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SKYLAB EXPERIMENT PERFORMANCE EVALUATION MANUAL

Appendix H: Experiment M553 Sphere Forming (MSFC)

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16. ABSTRACT

This appendix contains a series of analyses for Experiment M553 Sphere Forming (MSFC), to be used for evaluating the performance of the Skylab corollary experiments under preflight, inflight, and post-flight conditions. Experiment contingency plan workaround procedure and malfunction analyses are presented in order to assist in making the experiment operationally successful.

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APPENDIX H. EXPERIMENT M-553, SPHERE FORMING (MSFC)

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DEFINITION OF SYMBOLS

Symbol	Definition
ACC	Accessory
ACCESS	Accessory
ADJ	Adjust
ADV	Advance
ALIGN	Alignment
AM	Airlock Module
AUTO	Automatic
BAT.	Battery
BATT	Battery
CAM	Camera
cb	Circuit breaker
CHMBR	Chamber
CONT	Control
CSTR	Canister
ctr	Center
CUR	Current
DAC	Data Acquisition Camera
EBG	Electron Beam Gun
EXP	Experiment
FBD	Functional Block Diagram
FBNT	Functional Block Number and Title
FIL	Filament
FO	Functional Objective
HI	High
HOSC	Huntsville Operation Support Center

DEFINITION OF SYMBOLS (Continued)

Symbol	Definition
ID	Identification
INTLK	Interlock
LT	Light
lt	Light
MAN	Manual
MDA	Multiple Docking Adapter
MOM	Momentary
mom	Momentary
MPF	Materials Processing Facility
MSC	Manned Spacecraft Center
MSFC	Marshall Space Flight Center
N/A	Not Applicable
OA	Orbital Assembly
OSN	Operation Step Number
OWS	Orbital Workshop
P_{fn}	Net Probability of Failure
P_{ft}	Total Probability of Failure
PI	Principal Investigator
PLT	Pilot
pot	Potentiometer
PRESS	Pressure
P_s	Probability of Success
PWR	Power
REPRESS	Repressurization
SEPEM	Skylab Experiment Performance Evaluation Manual

DEFINITION OF SYMBOLS (Concluded)

Symbol	Definition
SEQ	Sequence
S/I	Speaker/Intercom
SL	Skylab
STS	Structural Transition Section
sw	Switch
TEMP	Temperature
vlv	Valve
VTS	Vault Temporary Storage
XPT	Transporter

SECTION I.

EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 1 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number*	Remarks
	min	nom	max		
3.0 Analyze and predict facet performance profile for Skylab Experiment M-553, Sphere Forming.				N/A	Refer to Functional Block Number and Title (FBNT) 3.1.
3.1 Make explicit statements about objectives in qualitative and quantitative terms.				N/A	Refer to FBNT 3.1.1.
3.1.1 Specify duration that the experiment is required to operate and provide useful information				N/A	The approximate time in hours and minutes required to operate and perform Experiment M-553 is: • Preparation/Operation 0:39 • Termination 0:22 Reference 1.
3.1.2 Specify the types of criteria that are to be maximized or minimized.				N/A	The Functional Objectives (FO's) for Experiment M-553 are: • FO-1 and FO-2: Perform sphere forming operations on each of two identical specimen wheels, collect data and samples for return to earth.

*Criticality Category Number Definition

- Category I--Experiment and equipment whose failure could adversely affect crew safety.
- Category II--Experiment and equipment whose failure could result in not achieving a primary mission objective, but does not adversely affect crew safety.
- Category IIIa--Experiment and equipment whose failure could result in not achieving a secondary mission objective, but which does not adversely affect crew safety or preclude the achievement of any primary mission objective.
- Category IIIb--Experiment and equipment whose failure could not result in a loss of primary or secondary mission objectives and does not adversely affect crew safety.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 2 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.1.2 (Concluded)					The basic objective of the experiment is to demonstrate the effects of zero-g on fundamental solidification phenomena. By melting high purity nickel, a Ni-12 percent Sn alloy, Stellite Star J, and 350 T Maraging Steel on stings and resolidifying in both the free floating and captive conditions, it should be possible to demonstrate: • Solidification of a pure metal (Ni) at undercooling not possible on earth. • The unique effects that are associated with solidification of an alloy having a wide freezing range and a high density difference between the components (Ni-12 percent Sn). • That homogeneous, wear resistant, hard and highly spherical structures of Stellite Star J and 350 Maraging Steel may be cast from the melt. References 2, 3, and 4.
3.1 3 Specify the percentage of max. / min. for each objective.			50% for each FO	N/A	It is not deemed necessary to determine the minimum or nominal percentage of data that must be obtained for the experiment to be a success • FO-1 and FO-2 Perform sphere forming operations on each of two identical specimen wheels, collect data and samples for return to earth Reference 2

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 3 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.1.4 Specify experiment constraints: • Musts • Must Nots • Wants • Don't Wants.				N/A	• Musts --The experiment must be operated with power from the battery --The work chamber must be evacuated to space vacuum for experiment operation. • Must Nots --An attempt must not be made to recover the spheres until after the spheres have been allowed to cool. --The Electron Beam Gun (EBG) must not be fired with low EBG canister pressure. • Wants --The magnitude of any spacecraft accelerations and the time of occurrence will be furnished to the experiment Principal Investigator (PI) from available ground telemetered data if it occurs during the experiment performance. --Recordings will be made of the astronaut's voice comments during the performance of the experiment. --A logbook will be kept on the experiment. --The sphere forming tasks associated with each of the two specimen wheels should be continuous and uninterrupted. • Don't Wants --All vehicle accelerations of any significant magnitude should be avoided during the performance of the experiment. References 2, 3, 4, and 5.
3.1.5 Specify experiment operational tolerances: • Musts • Must Nots • Wants • Don't Wants.				N/A	Refer to FBNT 3.1.4. • Musts --The M-512 battery has a minimum "wet stand" life of 90 days after activation (which occurs approximately 57 days prior to SL-1 launch). --The work chamber must be evacuated to space vacuum (equal to or less than 1 x 10^{-4}* torr) for experiment operation • Must Nots --A 30 min cooldown period will be required after completion of the

*There is inconsistency in the documentation for the experiment work chamber vacuum requirement This value is based upon the requirement shown in the Mission Rules (March 1, 1973)

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 4 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.1.5 (Concluded)					processing of each specimen wheel before the sphere samples can be removed from the Materials Processing Facility (MPF) vacuum chamber. --The EBG canister pressure must be 24 psia, or above, before the EBG is fired. • Wants --N/A • Don't Wants --Accelerations greater than 5×10^{-4} g. This can influence the results of the experiment.
3.2 Define decision rules and success criteria for the experiment objectives.				N/A	If the experiment is aborted, then the probability of success (P_S) is equal to 0.0. If the experiment is compromised and minimum information is salvaged, $P_S = 0.1 \rightarrow 0.5$, if the maximum information is salvaged, $P_S = 0.6 \rightarrow 0.9$. If the experiment is completed as scheduled, $P_S = 1.0$. The success criterion is: • Determine the effects of zero g and space vacuum on solidification of certain metallic alloys. Reference 2
3.3 Specify experiment priority (numerical statement) for a given Skylab flight designation.				N/A	Experiment M-553 is assigned to mission SL-1/SL-2 and the experiment priority number is 160. References 6 and 7.
3.4 Briefly describe and list the major subsystems for Experiment M-553.				N/A	Refer to FBNT's 3.4.1 and 3.4.2.
3.4.1 Describe the major functions.				N/A	The basic objective of the experiment is to demonstrate the effects of zero g on fundamental solidification phenomena.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 5 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.4.1 (Continued)					This experiment makes use of the electron beam to form twenty-eight 0.25-in. spheres by melting small metal cylinders attached to the rim of two specimen discs and allowing some of them to float free in the work chamber. The zero-g environment is expected to affect solidification by eliminating density differences and thermal convection, thereby emphasizing surface tension forces. A high degree of supercooling may be possible by solidification of free-floating melts out of contact with container walls which often serve as nucleation sites. When solidification occurs in significantly undercooled metals and alloys, substantial structural modifications and reduction of segregation ratio can be observed. Nucleation phenomena, even in captive melts, may be very different in zero g because some of the structure in castings has been ascribed to thermal convection. The absence of thermal convection and constitutional density differences in zero g may result in extremely fine dendritic structures, low segregation ratios, and fine and uniformly dispersed inclusions. The net result may be structures with greatly improved properties. There are a total of 28 specimens to be melted. Six of these are fixed on stings and 22 are allowed to float freely in the work chamber after being melted. These samples have been prepared and will be mounted on a rotating sample holder such that the samples form the spokes of a wheel, the hub of which is connected to a rotation and positioning mechanism. The astronaut will position each sample, in turn, in the electron beam. For the fixed specimens, the electron beam will have to be cut off by the astronaut when the specimen melts. For the floating specimens, the electron beam will automatically be cut off when the specimens are released from the sting. The successful performance of this experiment requires the complete separation of the molten specimen from the pinwheel assembly. Severing of the small wire used as a retention device will occur when the specimen has been completely melted by the electron beam. The wire will then be automatically withdrawn, leaving the molten metal in contact with a nonwetting ceramic surface at a low temperature. The shape of the liquid metal will be deformed when the wire is withdrawn. Surface tension will cause the liquid metal to quickly form a sphere, resulting in a change of center of mass and causing separation at a very small velocity The separation velocity is not to exceed 1/3 cm/sec. Approximately 55 sec will be required for the free floating nickel sphere to solidify by radiation cooling. Oscillations will be present in the molten spheres at time of separation but should be dampened by its mass to 1 percent of the original oscillation within a few seconds after separation from its holder. If any molten spheres should inadvertently contact equipment of the chamber wall, they would stick to it but, development tests have shown that the safety of the crewman would not be compromised

