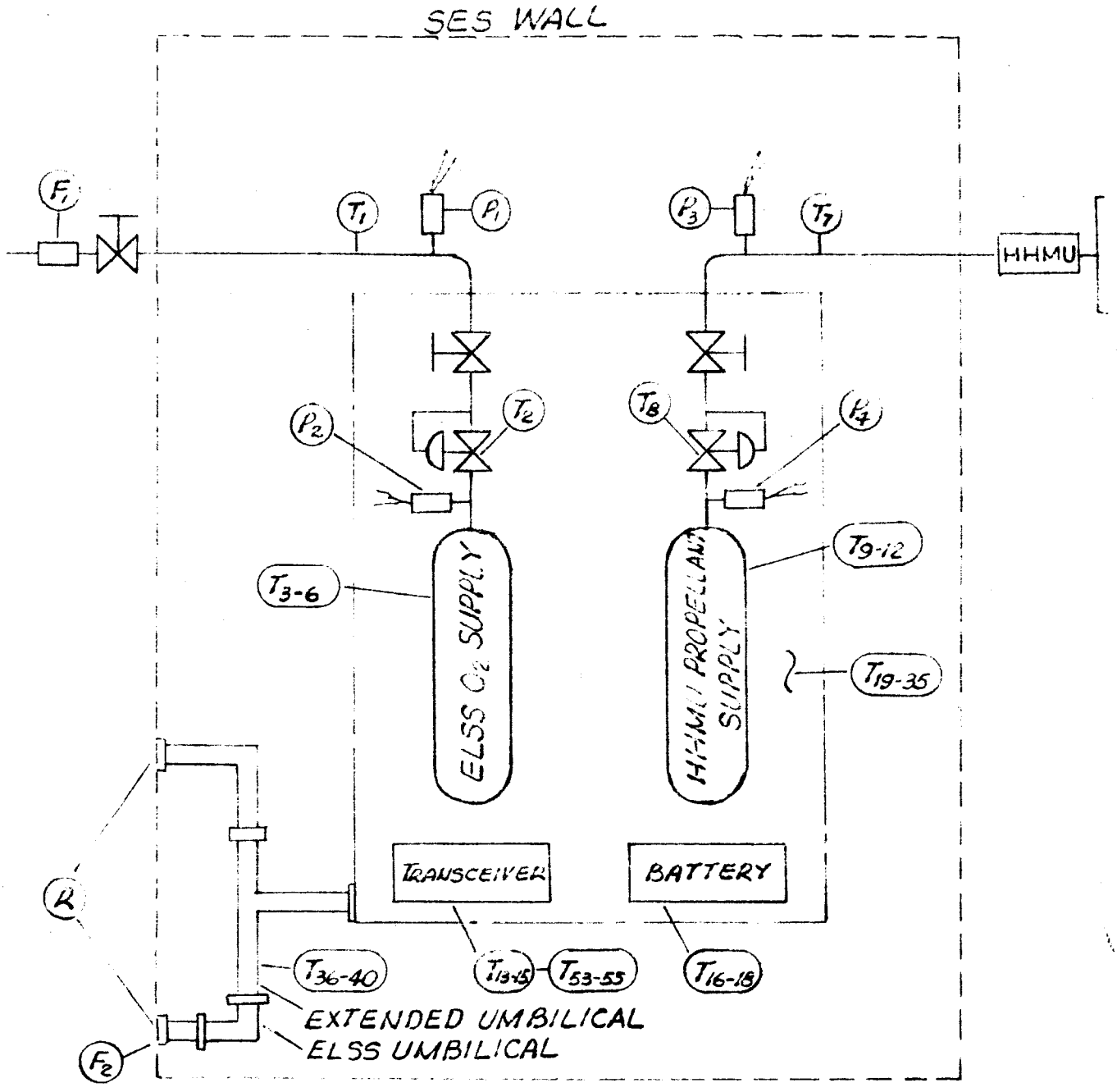
NOTE: Real time readout will be made of all the above pressures.

- o ELSS Umbilical Pressure (Inlet) - will be visually read and recorded from a bourdon tube pressure gauge.

- o Suit Pressure - will be visually observed from a manometer and periodically recorded.

Flows

- o ELSS oxygen supply regulated flow shall be 0, 5.1 ± 4, 7.8 ± .4, or 13.5 ± 1 lbs/hr at prescribed test times. The flow shall be regulated and measured outside the SES chamber by means of an LTV furnished manual flow control valve and Model HF-5 Hastings-Raydist mass flow meter. The flows shall be recorded manually at periodic intervals and continually recorded on the DVM system.



(T) TEMPERATURE
(P) PRESSURE
(F) FLOW
(R) ELECTRICAL RESISTANCE

MEASUREMENTS ON ESP AND UMBILICALS

FIGURE 1

Electrical Resistance

- The extended & ELSS umbilical (in series) shall be checked for resistance before and after each transition between simulated day and night orbital conditions and 25 minutes after simulated day conditions have been established. Pins to be checked are listed on Table IV.

- The equipment required for the test system instrumentation is detailed in Table V.

4.3.2 Data Acquisition and Recording System

The data generated by the instrumentation system will be recorded in the following manner:

1. Strip Chart Recorders

2. Visual Observation

3. Circular Chart Recorder

4. Digital Recorder

The test parameter recording system is shown on Figures 2 & 3.

TABLE V

INSTRUMENTATION EQUIPMENT LIST

Quantity	Nomenclature	Model No.	Range	Calibration Data & Date	Checked T.C.	Checked Q.	Parameter
1	Hastings-Raydist Mass Flowmeter	HF-5	0-5SCFM	2%			Oxygen Flow
1	Electro-Instruments, Inc. Digital Voltmeter System			.06 MV			Test Data Recorder
1	Pace Pressure Sensor	CP60-A	0-120 PSIA	1%			Oxygen Press. Sensor
1	Pace Pressure Sensor	CP60-A	0-140 PSIA	1%			Freon Press Sensor
4	Westronics Input Divider	D-1					
4	Westronics Adjustable Span-Zero Module	A SZ-2					
1	Westronics 4-Channel Strip-Chart Recorder	DD11A/U1/ DV5H5M					Real Time Read Out
2	Brown Temperature Recorders			1%			Real Time Read Out
1	Mercury Manometer		40 In.				Suit Press. Sensor
1	Ohmmeter	Triplet					Resistance Check
45	24 Ga. Thermocouples	C_u-C_n	-150°F to -75°F	2%			ESP Temperatures
			-75°F to 200°F	1 1/2°F			
			200°F to 700°F	3/4 %			
25	36 Ga. Thermocouples	C_u-C_n	-150°F to -75°F	1%			Suit and Dummy Temperatures
			-75°F to 200°F	3/4°F			
			200°F to 700°F	3/8%			