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 6 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.4.1 (Concluded) 3.4 2 List the major components.				N/A	References 3 and 8. The only items of hardware peculair to Experiment M-553 are the two sample wheels with the 28 specimens and 2 targets. In addition to the 2 sample wheels with the 28 specimens and 2 targets, the following hardware is used • M-512 hardware --Vacuum Work Chamber Assembly --EBG Assembly --Battery --Vent Valves --Vent Lines --Camera Mount --M553 HATCH VIEW-PORT SHIELD SPHERE FORMING --M553 CAMERA PORT SHIELD SPHERE FORMING --M512 FLOOD LIGHT SHIELD --Work Chamber Vent Filter No. 1 --M553 SPHERE CATCHER 1 --M553 SPHERE CATCHER 2 --M553 SPHERE CATCHER INSTALLATION TOOL --M479 WATER SPRAY CONNECTION COVER --EQUIPMENT STORAGE CONTAINER --Controls and Displays --Floodlight • Operational Support Equipment --Vacuum Cleaner --Photographic Equipment A Functional Block Diagram (FBD) is submitted as Figure H-1, and is used as a subsystem component listing. Critical subsystem components will be identified and evaluated for failure and correlated to possible experiment/carrier interface problems. References 4, 5, and 8.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 7 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5 Define the M-553 experiment/ carrier system interfaces • Physical --Mechanical --Electrical --Communications and Data --Support • Environmental --Natural and Induced --Contamination • Operability --Pointing and Control --Crew Safety --Sequence --Operability.				N/A	Experiment M-553 hardware has no physical interface with the carrier. An interface block diagram is submitted as Figure H-2 and is used to define the various interfaces for Experiment M-553.
3.5.1 M-512 Materials Processing Facility.				N/A	The M-512 MPF is used to accommodate the performance of Experiments M-479, M-518, M-551, M-552, M-553, and M-555. For more extensive information concenring the M-512 MPF, refer to Skylab Experiment Performance Evaluation Manual (SEPEM), Appendix E. For more information concerning the M-512 MPF associated with Experiment M-553, refer to FBNT's 3.5.1.1 through 3.5.1.17.
3.5.1.1 Vacuum Work Chamber Assembly.				N/A	The Vacuum Work Chamber Assembly provides a facility to perform Experiment M-553 under controlled environmental conditions. Refer to SEPEM, Appendix E, FBNT's 3.5.3.1, 3.5.3.2, 3.5.3.2.1, 3.5.3.3, 3.5.3.4, 3.5.3.5, 3.5.3.6, and 3.5.3.9.
3.5 1.2 Electron Beam Gun Assembly.				N/A	The Electron Beam Subsystem is a gun that emits electrons from a hot filament These electrons impinge upon and melt the specimens. Refer to SEPEM, Appendix E, FBNT's 3.5.2, 3.5.2.1, 3.5.2.2, and 3.5.2.3.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 8 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.3 Specify the total probability of failure (Pf_t) and the net probability of failure (Pf_n) for the battery.				IIIa	The battery is the power source to perform the experiment. Refer to SEPEM, Appendix E, FBNT 3.5.6.
3.5.1 4 Vent Valves.				N/A	The vent valves are used in the pressurization/venting system to obtain the desired atmospheric pressures for Experiment M-553. Refer to SEPEM, Appendix E, FBNT's 3.5.8.1 through 3.5.8.6.
3.5.1 Vent Lines.				N/A	The vent lines are used in the pressurization/venting system to obtain the desired atmospheric pressure for Experiment M-553. The 4-in. vent line is Multiple Docking Adapter (MDA) hardware, but, because of its importance to the experiment, it is considered with the M-512 MPF. Refer to SEPEM, Appendix E, FBNT's 3.5.9.1 through 3.5.9.3.
3.5.1.6 Specify the Pf_t for the camera mount.				IIIb	The camera mount is a bayonet type adapter used to mount the 16mm Data Acquisition Camera (DAC). The camera mount is located under the work chamber next to the camera viewport. Refer to SEPEM, Appendix E, FBNT 3.5.10.
3.5.1.7 Specify the Pf_t and the Pf_n for the M553 HATCH VIEW-PORT SHIELD SPHERE FORMING.				IIIb	The M553 HATCH VIEW-PORT SHIELD SPHERE FORMING is installed inside the chamber on the hatch viewport to protect the viewport during the experiment. Refer to SEPEM, Appendix E, FBNT 3.5.11.5.
3.5.1.8 Specify the Pf_t and the Pf_n for the M553 CAMERA PORT SHIELD SPHERE FORMING.				IIIb	The M553 CAMERA PORT SHIELD SPHERE FORMING is installed inside the work chamber over the camera port window to prevent residue from collecting on the window during Experiment M-553. Refer to SEPEM, Appendix E, FBNT 3.5.11.6.
3.5.1 9 Specify the Pf_t and the Pf_n for the M512 FLOOD LIGHT SHIELD.				IIIb	The M512 FLOOD LIGHT SHIELD is installed inside the work chamber on the floodlight port to protect the floodlight lens during the performance of the experiments using the MPF. The shield was used in Experiment M-551 and is still installed in the work chamber. The floodlight will be used to provide the lighting for the photography during the experiment. A shield contamination failure could degrade the filming data. Refer to SEPEM, Appendix E, FBNT 3.5.11.3.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 9 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.10 Specify the Pf_t and the Pf_n for Work Chamber Vent Filter No. 1				IIIb	Work Chamber Vent Filter No. 1 is installed in the work chamber in the 4-in. vacuum vent line to trap contaminants and to prevent the free floating spheres from floating through the 4-in. vacuum vent line and into space. The filter was used in Experiment M-551 and is still installed in the 4-in vacuum vent line. Refer to SEPEM, Appendix E, FBNT 3.5.11.20.
3.5.1.11 Specify the Pf_t for the M553 SPHERE CATCHER 1.				IIIb	M553 SPHERE CATCHER 1 is used to collect the spheres formed from M553 SPHERE FORMING SPECIMEN 1. Refer to SEPEM, Appendix E, FBNT 3.5.11.16.
3.5.1 12 Specify the Pf_t for the M553 SPHERE CATCHER 2.				IIIb	M553 SPHERE CATCHER 2 is used to collect the spheres formed from M553 SPHERE FORMING SPECIMEN 2 and is identical to M553 SPHERE CATCHER 1. For description, Pf_t, effects of failure, and indications of failure, refer to SEPEM, Appendix E, FBNT 3.5.11.16.
3.5.1.13 Specify the Pf_t for the M553 SPHERE CATCHER INSTALLATION TOOL.				IIIb	The M553 SPHERE CATCHER INSTALLATION TOOL inserts into the top of the sphere catcher and opens the mylar valve in the catcher. The tool handle is used to install and remove the sphere catchers from the vacuum cleaner port inside the work chamber. Refer to SEPEM, Appendix E, FBNT 3.5.11.18.
3.5.1.14 Specify the Pf_t for the M479 WATER SPRAY CONNECTION COVER.				IIIb	The M479 WATER SPRAY CONNECTION COVER is used to cap the end of the water supply line in the work chamber until the water quench system is required for Experiment M-479. Refer to SEPEM, Appendix E, FBNT 3.5.11.12.
3.5.1.15 Specify the Pf_t for the EQUIPMENT STORAGE CONTAINER.				IIIb	The EQUIPMENT STORAGE CONTAINER, or accessories container, contains the specimens for the sphere forming experiment as well as corollary equipment for conducting the experiment, it also provides temporary stowage for the diagonal cutters used to cut off the specimens retained on the wheel. Refer to SEPEM, Appendix E, FBNT 3.5.11.
3.5.1.16 Controls and Displays				N/A	Controls and displays are used in performing Experiment M-552. Refer to FBNT's 3.5.1.16.1 and 3.5 1.16.2.
3.5.1 16.1 Control Panel.				N/A	All the electrical controls and displays used in performing Experiment M-553 are located on the control panel with the exception of the MAIN BATTERY cb (CB1). Refer to FBNT's 3.5.1.16.1.1 through 3.5.1.16.1.18.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 10 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.1 Specify the P_{ft} for the POWER CONTROL BATT cb (CB2).		0 1			The POWER CONTROL BATT cb (CB2) is a 5 A push-pull type cb. The CB2 cb receives power from the battery through the MAIN BATTERY cb (CB1). When closed, power is available to the ELECTRON BEAM POWER sw (S3).
				IIIb	If the CB2 cb should fail in the closed position, there would be no effect on Experiment M-553
				IIIa	If the CB2 cb should fail in the open position, the following conditions would occur: • Support --A loss of the electron beam resulting in termination of the experiment. The following indications can be used to determine the failure of the CB2 cb: • Failed closed --No indication • Failed open --There would be no electrical functions for Experiment M-553. Failure of other electrical components would give this same indication A malfunction analysis could be performed by the astronaut to verify this failure. References 8 and 9.
3.5.1.16.1.2 Specify the P_{ft} for the POWER FIL BATT cb (CB3).		0 1			The POWER FIL BATT cb (CB3) is a 7.5 A push-pull type cb. The CB3 cb receives battery power through the MAIN BATTERY cb (CB1). When closed, power is available to the FIL/BEAM CONT sw (S12).
				IIIb	If the CB3 cb should fail in the closed position, there would be no effect on Experiment M-553.
				IIIa	If the CB3 cb should fail in the open position, the following condition would occur: • Support --A loss of the electron beam resulting in termination of the experiment. The following indications can be used to determine the failure of the CB3 cb:

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 11 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.2 (Concluded)					• Failed closed --No indication. • Failed open --There would be no low voltage EBG filament glow when the FIL/BEAM sw (S12) was placed in the ON position. Failure of other electrical components would give this same indication. A malfunction analysis by the astronaut would not verify this failure. References 8 and 9.
3.5.1.16.1.3 Specify the Pf_t for the FIL BEAM CONT sw (S12).		0 1			The FIL/BEAM CONT sw (S12) activates the filament by applying a low voltage to heat the filament before the high voltage is applied. It is used as a double-pole, single-throw sw with two positions OFF and ON The S2 sw is in the ON position when operating the EBG It receives power from the battery through the POWER FIL BATT cb (CB3). When the S12 sw is in the ON position, low voltage is applied to the EBG filament.
				IIIb	If pole 1-2-3 of the S12 sw should fail in the ON position, the following conditions would occur • Operability --There would be no effect on the experiment. The ELECTRON BEAM POWER sw (S3 or the POWER FIL BATT cb (CB3) could be used to remove the low voltage from the EBG filament. Note that if the S3 sw is used, battery power could not be used for the instrumentation. A malfunction operating procedure will have to be used by the astronaut to perform the experiment.
				IIIa	If pole 1-2-3 of the S12 sw fails in the OFF position, the following condition would occur: • Support --Voltage cannot be applied to the EBG filament and the experiment will be terminated.
				IIIb	If pole 4-5-6 of the S12 sw should fail in the ON position, there would be no effect on the experiment.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 12 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.3 (Concluded)				IIIa	If pole 4-5-6 of the S12 sw should fail in the OFF position, the following condition would occur • Support --High voltage could not be applied to the EBG filament and the experiment would be terminated. The following indications can be used to determine the failure of the S12 sw: • Pole 1-2-3 failed in ON --The EBG filament will continue to glow after the S12 sw is placed in the OFF position. A malfunction analysis performed by the astronaut would verify this problem. • Pole 1-2-3 failed in OFF --No filament glow when the S12 sw was placed in the ON position. Failure of other electrical components would give this same indication. A malfunction analysis performed by the astronaut would not verify this failure. • Pole 4-5-6 failed in ON --The READY lt (L4) continues to illuminate after the S12 sw is placed in the OFF position. A malfunction analysis performed by the astronaut would verify this failure. • Pole 4-5-6 failed in OFF --READY lt (L4) does not illuminate when the HI VOLT/CAM sw (S14) is placed in the READY/RESET position --Low voltage can be applied to the EBG filament but there is no high voltage electron beam or DAC operation when the HI VOLT/CAM sw (S14) is placed in the ON position Failure of other electrical components would give these same indications. A malfunction analysis performed by the astronaut would not verify this failure. References 8 and 9.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 13 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.4 Specify the P_{f_t} for the ELECTRON BEAM POWER sw (S3).		0.1			The ELECTRON BEAM POWER sw (S3) turns the EBG subsystem circuitry off and on. It is a double pole, double-throw sw with two positions: OFF and ON. The S3 sw receives power from the battery through the POWER CONTROL BATT cb (CB2) When placed in the ON position, power is applied to the 30 V max. - 26 V min. regulator.
				IIIb	If pole 1-2-3 or pole 3-4-5 of the S3 sw should fail in the ON position, there would be no effect on the experiment.
				IIIa	If pole 1-2-3 or pole 3-4-5 of the S3 sw should fail in the OFF position, the following conditions would occur· • Support --Voltage could not be applied to the EBG filament and the experiment would be terminated The following indications can be used to determine the failure of the S3 sw· • Pole 1-2-3 or Pole 4-5-6 failed in ON --No indication. • Pole 1-2-3 or Pole 4-5-6 failed in OFF --The FIL CHMBR PRESS gage (M4) would not operate when the ELECTRON BEAM POWER sw (S3) was placed in the ON position. --The INSTRUMENTATION TEMP gage (M4) would not operate when the INSTRUMENTATION POWER sw (S2) is placed in the BATT position. --There would be no EBG filament glow when the FIL/BEAM CONT sw (S12) was placed in the ON position. Failure of other electrical components would give these same indications. A malfunction analysis could be performed by the astronaut to verify these failures. References 8 and 9.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 14 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.5 Specify the P_{f_t} for the INSTRUMENTATION POWER sw (S2).		0.1			The INSTRUMENTATION POWER sw (S2) is used to turn the instrumentation panel off and on by selecting the desired power source--either the battery or AM BUS 1. It is a double-pole, double-throw sw with three positions: BATT, OFF, and AM BUS 1. The S2 sw is in the BATT position when monitoring the work chamber or the EBG canister pressure. It receives battery power through the 30 V max. - 26 V min. regulator. When the S2 sw is in the BATT position, power is applied to the Power Supply Module.
				IIIb	If pole 1-2-3 or pole 4-5-6 of the S2 sw should fail in the BATT position, there would be no effect on the experiment.
				IIIb	If pole 1-2-3 or pole 4-5-6 of the S2 sw should fail in the OFF position, the following conditions would occur: • Communications and Data --The INSTRUMENTATION PRESS gage (M5) could not be used to measure the work chamber or the EBG canister pressure. --Loss of battery power to the DAC (Refer to Operability listed below). • Operability --The astronaut will have to wait a prescribed length of time before opening the hatch when repressurizing the work chamber. --If the DAC is to be used for this experiment, the astronaut will have to obtain a power cable to operate the DAC using AM Bus 1 power. The DAC will have to be manually cut off and on by the astronaut. • Support --This interface is mentioned here because a decision will have to be made on whether or not to continue the experiment. If the EBG canister pressure is below 24 psia, a reading of 8 psia on the INSTRUMENTATION PRESS gage (M5), there is a possibility of electrical arcing in the canister when the EBG is activated. This pressure cannot be measured without the use of the M5 gage. The following indications can be used to determine the failure of the S2 sw:

TABLE H-1. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 15 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.5 (Concluded)					• Pole 1-2-3 or pole 3-4-5 failed in BATT --No indication • Pole 1-2-3 or pole 3-4-5 failed in OFF --The DAC will not operate with the S2 in the BATT position. --The INSTRUMENTATION TEMP gage (M4) does not operate when the S2 sw is placed in the BATT position. --The INSTRUMENTATION PRESS gage (M5) does not operate when the INSTRUMENTATION CSTR X3 sw (S1) is placed in the CSTR X3 or WORK CHMBR position. Failure of other electrical components will give these same indications. A malfunction analysis performed by the astronaut would not verify this failure. References 8 and 9.
3.5.1.16.1.6 Specify the P_{f_t} for the FLOOD LT (S19) sw.		0.1			The FLOOD LT sw (S19) selects the power source for the floodlight and also cuts the floodlight off. It is a double-pole, double-throw switch with three positions AM BUS 1, OFF, and BATT. The S19 sw is placed in the BATT position for this experiment. It receives battery power from the POWER CONTROL BATT cb (CB2). When the S19 sw is placed in the BATT position, power is available to the floodlight. The floodlight will be used to assist in filming the experiment. If pole 1-2-3 or pole 4-5-6 of the S19 sw should fail in the OFF position, the following conditions would occur. • Communications and Data --The floodlight would not illuminate and the film data would be degraded. If pole 1-2-3 or pole 4-5-6 of the S19 sw should fail in the BATT position, there would be no effect on the experiment. The following indications can be used to determine the failure of the S19 sw. • Pole 1-2-3 or pole 4-5-6 failed in OFF --The floodlight would not illuminate when the S19 sw was placed in the BATT position Failure of other electrical components would give this same indication A malfunction analysis performed by the astronaut would not verify this failure.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 16 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5 1.16.1.6 (Concluded)					• Pole 1-2-3 or pole 4-5-6 failed in BATT --No indication. References 8 and 9.
3.5.1.16.1.7 Specify the P_{f_t} for the EXP ADV sw (S16)		0.1			The EXP ADV sw (S16) controls the rotation of the sphere forming motor. It is a single-pole, double-throw sw with three positions: AUTO, OFF, and MAN/RESET. The S16 sw is held in the MAN/RESET position for a minimum of 2 sec and then placed in the AUTO position. This causes the sphere forming specimen to step to the next position and stop. The motor will not advance more than one step in the AUTO position. The S16 sw must be reset for 2 sec for each succeeding step of the motor. It receives battery power through the Filament Chamber Interlock sw (S27). When the S16 sw is placed in the MAN/RESET position, 28 V are applied to the motor. When placed in the AUTO position, 10 V are applied to the motor. If the S16 sw should fail in the MAN/RESET or OFF position, the following condition would occur • Support --The specimens could not be rotated to the proper position to allow the electron beam to impinge on the specimens. The experiment would be terminated. If the S16 sw should fail in the AUTO position, the following condition would occur· • Communications and Data --The last specimen melted by the electron beam will be the last specimen to be melted in the experiment. The specimens cannot be rotated to the next position to allow another specimen to be melted. The experiment will be terminated. The following indications can be used to determine the failure of the S16 sw· • Failed in MAN/RESET --The sample wheel began to rotate when the S16 sw was placed in the MAN/RESET position for 2 sec and would not rotate further when placed in the AUTO position. Note· It was assumed that the S16 sw failed after it was placed in the MAN/RESET position. Failure of

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 17 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.7 (Concluded)					other electrical components would give this same indication. A malfunction analysis could be performed by the astronaut to verify this failure. • Failed in OFF --The sample wheel would not rotate when the S16 sw was placed in the MAN/RESET or AUTO position. A malfunction analysis could be performed by the astronaut to verify this failure. • Failed in AUTO --The sample wheel rotated to the proper position when placed in the AUTO position but would not rotate when placed back in the MAN/RESET position. Note: It was assumed that the S16 sw failed after it was placed in the AUTO position. Failure of other electrical components would give this same indication. A malfunction analysis could be performed by the astronaut to verify this failure. References 8 and 9.
3.5.1 16.1.8 Specify the Pf_t for the HI VOLT/CAM sw (S14).		0 1			The HI VOLT/CAM sw (S14) is used to apply high voltage to the electron beam subsystem and to turn on the camera. It is a three position sw: ON, middle position is neutral and unlabeled, and READY/RESET. The ON and READY/RESET positions are momentary positions. When the sw is momentarily placed in the READY/RESET position, the READY lt (L4) illuminates. When momentarily put in the ON position, high voltage is applied to the EBG subsystem and the camera begins filming the process in the work chamber. When the S14 sw is again placed in the READY/RESET position, high voltage is removed from the EBG subsystem and the camera stops. Note that if the READY lt (L4) is illuminating, the S14 sw does not have to be placed in the READY/RESET position before being placed in the ON position. The S14 sw receives battery power through pole 4-5-6 of the FIL BEAM CONT sw (S12).
				IIIa	If pole 1-2-3 of the S14 sw should fail in the neutral position or pole 4-5-6 of the S14 sw should fail in the neutral position when the READY lt (L4) was not illuminating, the following condition would occur • Support --The high voltage EBG subsystem could not be activated and the experiment would be terminated.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 18 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5 1.16.1.8 (Continued)				IIIb	If pole 4-5-6 of the S14 sw should fail in the neutral position with the READY lt (L4) illuminating, the following conditions would occur: • Communications and Data --The high voltage EBG subsystem could not be activated again once it was turned off Assuming this failure occurred with the first specimen wheel in the work chamber, the second specimen wheel could not be run. • Operability --The electron beam and camera could not be cut off using the S14 sw. The astronaut could cut the electron beam and camera off by performing one of the following -ELECTRON BEAM POWER sw (S3) - OFF -FIL/BEAM CONT sw (S12) - OFF -POWER CONTROL BATT cb (CB2) - open -POWER FIL BATT cb (CB3) - open -MAIN BATTERY cb (CB1) - open
				IIIb	If pole 4-5-6 of sw S14 should fail in the READY/RESET position, the following conditions would occur • Support --The high voltage EBG subsystem could not be activated and the experiment would be terminated.
				IIIb	If pole 1-2-3 of the S14 sw should fail in the ON position, the following conditions would occur • Communications and Data --After power was removed from the S14 sw, the high voltage EBG subsystem could not be activated again. Following normal operating procedures, power would either be removed from the S14 sw when a floating specimen was melted and released from the wheel or when the FIL/BEAM CONT sw (S12) was placed in the OFF position after a specimen wheel had been completed. • Operability --For fixed specimens

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 19 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.8 (Continued)					-The astronaut would have to hold the S14 sw in the READY/RESET position to cut off the electron beam and camera while advancing the specimen wheel to the next specimen. When the S14 sw is released, the electron beam and camera will operate. The following indications can be used to determine the failure of the S14 sw· • Pole 1-2-3 failed in the neutral position --There would be no electron beam or camera operation and the READY lt (L4) would continue to illuminate when the S14 sw was placed in the ON position. • Pole 4-5-6 failed in the neutral position when the READY lt (L4) was not illuminating --The READY lt (L4) would not illuminate when the S14 sw was placed in the READY/RESET position. --There would be no electron beam or camera operation when the S14 sw was placed in the ON position Failure of other electrical components would give these same indications. A malfunction analysis performed by the astronaut would not verify this failure. • Pole 4-5-6 failed in neutral position with the READY lt (L4) illuminating --The electron beam and camera would not cut off and the READY lt (L4) would not illuminate when the S14 sw was placed in the READY/RESET position. • Pole 4-5-6 failed in READY/RESET --The electron beam and camera would not operate and the READY lt (L4) would not go out when the S14 sw was placed in the ON position. • Pole 1-2-3 failed in ON --For fixed specimens -After the S14 sw has been placed in the READY/RESET position to cut off the electron beam and camera, the electron beam and camera will come back on and the READY lt (L4) will go out when the S14 sw is released from the READY/RESET position.

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Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.8 (Concluded)					--For floating specimens -The electron beam and camera will operate and the READY lt (L4) will go out after the S14 sw is placed in the READY/RESET position and then released. References 8 and 9.
3.5.1.16.1.9 Specify the P_{f_t} for the INSTRUMENTATION CSTR X3 sw (S1).		0 1			The INSTRUMENTATION CSTR X3 sw (S1) turns the INSTRUMENTATION PRESS gage (M5) off or selects the work chamber or EBG canister pressure for display on the M5 gage. It is a single-pole, double-throw sw with three positions· CSTR X3, OFF, and WORK CHMBR. The S1 sw is placed in the WORK CHMBR position to monitor the work chamber pressure and in the CSTR X3 position to monitor the EBG canister pressure on the M5 gage. It receives battery power through either the chamber or canister pressure transducer. With the S1 sw in either the WORK CHMBR or CSTR X3 position, battery power is applied to the M5 gage.
				IIIb	If the S1 sw should fail in the CSTR X3 position, the following conditions would occur: • Communications and Data --The INSTRUMENTATION PRESS gage (M5) could not be used to monitor the work chamber pressure. • Operability --The astronaut would have to wait an appropriate length of time before opening the FILAMENT CHAMBER VENT vlv to monitor the work chamber pressure on the FIL CHMBR PRESS gage (M3).
				IIIb	If the S1 sw should fail in the OFF position, the following conditions would occur • Communications and Data --The INSTRUMENTATION PRESS gage (M5) could not be used to monitor the work chamber pressure. --The EBG canister pressure could not be measured. • Operability --The astronaut would have to wait an appropriate length of time before opening the FILAMENT CHAMBER VENT vlv to monitor the work chamber pressure on the FIL CHMBR PRESS gage (M3).

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 21 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.9 (Continued)					• Support --This interface is listed here in case the experiment is terminated. A decision would have to be made concerning whether or not to activate the EBG without measuring the canister pressure. The EBG canister pressure is supposed to be 24 psia (8 psia on the M5 gage), or above, before firing the EBG. This pressure cannot be measured if the S1 sw will not make contact in the CSTR X3 position.
				IIIb	If the S1 sw should fail in the WORK CHMBR position, the following conditions would occur • Communications and Data --The EBG canister pressure cannot be measured. • Support --This interface is listed here in case the experiment is terminated. A decision would have to be made concerning whether or not to activate the EBG without measuring the canister pressure. The EBG canister pressure is supposed to be 24 psia (8 psia on the M5 gage) or above before firing the EBG. This pressure cannot be measured if the S1 sw will not make contact in the CSTR X3 position. The following indications can be used to determine the failure of the S1 sw· • Failed in CSTR X3 --The INSTRUMENTATION PRESS gage (M5) will display the canister pressure with the S1 sw in any one of three positions CSTR X3, OFF, or WORK CHMBR. --The INSTRUMENTATION PRESS gage (M5) will display the canister pressure when the INSTRUMENTATION POWER sw (S2) is placed in the BATT position with the S1 sw in any one of three positions CSTR X3, OFF, or WORK CHMBR. • Failed in OFF --The INSTRUMENTATION PRESS gage (M5) would not operate Failure of other electrical components would give this same indication. A malfunction analysis by the astronaut would not verify this failure.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 22 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3 5.1.16.1.9 (Concluded)					• Failed in WORK CHMBR --The INSTRUMENTATION PRESS gage (M5) will display the work chamber pressure with the S1 sw in any one of three positions CSTR X3, OFF, or WORK CHMBR. --The INSTRUMENTATION PRESS gage (M5) will display the work chamber pressure when the INSTRUMENTATION POWER sw (S2) was placed in the BATT position with the S1 sw in any one of three positions CSTR X3, OFF, or WORK CHMBR. References 8 and 9
3.5.1.16.1.10 Specify the P_{f_t} for the BEAM CONTROL CUR ADJ pot.		0.1			The BEAM CONTROL CUR ADJ pot (R32) is used to adjust the current applied to the electron beam subsystem. It has a maximum resistance of 2000 Ω. According to the checklist, the R32 pot will be set at 0.6 on the pot scale before the EBG is activated
				IIIb	If the R32 pot should fail with the BEAM CUR gage (M2) displaying an electron beam current of >40 mA and <100 mA, there will be no effect on the experiment
				IIIa	If the R32 pot should fail with the BEAM CUR gage (M2) displaying an electron beam current <40 mA and ≥100mA, the following conditions would occur: • Support --Terminate the experiment. The following indications can be used to determine the failure of the R32 pot • Failed with the BEAM CUR gage (M2) displaying an electron beam current of 50 mA. --No indication. The M2 gage should be displaying an electron beam current of 50 mA, there would be no need to adjust the R32 pot. • Failed with the BEAM CUR gage (M2) displaying an electron beam current <50 or >50 mA. --The electron beam current reading being displayed on the M2 gage would not increase or decrease with a cw or ccw rotation of the R32 pot. References 5, 8, 9, and 10.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 23 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.11 Specify the Pf_t for the BEAM CONTROL FOCUS ADJ pot (R31)		0.1			The BEAM CONTROL FOCUS ADJ pot (R31) is used to focus the electron beam on the specimens. It has a maximum resistance of 2000Ω. According to the checklist, the R31 pot will be set at 1.17 on the pot scale before the EBG is activated.
				IIIb	If the R31 pot should fail with the electron beam properly focused, there would be no effect on the experiment.
				IIIa or IIIb	If the R31 pot should fail with the electron beam not properly focused, the following conditions could occur: • Support --The experiment would be terminated if the electron beam would not melt the specimens. • Communications and Data --It might take a longer than normal time to melt the specimens. This would use more battery power than would be required to perform M-553. A decision would have to be made concerning whether or not to melt all of the specimens for M-553 or to melt part of the specimens and conserve battery power to enable the performance of M-552. The following indications can be used to determine the failure of the R31 pot • Failed with electron beam focused: --No indication. If the electron beam is properly focused, there would be no need to adjust the R31 pot. • Failed with electron beam not properly focused --The electron beam will not focus or defocus with the cw or ccw rotation of the R31 pot. References 5, 8, 9, and 10.
3.5.1.16.1 12 Specify the Pf_t for the BEAM CONTROL ALIGN X pot (R58).		0.1			The BEAM CONTROL ALIGN X pot (R58) aligns the beam in the X direction of a conventional X-Y coordinate system when looking at the front of the specimen wheel. It has a maximum resistance of 1000Ω. According to the checklist, the R58 pot will be set at 1.5 on the pot scale before the EBG is activated.