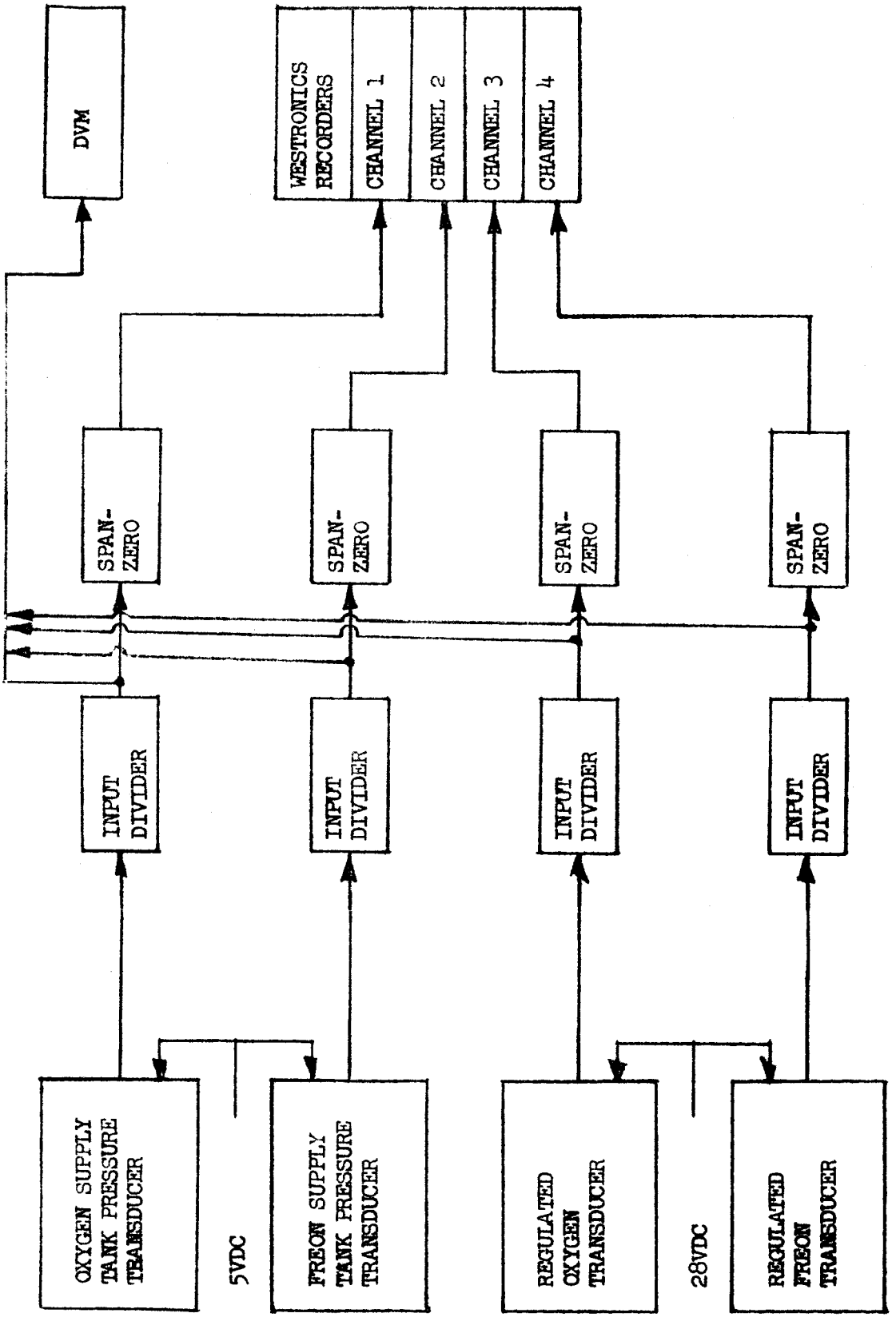


FIGURE 2 ESP GAS PRESSURE INSTRUMENTATION BLOCK DIAGRAM

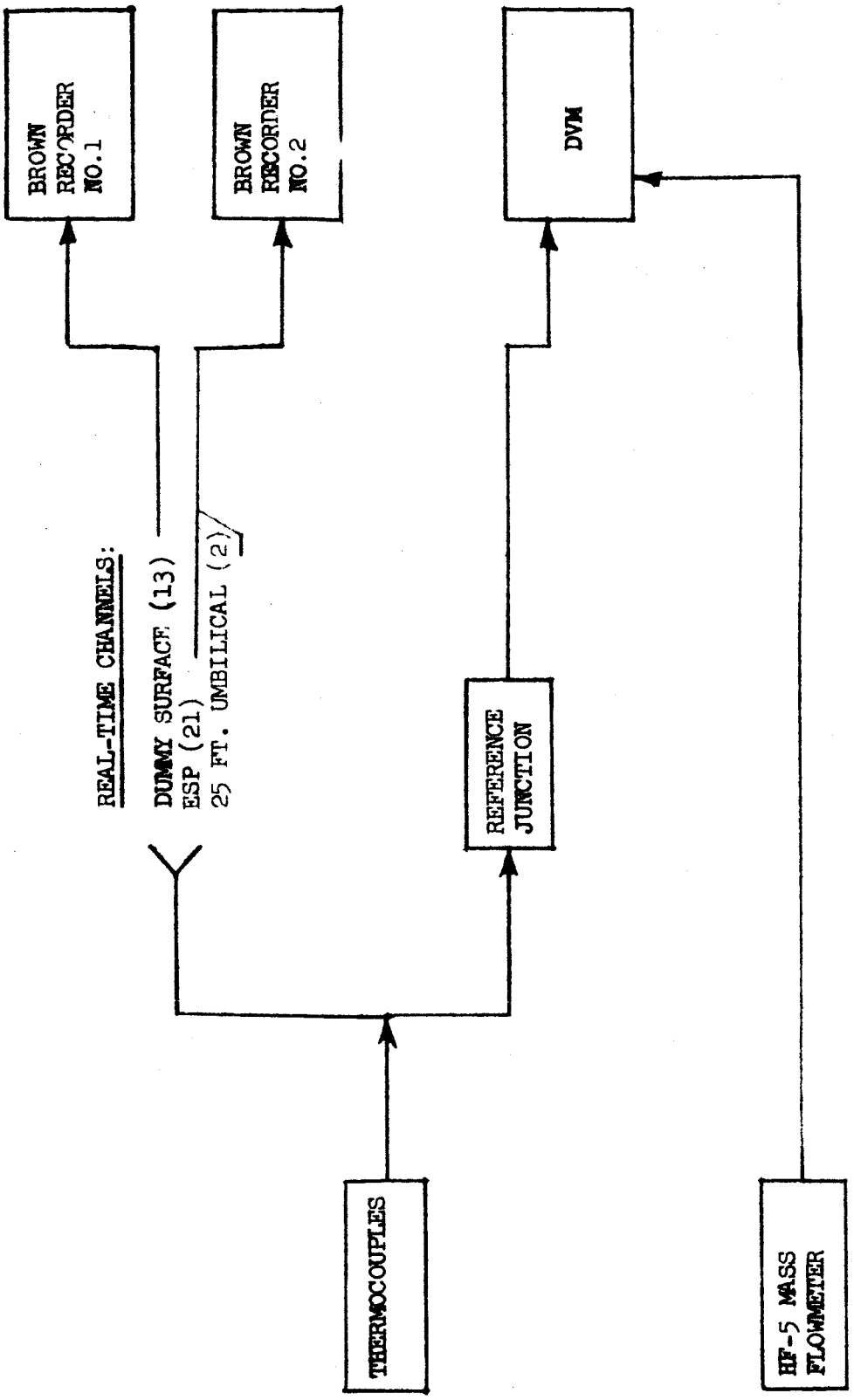


FIGURE 3 ESP THERMOCOUPLE, GAS-FLOW, AND BATTERY VOLTAGE INSTRUMENTATION BLOCK DIAGRAM

TABLE IV

EXTENDED & ELSS UMBILICALS ELECTRICAL RESISTANCE TABLE

ELSS Jumper Pin	Space Craft End
34	34
33	33
17	17
14	14
4	4
1	1
20 and 36	20
35	35
37	37
18	18
30	30
15	15
5	5
16	16
11, 21, and 24	24
22, 23, and 25	23
10	10
8	8

5.0 DATA PROCESSING

5.1 TEMPERATURE DATA

The temperature data generated by thermocouple outputs will be recorded in millivolt values on the automatic printout of the Electro Instruments Digital Voltmeter and Recording System and subsequently converted by computer to temperature values by the LTV Aerospace Flight Test Section. All values will be identifiable with respect to test time, test conditions, and significant events. For inclusion in the test report, graphs of temperature vs times, along with adequate notation of significant test conditions, will be provided by LTV.

5.2 PRESSURE DATA

The system pressure data (except ELSS umbilical) will be continuously recorded on strip chart recorders throughout the test. This record will be marked to indicate test time, test periods or conditions, and any significant events occurring at the time of record. ELSS umbilical pressure will be manually recorded.

5.3 INSTRUMENTATION LOG BOOK

As a means to facilitate data reduction, increase reliability of test data and to provide a record of significant test conditions, an instrumentation log book will be maintained throughout the test. This log book will serve to provide associated details, explanatory notes, and any other pertinent comments in support of actual test data.

6.0 SYSTEMS CHECK PROCEDURES

The following pages present check procedures for the several test systems included in the over-all test setup. The persons responsible for the checks will initial each event and record all significant data and deviations in the test conductors control test plan. During second and subsequent checks, completion of checks only is required. Each system checklist has provisions for both test conductor and NASA-MSC Flight Safety Office-Quality Assurance (FSO-QA) write-off of procedures.

The check lists included in this section are as follows:

Table	Title
VI	SES Chamber Check List
VII	SES Pump Down Check List
VIII	LN_2 System Check List
IX	Solar Simulator Check List
X	Instrumentation Subsystem Check List
XI	Data Acquisition and Recording System (DAR) Check List
XII	LN_2 Warm-up System Check List
XIII	Suit Flow System Check List

TABLE VI

SES CHAMBER CHECK LIST

No.	Description	Checked
1	Chamber walls cleaned.	B.J.
2	LN_2 Shroud installed and cleaned.	B.J.
3	LN_2 Shroud leak checked.	B.J.
4	Chamber feedthrough visually inspected.	B.J.
5	Mechanical Pump oil level checked.	B.J.
6	Ejector Pump oil level checked.	B.J.
7	Diffusion Pump oil levels checked.	B.J.
8	Water chiller system operating.	B.J.
9	Pneumatic Valve nitrogen supply checked.	B.J.
	Approved: T.C. E.W. Tyler	
	Approved: MSC-FSO-QA W.S. Faust	

TABLE VII

SES PUMP DOWN CHECK LIST

No.	Description	Checked
1	Magnivac & GIC-100 gauge tubes visually inspected.	BJ
2	Inside of chamber cleaned.	BJ
3	Grating and rails removed.	BJ
4	Door O-rings and all chamber penetrations visually inspected.	BJ
5	Mass spectrometer leak detector connected.	N/A
6	Vacuum valve control nitrogen pressure set to 40 psig.	BJ
7	LN_2 shroud thermocouples connected and operating.	BJ
8	Chamber area cleared and door closed.	BJ
9	Door vacuum line connected and valve open.	BJ
10	Door water lines connected and valves opened.	BJ
11	KD310 pump oil level checked.	BJ
12	KD310 pump cleared for operation.	BJ
13	Magnivac gauge turned on.	BJ
14	Magnivac gauge calibrated for atmospheric pressure.	BJ
15	Mechanical pump started.	BJ
16	Door LN_2 lines connected.	BJ
17	Door safety cable installed.	N/A
18	Door retainer bolts disconnected.	BJ
19	Ejector and diffusion pumps turned on.	BJ
20	GIC-100 pressure gauge turned on.	BJ

TABLE VII (Cont'd)

No.	Description	Checked
21	GIC-100 pressure gauge calibrated.	BJ
	Approved: T.C. B. W. Tyler	
	Apprcved: MSC-FSO-QA N. S. Jennings	

TABLE VIII

LN_2 SYSTEM CHECK LIST

No.	Description	Checked
1	LN_2 system visually inspected.	BJ
2	LN_2 storage tank level noted in log book.	BJ
3	Emergency dump valve closed.	BJ
4	Tank exhaust valve opened.	BJ
5	Shroud inlet valve opened.	BJ
6	Shroud outlet valve opened.	BJ
7	Inlet line pressure gauge operating.	BJ
8	Outlet line pressure gauge operating.	BJ
9	LN_2 storage tank supply valve opened.	BJ
10	Shroud temperature recorder turned on.	BJ
11	LN_2 pump outlet valve opened.	BJ
12	Lines and shroud cooled gradually by gravity flowing LN_2.	BJ
13	LN_2 pump turned on.	BJ
14	Shroud pressure adjusted with pump.outlet valve.	BJ
15	Shroud temperatures monitored.	BJ
	Approved: T.C. B. W. Tyler	
	Approved: MSC-PSO-QA N. S. Jarrett	

TABLE IX

SOLAR SIMULATOR CHECK LIST

No.	Description	Checked
1	Lamp house cleared of equipment and personnel.	BJ
2	Chamber quartz windows cleaned.	BJ
3	Air filters visually inspected.	BJ
4	Lamp cooling system visually inspected.	BJ
5	All lamp stepping switches set to zero position.	BJ
6	Solar control switch turned on.	BJ
7	Lamp power supply switches turned on.	BJ
8	Lamp start switches turned on.	BJ
9	Using lamp stepping switches maintain lamp current less than 60 amps until stable output is obtained.	BJ
10	Temperature of hemispherical reflectors not exceeding 400°F.	BJ
11	Operate SES lamps at 1 solar constant.	BJ
	Approved: T.C. B. W Tyler	
	Approved: MSC-FSO-QA N. S Garrity	

TABLE X

INSTRUMENTATION SUBSYSTEM
CHECK LIST

No.	Description	Checked
1	ESP Oxygen Tank Pressure Sensor checked and operating	E.I.
2	ESP Freon Tank Pressure Sensor checked and operating	E.I.
3	ESP Regulated Oxygen Pressure Sensor checked and operating	E.I.
4	ESP Regulated Freon Pressure Sensor checked and operating	E.I.
5.	ESP Oxygen Flowmeter checked and operating	E.I.
6	ELSS umbilical thermocouples checked and operating	E.I.
7	Suit Pressure Manometer connected and operating	
8	Thermocouple Channels on Brown Recorders indicating	E.E.
	properly.	
9	ESP Thermocouples checked and operating	E.I.
10	Suit and Dummy Thermocouples checked and operating	E.I.
11	Extended umbilical thermocouples checked and operating	E.I.
12	Electrical resistance check on extended and ELSS	E.I.
	umbilicals completed and recorded	
	Approved: T.C. E.J. Mulcahy	
	Approved: MSC-FSO-QA N.S. Kennedy	

TABLE XI

DARS CHECK LIST

No.	Description	Checked
1	Check chart paper in Westronics Recorder to be adequate for test run.	E.I.
2	Check chart paper in Brown Recorders to be adequate for test run.	E.I.
3	Check paper tape in DVM System printer to be adequate for test run.	E.I.
4	Print complete cycle of all DVM channels to assure proper operation. ONE Vc OUT	E.I. #A8
5	Verify proper operation of each ESP Parameter prior to test run.	E.I.
6	Verify that SES Chamber pressure recorder is on and ready for operation.	GJM
	Approved: T.C. G J Mulcahy	
	Approved: MSC-FSO-QA N.S Fennity	

TABLE XII

LN_2 SYSTEM WARM-UP CHECK LIST

No.	Description	Checked
1	LN_2 pump switch turned off.	BJ
2	LN_2 storage tank valve closed.	BJ
3	Shroud inlet valve closed.	BJ
4	After shroud pressurized to 5 psig, shroud inlet valve opened.	BJ
5	Shroud inlet valve closed.	BJ
6	Warm-up blower suction valve opened.	BJ
7	Warm-up blower outlet valve opened.	BJ
8	Shroud makeup gas valve opened.	BJ
9	After shroud pressurized to 20 psig shroud makeup gas valve opened.	BJ
10	Warm-up heater temperature set to 120°F (position 7).	BJ
11	Warm-up heater temperature limit set to 400°F.	BJ
12	Warm-up system switch turned on.	BJ
13	Maintain shroud pressure less than 25 psig with emergency dump valve during warm-up period.	BJ
14	After shroud temperature of 70°F is obtained, warm-up system switch turned off.	BJ BJ
15	Warm-up blower suction valve closed.	BJ
16	Warm-up blower outlet valve closed.	BJ
	Approved: T.C. E.E. Tyler	
	Approved: MSC-FSO-QA N. S. Security	

TABLE XIII

SUIT FLOW SYSTEM CHECK LIST

No.	Description	Checked
1	ECS Connected to chamber bulkhead.	EJM
2	ECS-to-chamber vent line installed.	EJM
3	Oxygen supply connected to ECS.	EJM
4	Suit P transducer installed.	N/A
5	Suit P transducer installed.	N/A
6	Suit inlet and outlet temperature probes installed.	EJM
7	Oxygen lines connected to the chamber bulkhead and short circuited at suit connectors.	
8	Verify all valves closed and regulators backed off.	EJM
9	Open V-3 and V-2	EJM
10	System pressurized to ~~3.7~~ 1.0 psig utilizing V-9.	EJM
11	Complete ECS leak checked.	EJM
12	ECS leak rate measure with the mass flowmeter while maintaining a pressure of ~~3.7~~ 1.0 psig.	EJM
13	ECS depressurized with Valve 5.	EJM
14	Oxygen lines connected to the unit.	EJM
15	4-channel recorder turned on.	N/A
16	24-channel recorder turned on.	N/A
17	Cox flowmeter zeroed.	EJM
18	Suit pressure manometer zeroed.	EJM
19	Valves 1, 3, 5, 6, 9, 10 closed.	EJM
20	Valves 2, 4, 7 opened.	EJM
21	Valve 9 opened.	EJM
22	Start vacuum pump.	EJM

TABLE XIII (contd.)