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Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.12 (Concluded)				IIIb	If the R58 pot should fail with the electron beam properly aligned in the X direction, there will be no effect on the experiment.
				IIIa	If the R58 pot should fail with the electron beam not properly aligned in the X direction, the following conditions could occur: • Support --If the electron beam was misaligned enough for the electron beam to completely miss the specimen, the experiment could be terminated. • Operability --The astronaut could perform one or both of the following to try and melt the specimen· -Defocus the electron beam to allow the beam to impinge upon and melt the specimen -A small rotation of the specimen wheel and a readjustment of the BEAM CONTROL ALIGN Y pot (R57) may enable the electron beam to impinge upon and melt the specimen. The following indications can be used to determine the failure of the R58 pot: • Failed with electron beam properly aligned in the X direction: --No indication. If the electron beam is properly aligned in the X direction, there would be no need to adjust the R58 pot. • Failed with electron beam not properly aligned in the X direction: --The electron beam will not move in the X direction with the cw or ccw rotation of the R58 pot. References 5, 8, 9, and 10.
3.5.1.16.1.13 Specify the Pf_t for the BEAM CONTROL ALIGN Y pot (R57).		0.1			The BEAM CONTROL ALIGN Y pot (R57) aligns the beam in the Y direction of a conventional X-Y coordinate system when looking at the front of the specimen wheel. It has a maximum resistance of 1000 Ω. According to the checklist, the R57 pot will be set at 2.39 on the pot scale before the EBG is activated.
				IIIb	If the R57 pot should fail with the electron beam properly aligned in the Y direction, there will be no effect on the experiment. If the R57 pot should fail with the electron beam not properly aligned in the Y direction, the following conditions could occur

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 25 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.13 (Concluded)					• Support --If the electron beam was misaligned enough for the electron beam to completely miss the specimen, the experiment could be terminated. • Operability --The astronaut could try and melt the specimen by performing one or both of the following -Defocus the electron beam to allow the beam to impinge upon and melt the specimen. -A small rotation of the specimen wheel and a readjustment of the BEAM CONTROL ALIGN X pot (R58) may enable the electron beam to impinge upon and melt the specimen. The following indications can be used to determine the failure of the R57 pot. • Failed with electron beam properly aligned in the Y direction. --No indication. If the electron beam is properly aligned in the Y direction, there would be no need to adjust the R57 pot. • Failed with electron beam not properly aligned in the Y direction: --The electron beam will not move in the Y direction with the cw or ccw rotation of the R57 pot. References 5, 8, 9, and 10.
3 5.1.16.1.14 Specify the P_{f_t} for the INSTRUMENTATION PRESS gage (M5).		0.1		IIIa	The INSTRUMENTATION PRESS gage (M5) displays the pressure (psia) in either the work chamber or EBG canister. The gross work chamber pressure can be monitored when the chamber is being pressurized (5 psia) or depressurized (0 psia). The EBG canister pressure can be verified if > 24 psia. The M5 gage receives power from the battery through the INSTRUMENTATION CSTR X3 sw (S1). If the M5 gage should fail, the following conditions would occur. • Support --The EBG canister pressure could not be verified. The EBG canister pressure should be ≥ 24 psia before the EBG is fired. This pressure could not be verified and the experiment could be terminated.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 26 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.14 (Concluded)					• Sequence --If a decision were made to continue the experiment, even though the EBG canister pressure could not be verified, the astronaut could not monitor the gross work chamber pressure. He would have to wait an appropriate length of time before opening the FILAMENT CHAMBER VENT valve and monitoring the work chamber pressure on the FIL CHMBR PRESS gage (M3). The following indications can be used to determine the failure of the M5 gage • Open Circuit --The M5 gage would not measure the work chamber or EBG canister pressure when the INSTRUMENTATION CSTR X3 sw (S1) was placed in the WORK CHMBR or CSTR X3 position. Failure of either electrical components would give these same indications. A malfunction analysis by the astronaut would not verify this problem. References 5, 8, and 9.
3.5.1.16.1.15 Specify the Pf_t for the FIL CHMBR PRESS gage (M3)		0.1		IIIa	The FIL CHMBR PRESS gage (M3) displays the pressure (torr) within the filament chamber of the EBG subsystem when the work chamber has been vented to space and the filament chamber vent vlv is open. The M3 gage receives battery power through the vacuum module when the ELECTRON BEAM POWER sw (S3) is placed in the ON position. If the M3 gage should fail, the following conditions could occur: • Support --The EBG is not supposed to be fired until the pressure in the work chamber is 1×10^{-4} torr. This pressure cannot be verified if the M3 gage has failed, the experiment could be terminated. • Sequence --If the experiment is to be continued, the astronaut will have to wait an appropriate length of time for the work chamber pressure to decrease to 1×10^{-4} torr. • Communications and Data --The low pressure in the work chamber could not be verified.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 27 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.15 (Concluded)					The following indication can be used to determine the failure of the M3 gage· • Open circuit --The M3 gage does not operate when the ELECTRON BEAM POWER sw (S3) is placed in the ON position. Failure of other electrical components could give this same indication. A malfunction analysis performed by the astronaut would not verify this failure. References 5, 8, and 9.
3.5.1.16.1.16 Specify the Pf_t for the READY lt (L4).		0.1		IIIb	The READY lt (L4) indicates that high voltage can be safely applied to the system. The L4 lt has two bulbs connected in parallel. When relay K7 is activated, battery power is applied to the L4 lt through pole 4-5-6 of the FIL/BEAM CONT sw (S12). If one bulb of the L4 lt burns out, there will be no effect on the experiment. The other bulb will continue to burn. If the L4 lt shorts to ground, the following condition would occur • Support --Shorting the L4 lt to ground would prevent relay K7 from being energized and prevent high voltage activation of the EBG. The experiment would be terminated. The following indications can be used to determine the failure of the L4 lt: • One bulb out --The L4 lt will still illuminate but not as bright as normal. • Shorts to ground --The L4 lt does not illuminate when the HI VOLT/CAM sw (S14) is placed in the READY/RESET position. --The electron beam and camera will not operate when the HI VOLT/CAM sw (S14) is placed in the ON position Failure of other electrical components would give these same indications. A malfunction analysis performed by the astronaut will not verify this failure. References 8, 9, and 10.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 28 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.1.17 Specify the P_{f_t} for the BEAM CUR gage (M2).		0.1			The BEAM CUR gage (M2) displays the electron beam current. It receives battery power from the filament current regulator The electron beam current should be approximately 50 mA for the experiment.
				IIIb	If the M2 gage should fail, the following conditions would occur· • Communications and Data --The electron beam current cannot be measured during the experiment. • Operability --The astronaut will have to observe the electron beam and determine if the optimum beam is impinging on the specimen.
					The following indication can be used to determine the failure of the M2 gage: • Open circuit --The M2 gage will not indicate a beam current while the electron beam is operating.
					References 5, 8, 9, and 11.
3.5.1.16 1 18 Specify the P_{f_t} for the ELECTRON BEAM voltage gage (M1).		0.1			The electron beam voltage gage (M1) measures the voltage from the high voltage rectifier. The high voltage receifier transfers power to the EBG filament. The M1 gage should display a reading of approximately 4 (20 kV) during the operation of the electron beam.
				IIIb	If the M1 gage should fail, the following condition could occur· • Communications and Data --These voltage data will be lost.
					The following indication can be used to determine the failure of the M1 gage: • Open circuit -- The M1 gage will not indicate a reading during the operation of the EBG.
					References 5, 8, 9, and 11.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 29 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.2.1 Specify the Pf_t for the MAIN BATTERY cb (CB1).		0.1			The MAIN BATTERY cb (CB1) is a 100 A push-pull type cb. It is located on the battery control panel above the battery case. The CB1 cb receives battery power from the battery. When it is in the closed position, battery power is available to POWER CONTROL BATT cb (CB2), POWER FIL BATT cb (CB3), and relay K3 contact A1-A2.
				IIIa	If the CB1 cb should fail open, the following condition would occur: • Support --The EBG could not be operated to melt the specimens. The experiment would be terminated.
				IIIb	If the CB1 cb should fail closed, there would be no effect on the experiment. The following indication can be used to determine the failure of the CB1 cb. • Failed open --The FIL CHMBR PRESS gage (M3) would not operate when the ELECTRON BEAM POWER sw (S3) was placed in the ON position. --The INSTRUMENTATION PRESS gage (M5) would not operate when the INSTRUMENTATION CSTR X3 sw (S1) was placed in either the CSTR X3 or WORK CHMBR position. --The INSTRUMENTATION TEMP gage (M4) would not operate when the INSTRUMENTATION POWER sw (S2) was placed in the BATT position. --The EBG filament would not glow when the FIL/BEAM CONT sw (S12) was placed in the ON position. Failure of other electrical components would give these same indications. A malfunction analysis performed by the astronaut would verify this failure. • Failed closed --No indication. References 8 and 9.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 30 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.2.2 Specify the P_{f_t} for the filament chamber interlock sw (S27).		0.1			The filament chamber interlock sw (S27) is a microswitch that is opened and closed with the operation of the FILAMENT CHAMBER VENT vlv When the vlv is closed, the sw is open, and when the vlv is open, the sw is closed. The S27 sw receives battery power through the 30 V max. - 26 V min. regulator when the ELECTRON BEAM POWER sw (S3) is placed in the ON position. When the S27 sw is closed, battery power is available to the EXP ADV sw (S16) and pole 4-5-6 of the FIL/BEAM CONT sw (S12). The S27 sw is in the closed position during the operation of the EBG.
				IIIb	If the S27 sw should fail open, the following condition would occur • Operability --The astronaut could place the FIL CHMBR INTLK sw (S13) in the OVERRIDE position to bypass the S27 sw and continue with the experiment
				IIIb	If the S27 sw should fail closed, there would be no effect on the experiment. The following indication could be used to determine the failure of the S27 sw: • Failed open --The READY lt (L4) would not illuminate when the HI VOLT/CAM sw (S14) was placed in the READY/RESET position. --Neither the electron beam nor the camera would operate when the HI VOLT/CAM sw (S14) was placed in the ON position. Failure of other electrical components would give these same indications. A malfunction analysis performed by the astronaut would verify this failure. • Failed closed --No indication. References 8 and 9.
3.5.1.16.2.3 Specify the P_{f_t} for the HI PWR ACC OUTLETS 1 cb.		0.1			The HI PWR ACC OUTLET 1 cb is a 12 A cb. It is located in the Structural Transition Section (STS) on panel 202. The cb is closed to provide AM BUS 1 power to the HI PWR ACCESS OUTLET 1 in the MDA on panel 115. For this experiment, this cb is only used for the operation of the vacuum cleaner.
				IIIb	If the cb should fail open, the following condition would occur·