SUIT FLOW SYSTEM CHECK LIST

No.	Description	Checked
23	Valve 8 adjusted to allow system to purge of 30 minutes at a positive pressure with respect to ambient pressure.	✓
24	Valves 7, 8, 9 closed.	✓
25	Valves 3, 6 opened.	✓
26	Valve 5 adjusted during chamber pump down to allow the ECS and space suit to be evacuated at a rate slower than the chamber.	✓
27	Valve 5 closed when a suit pressure of less than 3.7 psia is obtained.	✓
28	Valve 1 opened.	✓
29	Automatic pressure regulator adjusted to hold a pressure of 3.7 psia.	✓
30	Oxygen pump drive motor started.	✓
31	Pump speed adjusted to obtain the desired flow rate.	✓
32	Temperature of oxygen adjusted as required by flowing cold water through the heat exchanger or by applying power to the electric heaters.	✓
To leak check suit:		
33	Valve 1 closed.	✓
34	Valve 9 adjusted to maintain a suit pressure constant at 3.7 psia	✓
35	Valve 9 closed.	✓
36	Valve 1 opened.	✓
To repressurize the suit:		
37	Valve 7 closed.	✓
38	Valve 6 opened.	✓
39	Valve 1 closed.	✓
40	Valve 9 adjusted to maintain a positive suit pressure with respect to chamber pressure during chamber repressurization.	✓
	Approved: T.C. E. F. Mulcahy Approved: MSC-FSO-QA N. S. Kennedy	

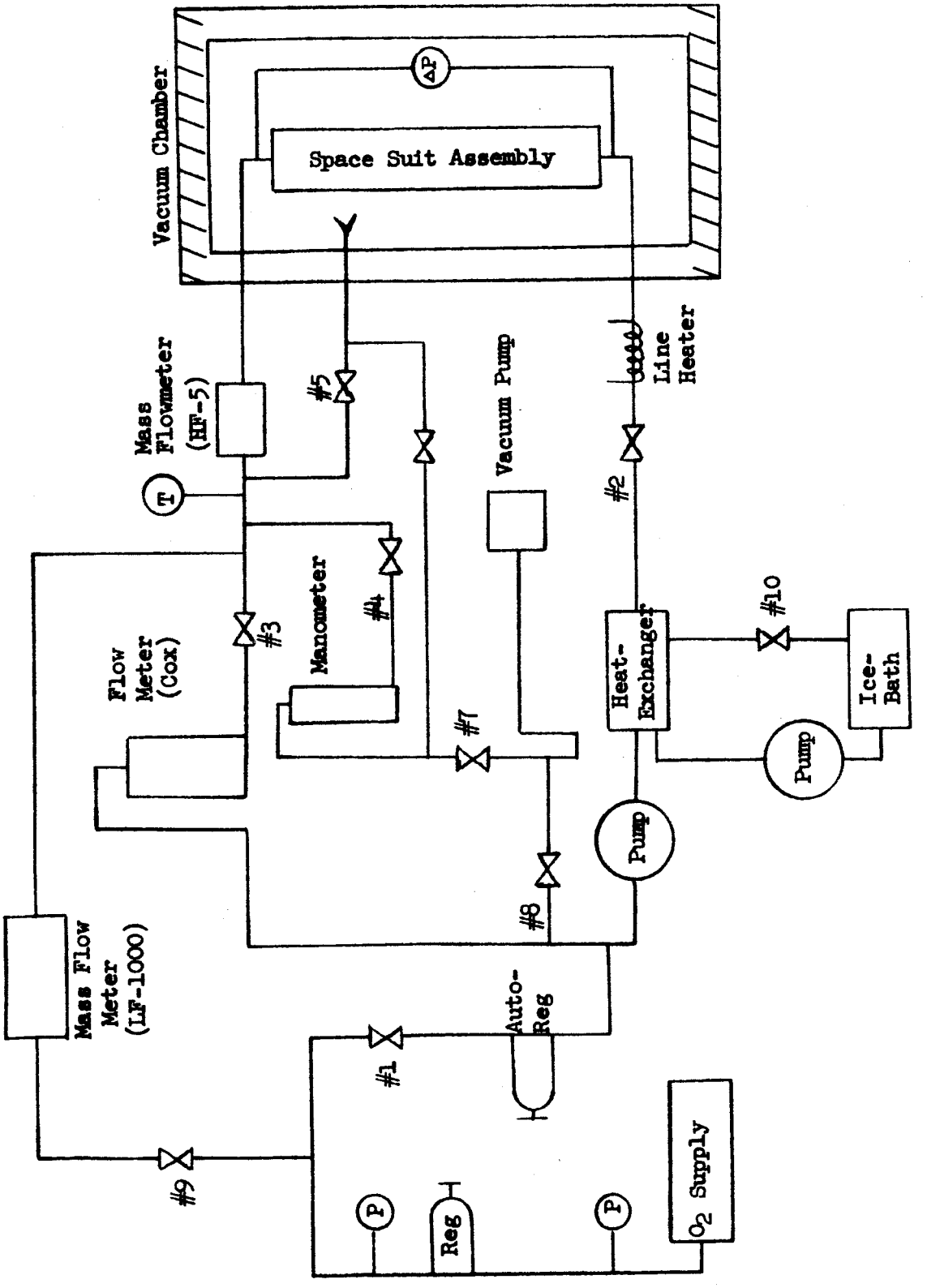


FIGURE 4
SUIT FLOW SYSTEM

7.0 TEST PROCEDURES

This test series will subject the Gemini ESP to a series of simulated conditions selected to accomplish the unmanned environmental qualification of the unit. The test objectives are presented in Section 3.0. The test conditions which will be used are summarized by Tables XIV and XV.

Tables XVI and XVII present the detailed test procedures and identification of tasks to accomplish the tests. The test conductor will direct, coordinate and record the accomplishment of the tasks in Tables XVI and XVII and the persons responsible will initial the test conductors record copy as evidence of accomplishment. The tables will be maintained such as to provide a complete record of the test events, significant data events and times. It should be noted that space for sign off of each test item by the test conductor and the NASA Flight Safety Office-Quality Assurance is provided on each of the tables.

8. PHOTOGRAPHY

Photographic coverage will be available. Colored photographs will be made of the test setup and specific areas as directed by NASA-MSC representatives.

TABLE XIV
SUMMARY OF ESP AND EXTENDED UMBILICAL
QUALIFICATION TEST

TEST DAY #1

Period	Pretest Pump Down	Test Period No. 1	Test Period No. 2	Test Period No. 3	Test Period No. 4	Test Period No. 5
Test Objective		Expose ESP & extended umbilical to a simulated night orbit.	Subject ESP & extended umbilical to a simulated orbital day at lowest flow conditions.	Verify HHMU operation after ESP subjection to a simulated day orbit	Subject ESP & extended umbilical to the transition from simulated day to night orbital conditions.	Establish gas temperature stabilization time for ELSS umbilical at a flow rate of 5.1 ± 0.4 lbs/hr.
Time of Period	--	5 minutes	45 minutes	5 minutes	40 minutes (O_2 depletion approximately 20 minutes).	To ELSS umbilical gas temperature stabilization.
Chamber Pressure	Ambient to test pressure.	5×10^{-4} torr max.	5×10^{-4} torr max.	5×10^{-4} torr max.	5×10^{-4} torr max.	5×10^{-4} torr max.
Solar Shutters	Closed	Closed	Open	Open	Closed	Closed
Solar Simulation	On (25 min.minimum prior to Test Period 1).	On	One solar constant.	One solar constant	Off	Off
Earth Albedo	Off	Off	On	On	Off	Off
Earth Thermal	Off	On	On	On	On	On
ESP O_2 Bottle	On	On	On	On	On	On
O_2 Flow Control Valve	Off	Flow 5.1 ± .4 lbs/hr	Flow 5.1 ± .4 lbs/hr	Flow 5.1 ± .4 lbs/hr	Flow 5.1 ± .4 lbs/hr	Pressure depleted.
HHMU Propellant Supply	On	On	On	On	On	On
HHMU	Off	Off	Off	Actuate for 2 sec	Off	Off
ELSS Umbilical Pressure (Inlet)	100 ± 10 PSIA, no flow	100 ± 10 PSIA, no flow	100 ± 10 PSIA, no flow	100 ± 10 PSIA, no flow	100 ± 10 PSIA, no flow	100 ± 10 PSIA 5.1 ± 0.4 lbs/hr flow
Transmitter	Off	Off	On	On	Off	Off
Receiver	Off	On	On	On	On	Off
Suit Pressure	3.7 ± .2 PSI > Chamber	3.7 ± .2 PSI > Chamber	3.7 ± .2 PSI > Chamber	3.7 ± .2 PSI > Chamber	3.7 ± .2 PSI > Chamber	3.7 ± .2 PSI > Chamber
Dummy Heaters	On (85°F nominal)	On (85°F nominal)	On (85°F nominal)	On (85°F nominal)	On (85°F nominal)	On (85°F nominal)
Cryowalls	On	On	On	On	On	On
IR Lamps[1]	On	Off	Off	Off	Off	Off
Specimen Position	Stationary	Stationary	Continuously rotated 270° from maximum solar on. ESP in horizontal plane.	Continuously rotated 270° from maximum solar on. ESP in horizontal plane.	Stationary	Stationary

[1] Control to maintain ESP and suit temperatures 40 to 110°F during pump down.

TABLE XV
SUMMARY OF ESP AND EXTENDED UMBILICAL
QUALIFICATION TEST

TEST DAY #2

Period	Pretest Pump Down	Test Period No. 1	Test Period No. 2	Test Period No. 3	Test Period No. 4	Test Period No. 5
Test Objective		Commence depletion of HHMU propellant supply & subject the ESP & extended umbilical to a simulated night orbit.	Expose ESP & extended umbilical to a simulated orbital day & the transition from a simulated orbital night while operating at a simulated high ELSS flow setting & constantly depleting the HHMU propellant supply.	Subject ESP to maximum O_2 withdrawal rate during a simulated orbital day.	Subject ELSS umbilical to simulated night environment.	Establish gas temperature stabilization time for ELSS umbilical at a flow rate of 5.1 ± 0.4 lbs/hr.
Time of period		5 minutes	25 minutes	25 minutes (O_2 depletion approximately 11 minutes).	40 minutes	To ELSS umbilical gas temperature stabilization.
Chamber Pressure	Ambient	5×10^{-4} torr max.	5×10^{-4} torr max.	5×10^{-4} torr max.	5×10^{-4} torr max.	5×10^{-4} torr max.
Solar Shutters	Closed	Closed	Open	Open	Closed	Closed
Solar Simulation	On (25 min. minimum prior to Test Period #1).	On	One solar constant	One solar constant	Off	Off
Earth Albedo	Off	Off	On	On	Off	Off
Earth thermal	Off	On	On	On	On	On
ESP O_2 Bottle	On	On	On	On	On	On
O_2 Flow Control Valve	Off	Flow 7.8 ± .4 lbs/hr	Flow 7.8 ± .4 lbs/hr	Flow 13.5 ± 1 lb/hr	Pressure depleted.	Pressure depleted.
HHMU Propellant Supply	On	On	On	On	On	On
HHMU	Off	Cycle: 5 sec on - 10 sec off - 10 sec on - 20 sec off - 3 sec on - 5 sec off			Pressure depleted.	Pressure depleted.
ELSS Umbilical Pressure (Inlet)	Vented to Chamber	Vented to Chamber	Vented to Chamber	Vented to Chamber	Vented to Chamber	100 ± 10 PSIA 5.1 ± 0.4 lbs/hr flow
Suit Pressure	3.7 ± .2 PSI > Chamber	3.7 ± .2 PSI > Chamber	3.7 ± .2 PSI > Chamber	3.7 ± .2 PSI > Chamber	3.7 ± .2 PSI > Chamber	3.7 ± .2 PSI > Chamber
Dummy Heaters	On (85°F nominal)	On (85°F nominal)	On (85°F nominal)	On (85°F nominal)	On (85°F nominal)	On (85°F nominal)
Cryowalls	On	On	On	On	On	On
Specimen Position	Stationary	Stationary	Continuously rotated 270° from maximum solar-on. ESP in horizontal plane.		Stationary	Stationary
IR Lamps[1]	On	Off	Off	Off	Off	Off

[1] Control to maintain ESP and suit temperatures 40 to 110°F during pump down.

TABLE XVI
TESTING PROCEDURE - TEST DAY NO. 1

Date: 12-2-65 Test Conductor: E. L. MULCAHY Observers: N. LAVERTY NASA F50-QA F. BURGETT NASA CSD

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked TC	Checked Q	Remarks
14:00	PD-1	Chamber Check List Complete	EJM		EJM	43M	
12-1-65	PD-2	Service ESP (Oxygen Only)	EJM		EJM		
12-1-65	PD-2a	Oxygen Bottle Serviced to 5000 PSIA	EJM		EJM		5100 PSIA
12-1-65	PD-2b	Freon Bottle Serviced to 5000 PSIA	EJM		EJM		5250 PSIA
12-1-65	PD-2c	ESP Installed in Test Position	EJM		EJM		
14:20	PD-2d	Oxygen Flow Control Valve OFF	EJM		EJM		
14:40	PD-2e	ESP O_2 Bottle Valve ON	EJM		EJM		
14:15	PD-2f	Transceiver Thermal Dummy Operational	EJM		EJM		
14:40	PD-2g	ESP Freon Bottle Valve ON	EJM		EJM		
14:44	PD-3	Umbilical Check	EJM		EJM		
14:43	PD-3a	ELSS Umbilical Pressurized to 100 ± 10 PSIA (No Flow)	EJM		EJM		100 PSIA
14:47	PD-3b	Extended & ELSS Umbilicals Installed & Checked for Resistance	EJM		EJM		
14:58	PD-4	Instrumentation Check List & Calibration Complete	EJM		EJM		
15:00	PD-5	DARS Check List Complete	EJM		EJM		
15:00	PD-6	Perform Functional and Leak Check of All Systems	EJM		EJM		O_2 & FREON REGULATOR PRESSURE SCALE REDUCED TO VERIFY LOCK-UP 16:00
16:40	PD-6a	Fire HHMU for Less Than One Second	EJM		EJM		
16:40	PD-6b	Crack Oxygen Flow Control Valve for Approximately One Second	EJM		EJM	43M	SEE DEVIATION #1

TABLE XVI - continued

Date: 12-2-65 Test Conductor: E.L. MULCAHY Observers:

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked TC	Checked Q	Remarks
16:00	PD-6c	Begin Suit Flow System Check List	RBP		EJM	43M	SEE DEVIATION # 2
12:00	PD-6d	Functional Check Rotation Mechanism	RBP		EJM		
16:00	PD-6e	Suit Sunvisor Up	RBP		EJM		
16:30	PD-7	Begin Data Acquisition & Recording (for Monitoring Purposes)	RJJ		BJ		
16:50	PD-8	Begin SES Pumpdown Check List	RJJ		BJ		
16:50	PD-8a	Start Suit Pressure Control System when Mechanical Pump is Started	RJJ		BJ		
19:30	PD-8b	Complete SES Pumpdown Check List	RBP		BJ		
19:45	PD-9	Begin LN_2 System Check List	RBP		BJ		
	PD-9a	Begin to Monitor Temperature of ESP, Extended Umbilical & Suit	RBP		BJ		!
19:50	PD-9b	Begin IR Lamp Array Control (& Earth Thermal) to 75 ± 35°F on ESP & Extended Umbilical Surfaces	RBP		BJ		!
19:30	PD-9c	Dummy Heaters ON (Nominal 85°F)	RBP		BJ		
20:10	PD-9d	Complete LN_2 Check List	RBP		BJ		
20:15	PD-10	Solar Simulator Check List Complete - Shutters Closed (25 Minutes Minimum Prior to Start of Test Period #1)	RBP		BJ		
20:00	PD-11	Chamber Pressure $< 5 \times 10^{-4}$ Torr	RBP		BJ		
20:47	PD-12	Chamber Wall Temperature < -290°F	RBP		BJ		
20:48	PD-13	Raise Earth Thermal to Calibrated Temperature	RBP		BJ		
20:48	PD-14	Extended & ELSS Umbilicals Checked for Resistance	RBP		BJ	43M	

TABLE XVI - continued

Date: 12-2-65 Test Conductor: BW TYLER Observers:

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked TC	Checked Q.A.	Remarks
20:52	1-1	Begin Test Period 1	RBP		BJ		
20:52	1-1a	Mark Test Time Zero	RBP		BJ		
	1-1b	ESP O_2 Flow - 5.1 ± .4 lbs/hr	RBP		BJ		
	1-1c	Infra-red Lamp Array OFF	RBP		BJ		
	1-1d	Solar Shutters Closed	RBP		BJ		
	1-1e	Begin Manual Recording of ESP Temperatures (Ref. Table II)	RBP		BJ		
20:52	1-1f	ESP Simulated Receiver ON	RBP		BJ		
20:55	1-2	Extended & ELSS Umbilicals Checked for Resistance	RBP		BJ		
20:57	1-3	Complete Test Period 1 (5 Minutes from Completion of 1-1)	RBP		BJ		
	2-1	Begin Test Period 2	RBP		BJ		
	2-1a	Solar Shutters Open and Supplementary IR ON	RBP		BJ		2:56 FOR FULL CYCLES
	2-1b	ESP & Dummy in Rotation	RBP		BJ		
20:57:30	2-1c	ESP Simulated Transmitter Cycle ON (One Minute On - One Minute OFF)	RBP		BJ		
21:00	2-2	Extended & ELSS Umbilicals Checked for Resistance (5 Minutes from Completion of 2-1)	RBP		BJ		21:35 SUIT PRESSURE PEAKED AT 1.6 △>CHAR FOR 2 MIN
21:21	2-3	Extended & ELSS Umbilicals Checked for Resistance (25 Minutes from Completion of 2-1)	RBP		BJ		OXYGEN REGULATED PRESSURE SPIKES ≈ 130 PSIA UNSTABLE
21:40	2-4	Extended & ELSS Umbilicals Checked for Resistance (45 Minutes from Completion of 2-1) Complete Test Period 2	RBP		BJ		O_2 FLOW INCREASE ≈ .055CFM/10 MIN ADJ. FREQUENTLY FOR TOL.
21:42:30	3-1	Begin Test Period 3	RBP		BJ		

TABLE XVI - continued

Date: 12-2-65 Test Conductor: B.W. TYLER Observers:

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked TC	Checked Q	Remarks
21:43:30	3-2	Actuate HHMU for Approximately 2 Seconds	RBP		BJ		
21:46	3-3	Extended & ELSS Umbilicals Checked for Resistance	RBP		BJ		
21:47:30	3-4	Complete Test Period 3 (5 Minutes from Start)	RBP		BJ		
	4-1	Begin Test Period 4	RBP		BJ		UMBILICAL FLOW 5.1 LB/HR FOR 3 MIN. ∴ 3 MIN ADDED
	4-1a	Suited Subject & ESP Stationary	RBP		BJ		TO TEST PERIOD 4
	4-1b	Solar Shutters Closed	RBP		BJ		IR LAMPS ON FOR NEXT 55 MINUTES
21:47:30	4-1c	ESP Transmitter OFF	RBP		BJ		
21:53:30	4-2	Extended & ELSS Umbilicals Checked for Resistance	RBP		BJ		
22:04:30	4-3	Oxygen Supply Exhausted (Approx. 20 Minutes from Start of 4-1)	RBP		BJ		72 PSIA OXYGEN REMAINING
22:30:30	4-4	Complete Test Period 4 (40 minutes from Completion of 4-1)	RBP		BJ		
22:30:30	5-1	Begin Test Period 5	RBP		BJ		
	5-1a	Solar Shutters Closed	RBP		BJ		
	5-1b	Solar OFF	RBP		BJ		
	5-1c	ELSS Umbilical Gas Flow 5.1 ± 0.4 lbs/hr	RBP		BJ		
22:30:30	5-1d	ESP Receiver OFF	RBP		BJ		
23:18	5-2	Extended & ELSS Umbilicals Checked for Resistance	RBP		BJ		
23:32	5-3	ELSS Umbilical Gas Temperature Stabilized Test Period 5 Complete	RBP		BJ		

TABLE XVI - continued

Date: 12-3-65 Test Conductor: BW Tyler Observers:

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked TC	Checked Q	Remarks
23:35	RA-1	Begin to Control ESP, & Extended Umbilical Temperatures to 75 ± 35°F with Infra-red Lamp Array	RBP		BJ		
23:35	RA-2	DARS OFF	RBP		BJ		
23:40	RA-3	LN_2 System Warm-Up Check List Complete	RBP		BJ		
1:53	RA-4	Return SES Pressure to Ambient	RBP		BJ		SUIT LEAK <200 SCC AT 1 PSID 2:10
1:56	RA-5	Open Chamber	RBP		BJ		
2:22	RA-6	Reduce Suit Pressure to Ambient	RBP		BJ		
2:35	RA-7	Remove ESP from Chamber	RBP		BJ		
		Approved By: T.C. B.W. Tyler					
		MSC-FSO-QA N.S. Lewis					

TABLE XVII A

TESTING PROCEDURE-TEST DAY NO. 2

Date: 12-3-65 Test Conductor: E. L. MULCAHY Observers: N. LAVERTY NASA FSO-QA F. BURGETT NASA CSD

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked TC	Checked Q	Remarks
6:00	PD-1	Chamber Check List Complete	RBP		BJ		
	PD-2	Service ESP	RBP				
6:15	PD-2a	Oxygen Bottle Serviced to 5000 PSIA	RBP		BJ		5100 PSIA
6:45	PD-2b	ESP Installed in Position	RBP		BJ		
7:00	PD-2c	Oxygen Flow Control Valve OFF	RBP		BJ		
7:00	PD-2d	ESP O_2 Bottle Valve ON	RBP		BJ		PRESSURE 5100
7:00	PD-2e	ESP Freon Bottle Valve ON	RBP		BJ		PRESSURE 4900
7:00	PD-3	Umbilical Check	RBP		EJM		
7:35	PD-3a	ELSS umbilical vented to chamber	RBP		BJ		!
7:48	PD-3b	Extended & ELSS Umbilicals Installed	RBP		EJM		
		& checked for resistance.					
7:30	PD-4	Instrumentation Check list and	EJM		BJ		TC #13 & TC #48 OPEN
		calibration complete					
7:30	PD-5	DARS Check List Complete	EJM		BJ		
7:45	PD-6	Perform Leak & Functional Check of all systems	EJM		BJ		
7:10	PD-6a	Fire HHMU for<One Second	EJM		BJ		
7:32	PD-6b	Crack oxygen flow control valve for approximately one second	EJM		BJ		

TABLE XVII A (continued)

Date: 12-3-65 Test Conductor: E. L. MULCAHY Observers:

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked TC	Checked C	Remarks
7:45	PD-6c	Begin suit flow system check list	EJM		BJ	KEY	
6:50	PD-6d	Functional check rotation mechanism	EJM		BJ		
7:07	PD-6e	Suit sunvisor down	EJM		BJ		
7:49	PD-7	Begin data acquisition and recording (for monitoring purposes)	EJM		BJ		
7:49	PD-8	Begin SES Pumpdown Check List	EJM		BJ		DOOR CLOSED 7:54
7:53	PD-8a	Start suit pressure control system when mechanical pump is started	EJM		BJ		O-RING LEAK - DOOR CLOSED 8:00 PUMP STOPPED - 8:01
1015	PD-8b	Complete SES Pumpdown check list	EJM		EJM		DAR POWER LOST 8:05 RESTORED: 8:08
1025	PD-9	Begin LN_2 system check list	EJM		EJM		
1025	PD-9a	Begin Monitoring Temperatures of ESP, Extended Umbilical and suit.	EJM		EJM		
1025	PD-9b	Begin 1R Lamp Array (& Earth Thermal) to 75 ± 35°F on ESP & Extended Umbilical	EJM		EJM		
1125	PD-9c	Complete LN_2 system check list	EJM		EJM		
1105	PD-10	Solar simulator check list complete - Shutters closed (25 minutes minimum	EJM		EJM		
		Prior to start of test period 1)					
	PD-11	Chamber Pressure < 5×10^{-4} Torr	EJM		EJM		
	PD-12	Chamber Temperature < -290°F	EJM		EJM		
	PD-13	Raise earth thermal to calibrated temperature	EJM		EJM		
	PD-14	Extended & ELSS Umbilicals Checked for Resistance	EJM		EJM	KEY	

TABLE XVII A (Continued)

Date: Test Conductor: E. L. MULCAHY Observers:

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked TC	Checked Q	Remarks
1130	1-1	Begin Test Period 1	EFM		EFM	MSK EFM	
1130	1-1a	Mark Test Time Zero	EFM		EFM		
	1-1b	ESP O_2 flow 7.8 ± .4 lbs./hr.	EFM		EFM		
1135	1-1c	Begin repeated actuation of HHMU through sequence 5 sec. ON - 10 sec. OFF -	EFM		EFM		
		10 sec. ON - 20 sec. OFF - 3 sec. ON - 5 sec. OFF					
1130	1-1d	Infrared Lamp array OFF	EFM		EFM		
1130	1-1e	Solar Shutters Closed	EFM		EFM		
1130	1-2	Extended & ELSS Umbilicals checked for Resistance	EFM		EFM		
1135	1-3	Completion of Test Period 1 (Five minutes from start of actuation of HHMU)	EFM		EFM		
1135	2-1	Begin Test Period 2	EFM		EFM		
1135	2-1a	Solar shutters open (supplementary 1R ON)	EFM		EFM		
1135	2-1b	Continued actuation of HHMU in prescribed sequence	EFM		EFM		
1135	2-1c	ESP & Dummy in rotation	EFM		EFM		
1140	2-2	Extended and ELSS Umbilicals checked for resistance (5 minutes from completion of 2-1)	EFM		EFM		Test Plan Deviated from at 1135 due to chamber pressure increasing to 10 microns
1147	2-3	Extended & ELSS umbilicals checked for resistance (25 minutes from completion of 2-1) - Test Period 2 Complete	EFM		EFM	MSK EFM	

SEE DEVIATION NO. 3

TABLE XVII (continued)

Date: 12-2-65 Test Conductor: E.L. MULCAHY Observers:

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked T	Checked O	Remarks
	3-1	Begin Test Period 3	SEE DEVIATION NO. 4				
	3-1a	ESP O_2 flow 13.5 ± 1 lb./hr.					
	3-2	Oxygen supply exhausted - (Approximately 11 minutes from start of 3-1)					
	3-3	Extended & ELSS umbilicals checked for resistance (25 minutes from completion of 3-1) Test period 3 complete					
	4-1	Begin test period 4					
	4-1a	Solar shutters closed					
	4-1b	Solar OFF					
	4-1c	ESP & Dummy stationary					
	4-2	Extended & ELSS umbilicals checked for resistance (within 5 minutes of completion of 4-1)					
	4-3	Extended & ELSS umbilicals checked for resistance (within 40 minutes of completion of 4-1) Test period 4 complete					
	5-1	Begin test period 5					
	5-1a	ELSS umbilical pressurized to 100 ± 10 PSIA 5.1 ± 0.4 lbs/hr flow					
	5-2	Extended & ELSS umbilicals checked for resistance					

TABLE XVI-A (Continued)

Date: 12-2-65 Test Conductor: E. L. MULCAHY Observers:

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked TC	Checked Q	Remarks
	5-3	ELSS umbilical gas temperature stabilized. Test period 5 complete					SEE DEV. NO. #4
	RA-1	Begin to control ESP & Extended Umbilical temperature to 75± 35°F with infrared array.					
	RA-2	BARS OFF					
	RA-3	LN_2 system warm-up check list complete					
	RA-4	Return SES Pressure to ambient					
	RA-5	Open chamber					
	RA-6	Reduce Suit Pressure to ambient					
	RA-7	Remove ESP from chamber					
							SEE DEVIATION NO. 5

TABLE XVII

TESTING PROCEDURE-TEST DAY NO. 2 B

N. LAVERTY NASA FSO-QA

Date: DEC 4, 1965 Test Conductor: B.W. TYLER Observers: F. BURGETT NASA CSD

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked TC	Checked C	Remarks
14:54	PD-1	Chamber Check List Complete	B. TYLER		BJ	ASM	
	PD-2	Service ESP					SEE DEVIATION NO. 6 & 7
14:54	PD-2a	Oxygen Bottle Serviced to 5000 PSIA			BJ		5200 PSIA @ 80°F
14:35	PD-2b	ESP Installed in Position			BJ		
14:59	PD-2c	Oxygen Flow Control Valve OFF			BJ		
15:07	PD-2d	ESP O_2 Bottle Valve ON			BJ		
14:55	PD-2e	ESP Freon Bottle Valve ON			BJ		3000 PSIA NITROGEN @ 78°F SEE DEV. No. 6
15:10	PD-3	Umbilical Check			BJ		
15:15	PD-3a	ELSS umbilical vented to chamber			BJ		!
15:20	PD-3b	Extended & ELSS Umbilicals Installed			BJ	RC	
		& checked for resistance.					
15:22	PD-4	Instrumentation Check list and			BJ		
		calibration complete					
15:20	PD-5	DARS Check List Complete			BJ		
15:30	PD-6	Perform Leak & Functional Check of all systems			BJ		
15:25	PD-6a	Fire HMU for<One Second			BJ		
15:37	PD-6b	Crack oxygen flow control valve for approximately one second			BJ	ASM	

TABLE XVII B (continued)

Date: DEC 4, 1965 Test Conductor: B.W. TYLER Observers: N. LAVERTY NASA-FSO-QA F. BURGETT NASA-CSD

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked JF	Checked ✓	Remarks
15:35	PD-6c	Begin suit flow system check list	B.TYLER		BJ		LEAK ≈ 200 SCC
15:30	PD-6d	Functional check rotation mechanism			BJ		
15:40	PD-6e	Suit sunvisor down			BJ		
16:00	PD-7	Begin data acquisition and recording (for monitoring purposes)			BJ		
15:50	PD-8	Begin SES Pumpdown Check List			BJ		Door Closed 15:50
15:56	PD-8a	Start suit pressure control system when mechanical pump is started			BJ		SEE DEVIATION NO. 8
17:50	PD-8b	Complete SES Pumpdown check list			BJ		
17:55	PD-9	Begin LN_2 system check list			BJ		
17:55	PD-9a	Begin Monitoring Temperatures of ESP, Extended Umbilical and suit.			BJ		
17:55	PD-9b	Begin IR Lamp Array (& Earth Thermal) to 75 ± 35°F on ESP & Extended Umbilical			BJ		
18:20	PD-9c	Complete LN_2 system check list			BJ		
18:20	PD-10	Solar simulator check list complete - Shutters closed (25 minutes minimum Prior to start of test period 1)			BJ		
18:30	PD-11	Chamber Pressure $< 5 \times 10^{-4}$ Torr			BJ		
18:30	PD-12	Chamber Temperature < -290°F			BJ		
18:30	PD-13	Raise earth thermal to calibrated temperature	LOFTICE		BJ		
18:37	PD-14	Extended & ELSS Umbilicals Checked for Resistance	HEDGE		BJ		