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 31 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.2.3 (Concluded)					• Operability --The astronaut would do one of the following: -Collect the floating spheres by hand -Connect the vacuum cleaner power cable to HI PWR ACCESS OUTLET 2 and continue the vacuum cleaner operation. Outlet 2 is located in the MDA on panel 139.
				IIIb	If the cb should fail closed, there would be no effect on the experiment. The following indications can be used to determine the failure of the cb • Failed open --The vacuum cleaner will not operate. Failure of other electrical components would give this same indication. A malfunction analysis analysis performed by the astronaut would not verify this problem. • Failed closed --No indication. References 5 and 12.
3.5.1.16.2.4 Specify the Pf_t for the HI PWR ACCESS OUTLETS 1 sw.		0.1			The HI PWR ACCESS OUTLETS 1 sw is a two position sw OFF and ON. The sw is located in the MDA on panel 115. The sw is placed in the ON position to provide power to the vacuum cleaner cb. For this experiment, the sw is only used for the operation of the vacuum cleaner.
				IIIb	If the sw should fail in the OFF position, the following condition would occur: • Operability --The astronaut would do one of the following: -Collect the floating spheres by hand -Connect the vacuum cleaner power cable to HI PWR ACCESS OUTLET 2 and continue the vacuum cleaner operation Outlet 2 is located in the MDA on panel 139
				IIIb	If the sw should fail in the ON position, there would be no effect on the experiment. The following indications can be used to determine the failure of the sw:

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 32 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.1.16.2.4 (Concluded)					• Failed OFF --The vacuum cleaner will not operate. Failure of other electrical components would give this same indication. A malfunction analysis by the astronaut would not verify this failure. • Failed ON --No indication. References 5 and 12.
3.5.1.17 Specify the Pf_t for the floodlight.				IIIb	The floodlight is mounted on the vacuum chamber next to the camera port, and will be used to provide the lighting for the photography during the experiment The light will operate on 28 Vdc. This lighting assembly will be enclosed with a protective heat shield. Refer to SEPEM, Appendix E, FBNT 3.5.4.
3.5.1.18 Specify the Pf_t for the M553 SPHERE FORMING MOTOR.				IIIa	The purpose of the M553 SPHERE FORMING MOTOR is to rotate the specimen disc and place the specimen in the proper position to interface with the electron beam when the EBG is activated. Refer to SEPEM, Appendix E, FBNT 3.5.11.2.
3.5.2 Experiment M-553					Refer to FBNT 3.5.2.1.
3.5.2.1 Specify the Pf_t for the Sphere Forming Disc Assembly.		0.1			There are two sphere forming disc assemblies in the EQUIPMENT STORAGE CONTAINER (M136). Each disc assembly contains 14 specimens to be melted and 1 target specimen used for aligning the electron beam. Four specimens on the holder will be permanently supported on 0.04-in.-diam rods of the same materials as the specimens. (The target sample will not be melted.) These sample specimens will be melted and remain in place on their supports while they solidify. When these specimens are processed, the crewman operating the experiment will manually cut off the electron beam when he observes that complete melting has occurred. The other 11 specimens on the holder will be mounted on supports that are designed to release them as soon as they melt so that they can float freely while they solidfy When the specimen melts, the release mechanism accomplishes the following

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 33 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3 5.2.1 (Continued)					• Sets up an oscillation in the molten spheroid that causes the spheroid to separate from the sample holder. • As the spheroid separates from the sample holder, switch contacts in the sample holder are opened and relays K3 and K8 in the M-512 Facility are deactivated This deactivation causes high voltage not be be applied to the EBG and cuts the camera off. Each specimen has a ground connection for the electron beam current. The specimens (for one specimen wheel) are made of: • Target --w (One specimen) • Retained Specimens --N_1 (One specimen) --N_1 + 12 percent Sn (One specimen) --N_1 + 1 percent Ag (One specimen) • Released specimens --N_1 (Three specimens) --N_1 + 12 percent Sn (Three specimens) --N_1 + 1 percent Ag (Three specimens) --N_1 + 30 percent Cu (Two specimens) For the spheriods that separate when the switch contacts in the sample holder fail open, the following condition would occur • Communications and Data --The specimen of the failed open switch contacts could not be melted. For the spheroids that separate when the switch contacts in the sample holder fail closed, the following condition would occur • Operability --The astronaut would have to manually cut off the EBG and camera. *The following indication can be used to determine the failure of the switch contacts in the sample holder (only for specimens that separate)*

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 34 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3. 5. 2. 1 (Concluded)					• Failed open --The READY lt (L4) would not illuminate when the HI VOLT/CAM sw (S14) was placed in the READY/RESET position. --The electron beam and camera would not operate when the HI VOLT/ CAM sw (S14) was placed in the ON position. Failure of other electrical components would give these same indications. A malfunction analysis performed by the astronaut would verify this failure • Failed closed --The electron beam and camera would not automatically cut off when the specimen melted and separated. The experiment would be continued and this failure would be verified. References 3, 8, 9, and 13.
3 5. 3. 1 Specify the P_{f_t} and the P_{f_n} for the vacuum cleaner.		0. 1			The vacuum cleaner is used to assist in the collecting of the floating spheres. The vacuum cleaner uses a gravity substitute airflow (suction) to pull the floating spheres into the sphere catcher mounted in the work chamber. The vacuum cleaner is stowed for ready accessibility in the Orbital Workshop (OWS) forward compartment, locker F522, together with its attachments, hose, and caddy. A beta fabric caddy completely encloses the blower unit and provides pouch-type stowage and convenient access of vacuum cleaner accessories. A waist tether stows around the caddy when not in use A short strap provides caddy stowage of the 15 ft hi-power accessories cable when the cable is not in use. The short strap is also used to secure the cable to convenient structure to restrain the cable when it is deployed for use. A 4 ft long flexible hose is supplied that connects to the vacuum cleaner inlet fitting The hose together with the vacuum cleaner and 15 ft power cable provides a radius of operation of approximately 20 ft. The blower unit is controlled by a blower unit integral POWER SWITCH located on the carrying handle The blower unit integral POWER SWITCH has two positions· MOM ON and ON. These are used for extended or short term usage. A vacuum cleaner CIRCUIT BREAKER is provided on the side of the caddy. The inlet adapter of the vacuum cleaner is completely removable to allow the blower unit to be interchanged with other blower units The vacuum cleaner blower unit is

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 35 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3. 5. 3. 1 (Continued)					identical to the fecal/urine collector blower unit and to the suit dryer blower unit and may be interchanged with each other in the event of failure. A spare blower unit is stowed in a spare parts stowage compartment in the OWS forward dome.
		P_{f_n}=0.04			If the vacuum cleaner POWER SWITCH should fail, in either the MOMON or ON position, the following condition would occur· • Operability --The astronaut would have to place the HI PWR ACCESS OUTLET 1 sw in the OFF position to turn off the vacuum cleaner. Note that the vacuum cleaner CIRCUIT BREAKER could be used to turn off the vacuum cleaner, but this would be using a cb as a switch and may not be acceptable.
		P_{f_n}=0.04			If the vacuum cleaner POWER SWITCH should fail in the OFF position, the following condition would occur: • Operability --The astronaut would have to collect the floating spheres by hand.
		P_{f_n}=0.02			If the vacuum cleaner blower unit should fail, the following condition would occur. • Operability --The astronaut would do one of the following -Collect the floating spheres by hand -Replace the blower unit with a spare blower unit and continue the vacuum cleaner operation. The following indications can be used to determine the failure of the vacuum cleaner: • POWER SWITCH failed in either MOMON or ON --The vacuum cleaner would not cut off when the POWER SWITCH was placed in the OFF position. A malfunction analysis performed by the astronaut would verify this failure • POWER SWITCH failed in OFF --The vacuum cleaner would not operate when the POWER SWITCH was placed in the MOM ON or ON position Failure of other electrical components would give this same indication. A malfunction analysis performed by the astronaut would not verify this failure

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 36 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.3.1 (Concluded)					• Blower unit failed --The vacuum cleaner would not operate when the POWER SWITCH was placed in the MOM ON or ON position. Failure of other electrical components would give this same indication. A malfunction analysis performed by the astronaut would verify this problem. References 5 and 12.
3.5.3.2 Photographic Equipment				N/A	The photographic equipment will be used to record the operation of the experiment. Refer to FBNT's 3.5.3.2.1 through 3.5.3.2.6.
3.5.3.2.1 Specify the Pf_t for the 16mm Data Acquisition Camera.		0.1			The DAC will be used to record the operation of the sphere forming task. It will be operated using power from the M-512 battery. The DAC will be remotely controlled from the M-512 MPF control panel. The DAC settings will be: • f 5.6 • Focus 30 ft • Shutter speed 1/500 • Frame rate 24. The DAC will be placed in detent No. 2 on the camera mount. If the DAC should fail, the following condition would occur: • Communications and Data --If the experiment was performed without the DAC, the film data would be lost.
				IIIb	The following indication can be used to determine the failure of the DAC. • DAC will not operate --When the HI VOLT/CAM sw (S14) was placed in the ON position, failure of other electrical components would give this same indication. A malfunction analysis performed by the astronaut would verify this problem. References 5, 8, and 9

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 37 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3 5.3.2.2 Specify the Pf_t for the 75mm lens with extender.		0.1			The 75mm lens with extender is used in conjunction with the DAC to provide photographic coverage of the experiment. If a structural failure occurred (cracking or breaking of the mirror) the following condition would occur • Communications and Data --The filming of the experiment could be degraded. The following indications can be used to determine the failure of the lens· • Cracked or broken lens --This failure can be detected by the astronaut's inspecting the lens and extender. References 4 and 5.
3.5.3.2 3 Specify the Pf_t for the right angle mirror		0.1		IIIb	The right angle mirror connects to the DAC assembly and is used to reflect the DAC's line of sight into the camera port on the work chamber. If a structural failure occurred (cracking or breaking of the mirror) the following condition would occur • Communications and Data --The filming of the experiment could be degraded. The following indications can be used to determine the failure of the mirror· • Mirror cracked or broken --This failure can be detected by the astronaut's inspecting the lens and References 4 and 5
3.5.3.2.4 Specify the Pf_t for the film transport assembly		0.1			The film transport assembly connects to the DAC assembly and is used to transfer the film from one cassette to another while filming the experiment. If a structural failure occurred, causing the gears to bind or not mesh, the following condition would occur·

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 38 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.3.2.4 (Concluded)					• Communications and Data --The film data would be lost. The following indications can be used to determine the failure of the transport assembly • Binding or mismeshing gears --The DAC would not operate when the HI VOLT/CAM sw (S14) was placed in the ON position. Failure of other electrical components would give this same indication. The astronaut may be able to determine this failure by inspecting the DAC and transport assembly. References 4 and 5.
3.5.3.2.5 Specify the Pf_t for the film cassettes.		0.1		IIIb	In filming the experiment, the film is unwound from one cassette and wound onto another cassette. If the filming cassettes were to bind, preventing the unwinding and winding of the film, the following condition would occur· • Communications and Data --The film data would be lost. The following indication could be used to determine the failure of the film cassettes: • Binding film cassettes --The DAC would not operate when the HI VOLT/CAM sw (S14) was placed in the ON position. Failure of other electrical components would give this same indication. A malfunction analysis performed by the astronaut would not verify this failure. Reference 4.
3.5.3.2.6 Specify the Pf_t and the Pf_n for the film.		0.1 Pf_n=0.05			The film used in filming the experiment is color film, ESTAR EF-Daylite (7241) SO 168. If the film should break, the following condition would occur • Communications and Data --The film data for the experiment would be lost.

TABLE H-I. EXPERIMENT M-553, SPHERE FORMING PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS (Sheet 39 of 39)

Functional Block Number and Title	Expected Range and Dimension of Variables			Criticality Category Number	Remarks
	min	nom	max		
3.5.3.2.6 (Concluded)		P_{fr}=0.05			If the film is exposed to an excess amount of radiation, the following condition would occur: • Communications and Data --The film data for the experiment would be degraded. The following indications can be used to determine the failure of the film: • Film breakage --The film will build up in the cassette and could jam the DAC. This failure would be difficult for the astronaut to determine. • Film radiation --No indication observed by the astronaut. Reference 4.
3.5.3.3 Specify the Pf_t for the diagonal cutters.		nil			After the sphere forming task is completed, the diagonal cutters are used to cut off the three specimens retained on the wheel. The 4-in. diagonal cutters are in a tool kit located in the experiment area of the OWS in locker E623. Temporary stowage for the cutters is provided in the EQUIPMENT STORAGE CONTAINER. If the diagonal cutters should fail, the following condition would occur: • Communications and Data --The fixed specimens could not cut off the specimen wheel. The following indication can be used to determine the failure of the diagonal cutters: • Cutters fail to cut off fixed specimens --This failure would be noted by astronaut observation. References 8 and 14.