TABLE XVII B (continued)

Date: DEC 4, 1965 Test Conductor: B.W. TYLER Observers: N. LAVERTY NASA-FSO-Q; F. BURGETT NASA-CSD

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked BW	Checked C	Remarks
18:45	1-1	Begin Test Period 1			BJ		4950 Recon 5150 Q
18:45	1-1a	Mark Test Time Zero			BJ		
18:45	1-1b	ESP O_2 flow 7.8 ± .4 lbs./hr.	KELLY PETE		BJ		RECEIVER ON
	1-1c	Begin repeated actuation of HHMU through sequence 5 sec. ON - 10 sec. OFF -			BJ		SEE DEVIATION NO. 9
		10 sec. ON - 20 sec. OFF - 3 sec. ON - 5 sec. OFF					
18:45	1-1d	Infrared Lamp array OFF	LOFTICE		BJ		
18:20	1-1e	Solar Shutters Closed	LOFTICE		BJ		
	1-2	Extended & ELSS Umbilicals checked for Resistance	HEBBE		BJ		1
	1-3	Completion of Test Period 1 (Five minutes from start of actuation of HHMU)			BJ		
18:50	2-1	Begin Test Period 2			BJ		
	2-1a	Solar shutters open (supplementary 1R ON)	LOFTICE				CYCLE TRANSMITTER 1 MIN ON - 1 MIN OFF
✓	2-1b	~~Continued actuation of HHMU~~ in ~~prescribed~~ sequence					
✓	2-1c	ESP & Dummy in rotation	PEVITT				
✓	2-2	Extended and ELSS Umbilicals checked for resistance (5 minutes from completion of 2-1)	HEBBE				
19:08		CYCLE HHMU 15 SEC ON 30 SEC OFF (18 MIN FOR 1 START TP 2)	BURGETT		SEE DEVIATION NO. 9		
19:15	2-3	Extended & ELSS umbilicals checked for resistance (25 minutes from completion of 2-1) - Test Period 2 Complete	HEBBE				

TABLE XVIIB (continued)

Date: DEC 4, 1965 Test Conductor: B.W. TYLER Observers: N. LAVERY NASA-FSO-QA F. BURGETT NASA-CSD

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked QC	Checked Q	Remarks
						SEE	DEVIATION NO. 1
19:15	3-1	Begin Test Period 3					
19:15	3-1a	ESP O_2 flow 13.5 ± 1 lb./hr. 2.75	PETE				
19:32:20	3-2	Oxygen supply exhausted - (Approximately 11 minutes from start of 3-1)	[illegible]				190 PSI
19:35	3-3	Extended & ELSS umbilicals checked for resistance (25 minutes from completion of 3-1) Test period 3 complete	WEBBLE				
19:40	4-1	Begin test period 4					
✓	4-1a	Solar shutters closed	COFFICE				19:20 [illegible]
✓ ✓	4-1b	Solar OFF	KELLY COFFICE				OFF-SIGHT [illegible]
✓	4-1c	ESP & Dummy stationary	PEWITT				
19:45	4-2	Extended & ELSS umbilicals checked for resistance (within 5 minutes of completion of 4-1)	WEBBLE				19:49 FROM AUX. VALVE CLOSED DUE TO SLIGHT LEAK AT HOSE CONNECTION TO GUN
20:20	4-3	Extended & ELSS umbilicals checked for resistance (within 40 minutes of completion of 4-1) Test period 4 complete	WEBBLE				
20:20	5-1	Begin test period 5					
	5-1a	ELSS umbilical pressurized to 100 ± 10 PSIA 5.1 ± 0.4 lbs/hr flow 1.65	PETE				
✓	5-2	Extended & ELSS umbilicals checked for resistance	WEBBLE				

TABLE XVII B (continued)

Date: DEC 4, 1965 Test Conductor: B.W. TYLER Observers: F. BURGETT NASA-CSD N. LAVERTY NASA-FSO-2A

Time	Seq. No.	Operation	Responsible Individual	Reading	Checked NC	Checked Q	Remarks
21:00	5-3	ELSS umbilical gas temperature stabilized. Test period 5 complete	BURGETT		BJ		
21:00	RA-1	Begin to control ESP & Extended Umbilical temperature to 75± 35°F with infrared array.	LOFTICE		BJ		
21:00	RA-2	DARS OFF	LANGFORD		BJ		
	RA-3	LN_2 system warm-up check list complete	PRUITT				
	RA-4	Return SES Pressure to ambient	PRUITT				
	RA-5	Open chamber	PRUITT				
	RA-6	Reduce Suit Pressure to ambient					
	RA-7	Remove ESP from chamber					
		CHECK RESISTANCE OF ETM LEADS IS UNCHANGED					
		CALIBRATE CAN PRESSURE TRANSDUCERS					
		Approved: N S Laverty NASA-FSO-2A					
		B.W. Tyler Test Conductor					

9.0 REFERENCES

1. Goodnight, F. H., et al, "Unmanned Thermal Performance Evaluation of a Gemini Extravehicular Space Suit," Report No. 00.683, LTV Aerospace Corporation, dated 15 July, 1965.

2. Pearson, R. O., et al, "Performance and Thermal Response of the Gemini Extravehicular Space Suit, Experiment Ib," Report No. 00.573, LTV Astronautics Division, dated 23 December 1964.

3. Drummond, A. J., "Examination of Spectral Enegry Distribution of Mercury - Xenon Lamps," The Eppley Laboratory, Inc., dated 27 June 1962.

DEVIATION LIST
to
LTV Report No. 00.724

Deviation No.	Reference	Description	Reason
1.	Table XVI	ESP oxygen flowed for 1 min. instead of 2 sec.	To check DARS
2.	Table XVI	Suit pressure 1 psia instead of 3.7 psia.	Low pressure to prevent recurrence of pre-test leaks. Does not affect ESP qual. test.
3.	Table XVIIA	SES test pressure exceeded $5X10^{-4}$ mm Hg. (to 40 microns)	Leak at ESP freon regulator inlet exceeded SES pumping capacity.
4.	Table XVIIA	Test sequences 3-1 and subsequent deviated from and the following procedure followed: (a) Solar turned off at 1138. (b) ESP oxygen flow 5.1 continued - flow ceased at 1202. (c) HHMU firing sequence continued to depletion. (d) Solar and albedo on, ESP transmitter and receiver power on ESP rotated back to solar at 1205 hrs. (e) Solar and albedo off at 1305. (f) Earth thermal off at 1305. (g) Begin LN_2 warmup system checklist. (h) LN_2 system checklist complete. Chamber opened.	Attempt to correct leak which caused test chamber pressure to go to excessive value. (See deviation No. 6).
5.	Table XVIIA	ESP, HHMU and test freon line assembled in LTV cleanroom. ESP propellant serviced to 400 psi with Helium and then to 5300 psi with N_2. Propellant tank blown down by pulsing HHMU. Result: Inlet fitting to Freon regulator began to leak as regulator temperature fell below $0^{\circ}F$.	To identify and determine cause of leak that occurred during test.

Deviation No.	Reference	Description	Reason
5. (cont.)		No corrective action attempted. Revised procedure arrived at with MSC for retest to prevent reoccurrence. DR to be written by MSC FSO QA.	
6.	Table XVIIB	Freon bottle charged to 5000 psig at 78F.	Approved by MSC CSD representative. See servicing data sheet.
7.	Table XVIIB	Freon bottle charged with nitrogen.	Verbal instructions of NASA MSC.CSD.
8.	Table XVIIB	Suit pressure 1 psi instead of 3.7 psia.	To prevent reoccurrence of leaks experienced prior to test.
9.	Table XVIIB	HHMU not fired until 23 minutes after start of test. Cycle 15 sec. on, 30 sec. off.	Requested by MSC CSD.
10.	Table XVIIB	HHMU system leak occurred after 12 minutes of cycling. Nitrogen = 700 psi, Regulator = 0°F leak assumed to be o-ring at regulator inlet.	See DR submitted by FSO QA.

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F. A. Burgett
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