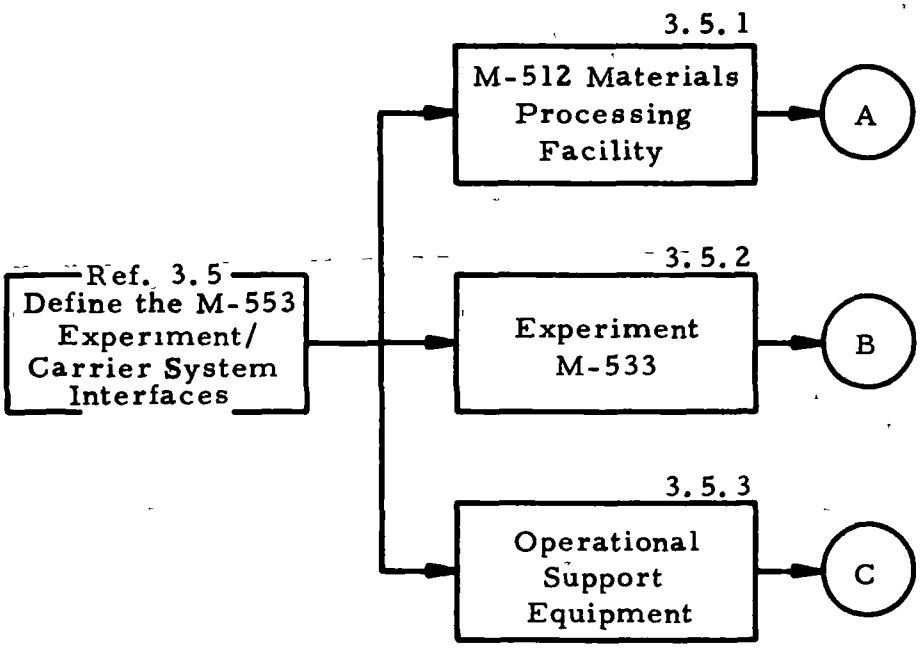

FIGURE H-1. EXPERIMENT M-553, SPHERE FORMING FUNCTIONAL BLOCK DIAGRAM (Sheet 1 of 6)

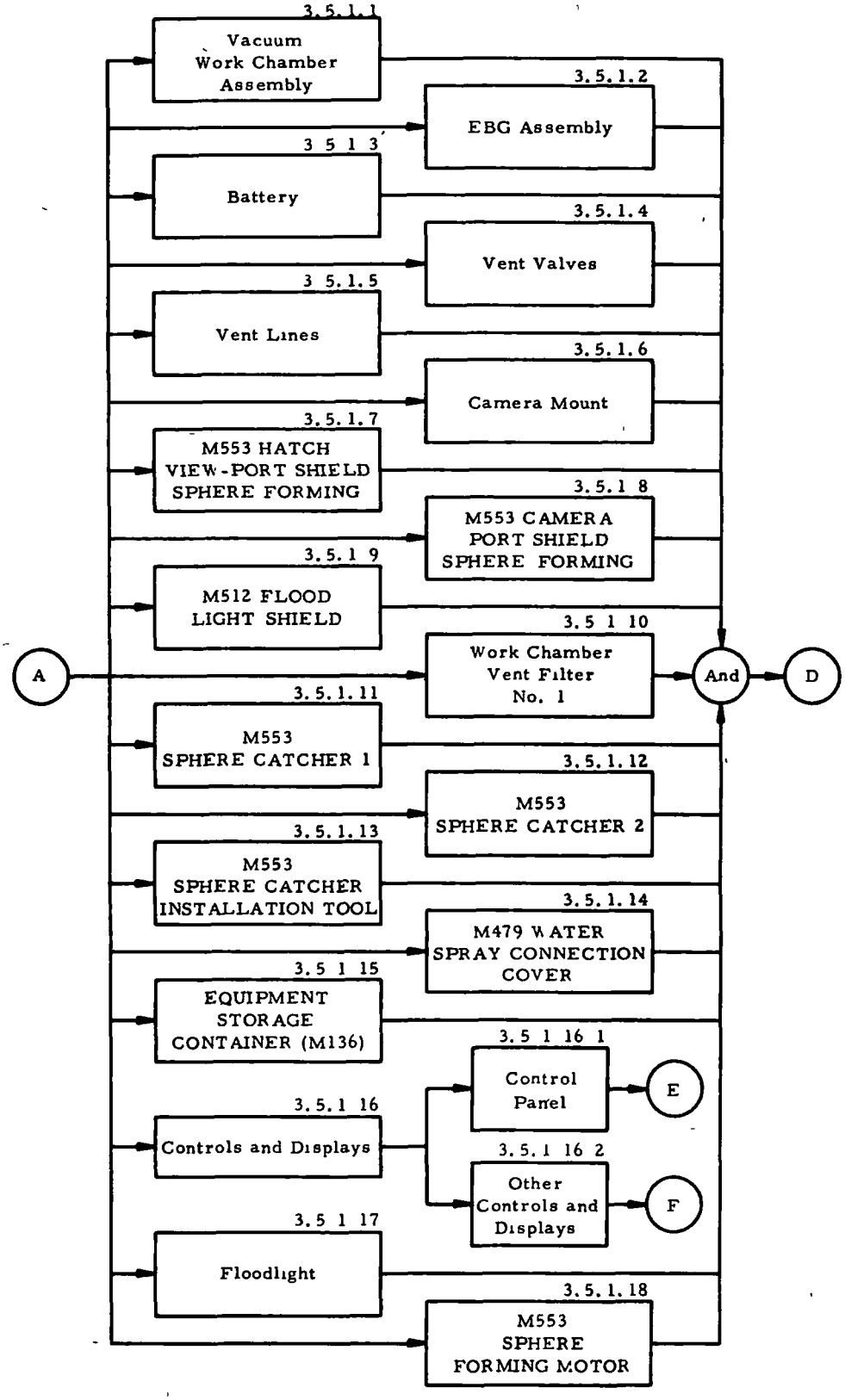

FIGURE H-1. EXPERIMENT M-553, SPHERE FORMING FUNCTIONAL BLOCK DIAGRAM (Sheet 2 of 6)

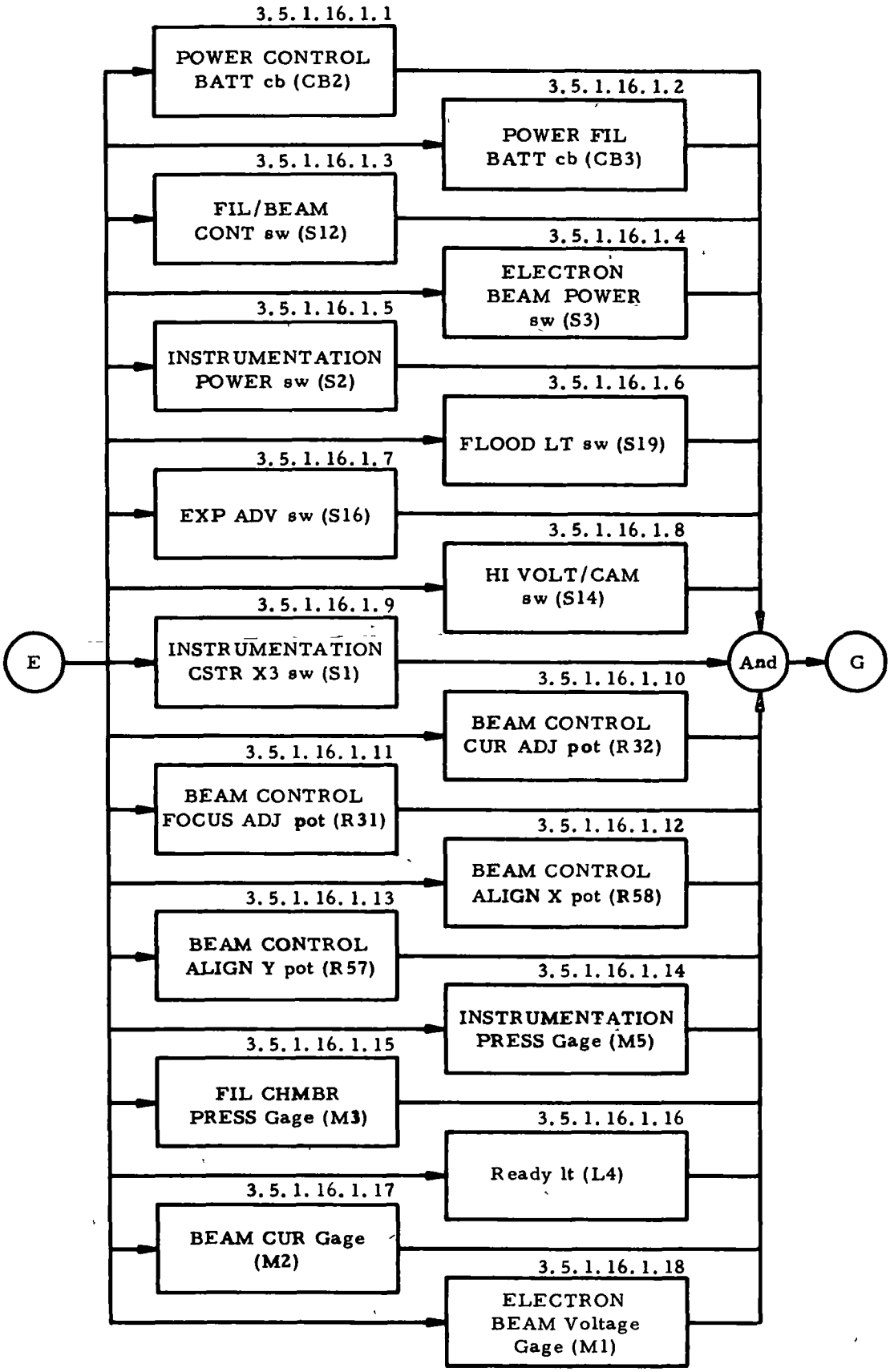

FIGURE H-1. EXPERIMENT M-553, SPHERE FORMING FUNCTIONAL BLOCK DIAGRAM (Sheet 3 of 6)

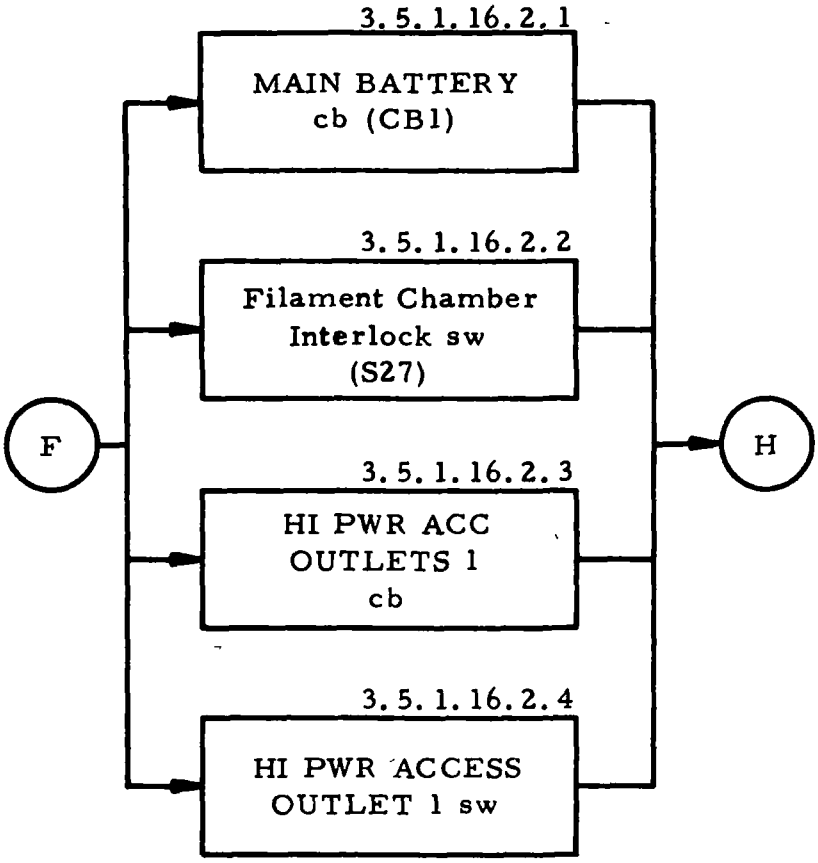

FIGURE H-1. EXPERIMENT M-553, SPHERE FORMING FUNCTIONAL BLOCK DIAGRAM (Sheet 4 of 6)

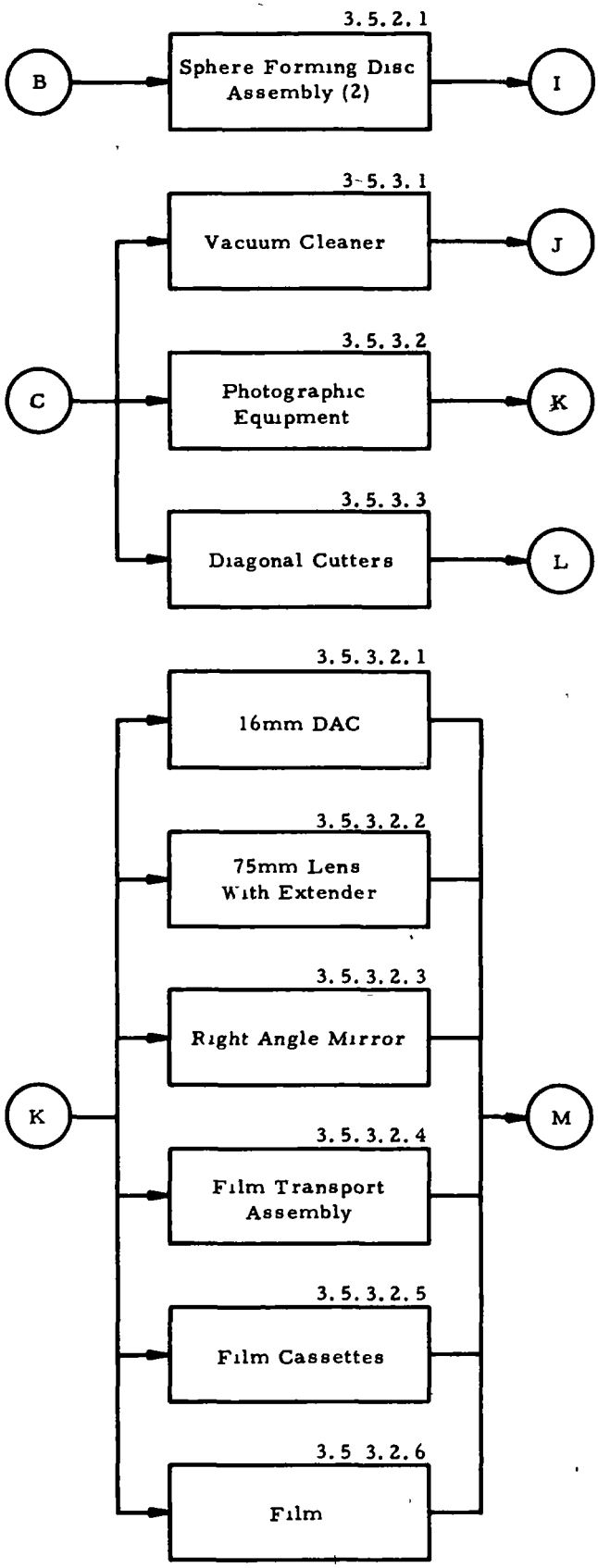

FIGURE H-1. EXPERIMENT M-553, SPHERE FORMING FUNCTIONAL BLOCK DIAGRAM (Sheet 5 of 6)

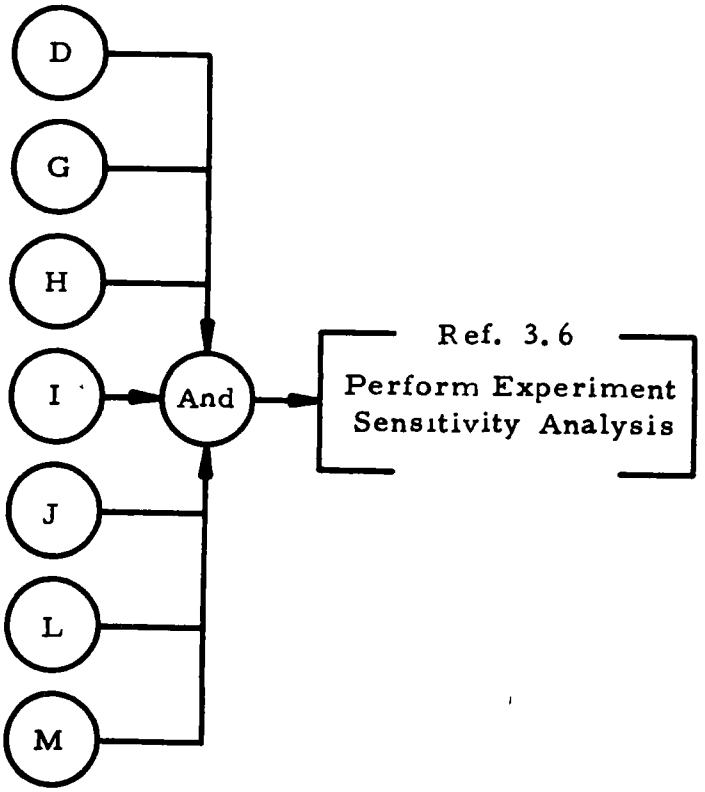

TABLE H-1. EXPERIMENT M-553, SPHERE FORMING FUNCTIONAL BLOCK DIAGRAM (Sheet 6 of 6)

SECTION II.

EXPERIMENT M-553, SPHERE FORMING INTERFACE BLOCK DIAGRAM

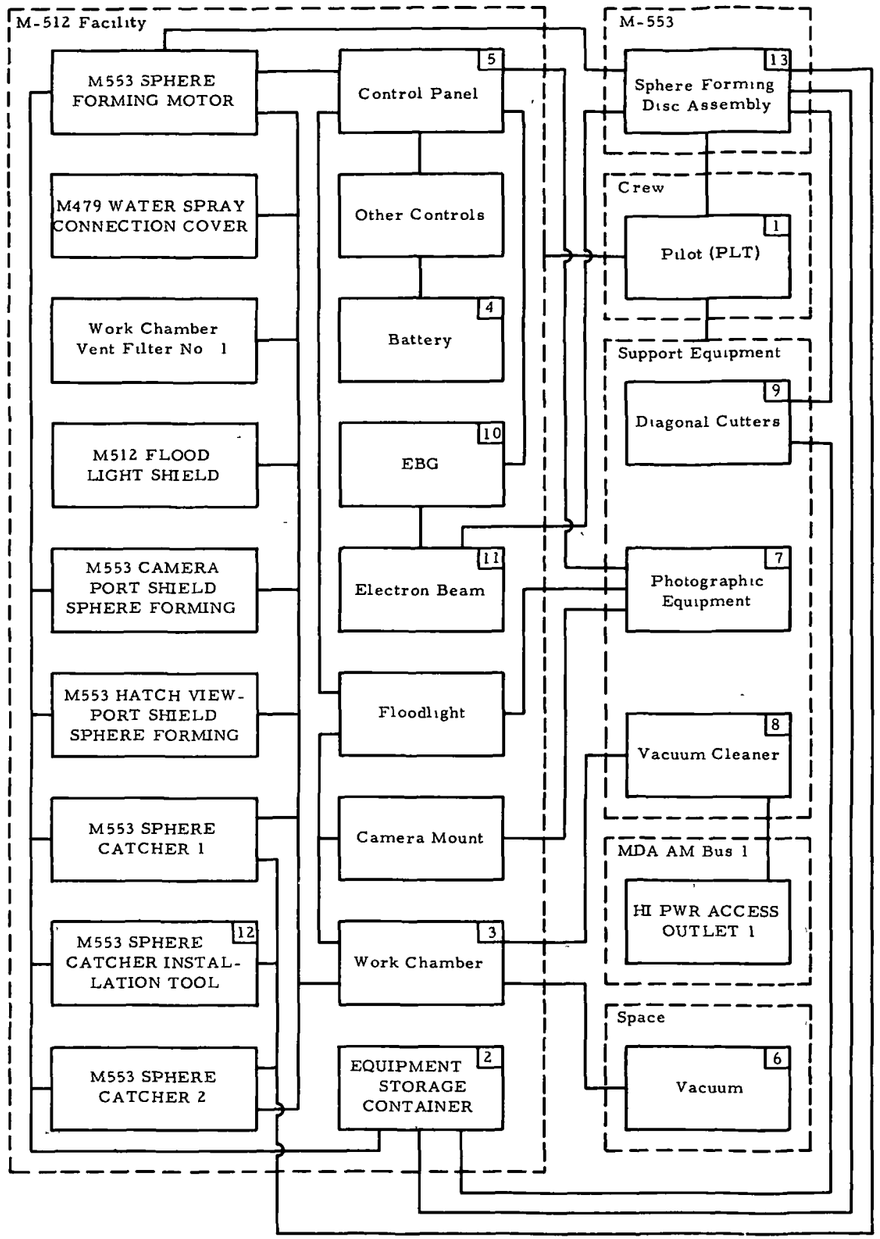

FIGURE H-2. EXPERIMENT M-553, SPHERE FORMING INTERFACE BLOCK DIAGRAM AND DEFINITION (Sheet 1 of 2)

Code	Data Source	Remarks
1	Crew	There is a crew interface between the PLT and each of the following • M-512 Facility • Sphere Forming Disc Assembly • Support Equipment The CDR mounts the DAC assembly onto the camera mount and mounts the following equipment in the work chamber • M553 SPHERE CATCHER 1 with M553 SPHERE CATCHER INSTALLATION TOOL (For first specimen wheel) (installed in vacuum cleaner port recess) • M553 SPHERE CATCHER 2 with M553 SPHERE CATCHER INSTALLATION TOOL (For second specimen wheel) (installed in vacuum cleaner port recess) • M553 CAMERA PORT SHIELD SPHERE FORMING (installed over the camera port) • M553 HATCH VIEW-PORT SHIELD SPHERE FORMING (installed over the hatch view-port) • M553 SPHERE FORMING MOTOR with M553 SPHERE FORMING SPECIMEN 1 or 2 mounted onto the motor (mounted over the work chamber heat sink) Note that the following equipment is already mounted in the work chamber • M479 WATER SPRAY CONNECTION COVER (mounted over the water line) • Work Chamber Vent Filter No 1 (mounted in the 4-in vent line) • M512 FLOOD LIGHT SHIELD (mounted over the floodlight) During the performance of the experiment, the CDR operates the control panel and other controls that supply control functions for the operation of the experiment After the performance of the experiment, the CDR uses the vacuum cleaner to collect floating spheres and the diagonal cutters to cut fixed specimens off the specimen wheel
2	Crew	There is a mechanical interface between the EQUIPMENT STORAGE CONTAINER and each of the following • M553 SPHERE CATCHER 1 • M553 SPHERE CATCHER 2 • M553 SPHERE CATCHER INSTALLATION TOOL • M553 CAMERA PORT SHIELD SPHERE FORMING • M553 HATCH VIEW-PORT SHIELD SPHERE FORMING • M553 SPHERE FORMING MOTOR • M553 SPHERE FORMING SPECIMEN 1 • M553 SPHERE FORMING SPECIMEN 2 • Diagonal Cutters This equipment is stowed in the EQUIPMENT STORAGE CONTAINER There is a place provided for the temporary storage of the diagonal cutters
3	Crew	There is a mechanical interface between the work chamber and each of the following • M479 WATER SPRAY CONNECTION COVER • Work Chamber Vent Filter No 1 • M512 FLOOD LIGHT SHIELD • M553 SPHERE CATCHER 1 (For first specimen wheel) • M553 SPHERE CATCHER 2 (For second specimen wheel) • M553 CAMERA PORT SHIELD SPHERE FORMING • M553 HATCH VIEW-PORT SHIELD SPHERE FORMING • M553 SPHERE FORMING MOTOR • Vacuum Cleaner (connected to the vacuum cleaner port external to the work chamber) • Floodlight (connected external to the work chamber) • Camera Mount (connected external to the work chamber)
4	Crew	There is an electrical interface between the battery and the MAIN BATTERY cb (CB1) Other controls are • MAIN BATTERY cb (CB1) (when closed, battery power is available to the control panel) • Filament Chamber Interlock sw (S27) [when closed, battery power is available to the EXP ADV sw (S16) and the HI VOLT/CAM sw (S14)] • HI PWR ACC OUTLETS 1 cb (when closed, AM BUS 1 power is available to the HI PWR ACCESS OUTLET 1 sw) • HI PWR ACCESS OUTLET 1 sw (when in the ON position, power is available to the vacuum cleaner cb) These controls are not on the control panel The CB1 cb is located on the M-512 Facility on the battery control panel above the battery case The S27 sw is located on the M-512 Facility and is opened and closed with the operation of the FILAMENT CHAMBER VENT vlv The HI PWR ACC OUTLETS 1 cb is located in the STS on panel 202 The HI PWR ACCESS outlet 1 sw is located in the MDA on panel 115
5	Crew	There is an electrical interface between the control panel and the MAIN BATTERY cb (CB1) The CB1 cb transfers power from the battery to the control panel There is an electrical interface between the control panel and the M553 SPHERE FORMING MOTOR The power required to operate the motor is controlled by electrical inputs from the control panel
6	Crew	During experiment operation, there is an environmental interface between the space vacuum and the work chamber Materials mounted in the work chamber are • M479 WATER SPRAY CONNECTION COVER • Work Chamber Vent Filter No 1 • M512 FLOOD LIGHT SHIELD • M553 SPHERE CATCHER 1 • M553 SPHERE CATCHER 2 • M553 CAMERA PORT SHIELD SPHERE FORMING • M553 HATCH VIEW-PORT SHIELD SPHERE FORMING • M553 SPHERE FORMING MOTOR • M553 SPHERE CATCHER INSTALLATION TOOL • M553 SPHERE FORMING SPECIMEN 1 • M553 SPHERE FORMING SPECIMEN 2
7	Crew	There is an electrical interface between the DAC and the control panel The power required to operate the DAC is controlled by electrical inputs from the control panel The photographic equipment used in this experiment is • 16mm DAC • 75mm lens with extender • Right angle mirror • Film transport assembly • Film cassette • Film There is a mechanical interface between the DAC and the camera mount on the work chamber The DAC is installed on the camera mount to film the experiment There is a communications and data interface between the photographic equipment and the floodlight The floodlight will be used to illuminate the interior of the work chamber during the filming of the experiment
8	Crew	There is an electrical interface between the vacuum cleaner and the HI PWR ACCESS OUTLET 1 This outlet is located in the MDA and is furnished AM BUS 1 power The vacuum cleaner is used to assist in collecting the free floating spheres
9	Crew	There is a mechanical interface between the diagonal cutters and M553 SPHERE FORMING SPECIMEN 1 and 2 The cutters are used to cut the fixed specimens off the specimen wheels
10	Crew	There is an electrical interface between the EBG and the control panel The power required to operate the EBG is controlled by electrical inputs from the control panel. There is an electrical interface between the EBG filament and the electron beam Power is applied to the filament and the electron beam is emitted
11	Crew	There is an electrical interface between the electron beam and the specimens on the specimen wheel The electron beam will impinge upon and melt the specimens
12	Crew	There is a mechanical interface between the M553 SPHERE CATCHER INSTALLATION TOOL and M553 SPHERE CATCHER 1 and 2 The tool is used to open the mylar valve in the catchers and as a handle to install and remove the catchers from the vacuum cleaner port inside the work chamber
13	Crew	There is a mechanical interface between the melted specimens and M553 SPHERE CATCHER 1 and 2 The melted specimens are collected in the catchers for stowage and return to earth There is a mechanical interface between the M553 SPHERE FORMING MOTOR and the sphere forming disc assemblies The disc assemblies mount on the motor for proper positioning of the specimens during the experiment

FIGURE H-2. EXPERIMENT M-553, SPHERE FORMING INTERFACE BLOCK DIAGRAM AND DEFINITION (Sheet 2 of 2)

SECTION III.

EXPERIMENT M-553, SPHERE FORMING SYSTEMS DIAGRAM

Note: Taken from Reference 11.

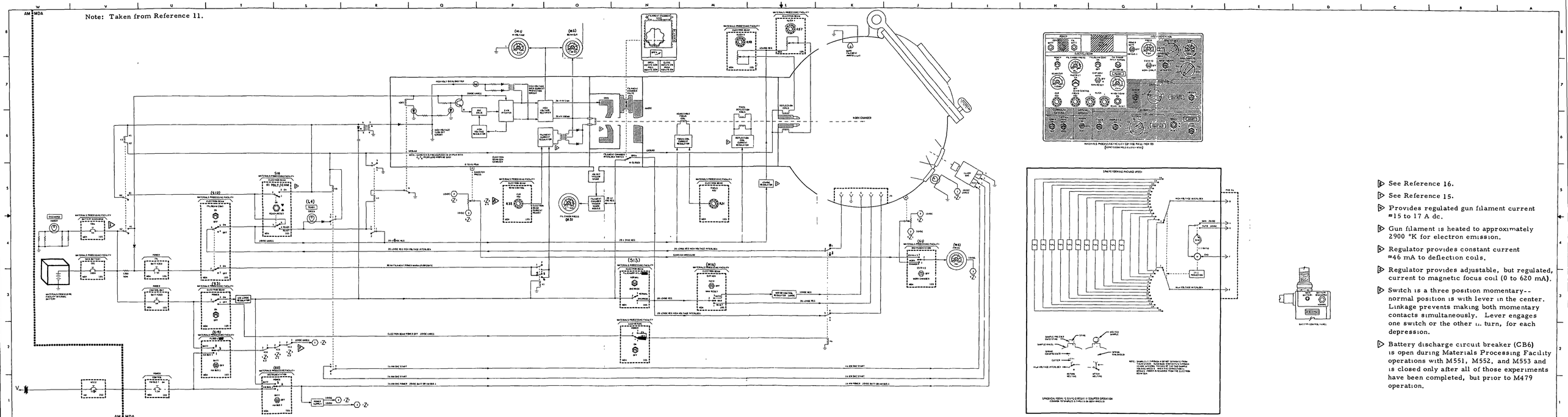

FIGURE H-3. EXPERIMENT M-553, SPHERE FORMING ELECTRICAL SYSTEMS DIAGRAM

See Reference 16.

See Reference 15.

Provides regulated gun filament current =15 to 17 A dc.

Gun filament is heated to approximately 2900 °K for electron emission.

Regulator provides constant current =46 mA to deflection coils.

Regulator provides adjustable, but regulated, current to magnetic focus coil (0 to 620 mA).

Switch is a three position momentary--normal position is with lever in the center. Linkage prevents making both momentary contacts simultaneously. Lever engages one switch or the other on turn, for each depression.

Battery discharge circuit breaker (CB6) is open during Materials Processing Facility operations with M551, M552, and M553 and is closed only after all of those experiments have been completed, but prior to M479 operation.

Note: Taken from Reference 17.

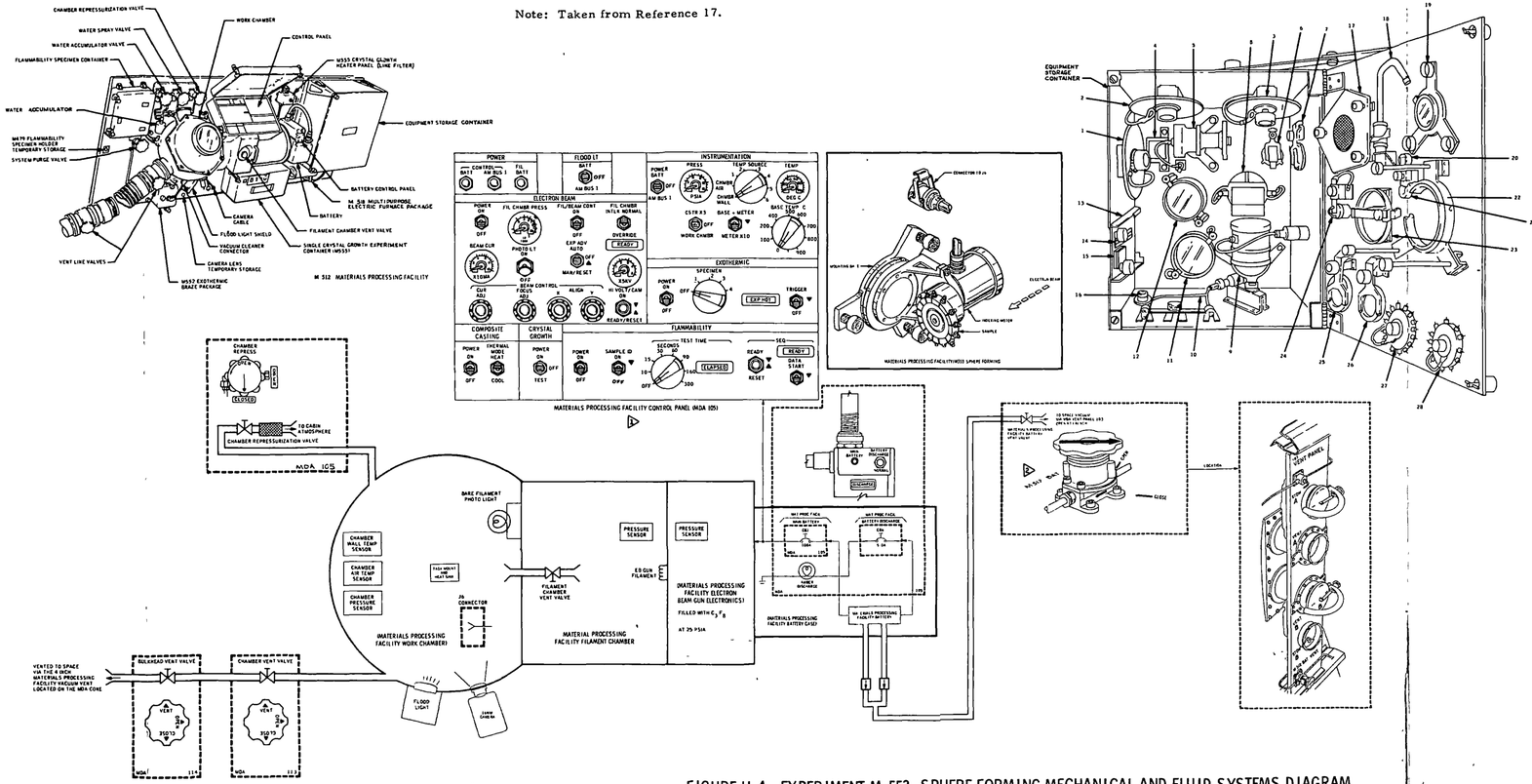

FIGURE H-4. EXPERIMENT M-553, SPHERE FORMING MECHANICAL AND FLUID SYSTEMS DIAGRAM

1 WELD SPECIMEN 1
2 WELD SPECIMEN 2
3 WELD SPECIMEN 3
4 DEFLECTION MIRROR
5 ELECTRON BEAM WELD MOTOR
6 CAMERA MIRROR
*7 FLOOD LIGHT SHIELD
8 HATCH VIEW PORT MIRROR
*9 SPHERE FORMING MOTOR
10 WATER SPRAY NOZZLES
11 HATCH VIEW PORT SHIELD FLAMMABILITY
*12 HATCH VIEW PORT SHIELD SPHERE FORMING
13 BATTERY ACCESS PANEL
14 COMPOSITE CASTING SPECIMEN STORAGE
*15 TOOL STORAGE
*16 WATER SPRAY CONNECTION COVER
17 ELECTRON BEAM COVER
18 FLAMMABILITY SPECIMEN HOLDER
19 HEAT SINK COVER
*20 SPHERE CATCHER 1
*21 SPHERE CATCHER 2
22 CRYSTAL GROWTH OR COMPOSITE CASTING CLAMP
*23 WORK CHAMBER VENT FILTER 1 and 2
*24 SPHERE CATCHER INSTALLATION TOOL
*25 CAMERA PORT SHIELD-SPHERE FORMING
26 CAMERA PORT SHIELD-FLAMMABILITY
*27 SPHERE FORMING SPECIMEN 1
*28 SPHERE FORMING SPECIMEN 2

*Used for Experiment M-553

▷ Until recently, the Materials Processing Facility was called M512, consequently much of its hardware is still labeled M512 The facility is no longer a formal experiment unto itself

▷ All Materials Processing Facility associated switches, circuit breakers, lights, and valves are listed as being common to MDA Panel 105 The exceptions are the 4-in vent valves and the battery vent valve These are MDA hardware

SECTION IV.

EXPERIMENT M-553, SPHERE FORMING DATA REQUIREMENTS SUMMARY

TABLE H-II. EXPERIMENT M-553, SPHERE FORMING DATA REQUIREMENTS SUMMARY

Measurement Name	Range and Dimension of Variables	Measurement No.	Telemetry Assignment Channel	Data Return	Data Time	Remarks
Voice Comments	N/A	N/A	N/A	N/A	Real	Recordings will be made of the astronaut's voice comments during the performance of the experiment.
Crew Log	N/A	N/A	N/A	N/A	All	Pertinent observations will be entered in the experiment logbook.

SECTION V. EXPERIMENT M-553, SPHERE FORMING DATA REQUEST FORMS

These data required for evaluation of Experiment M-553 consist completely of voice comments by the crewman concerning experiment operations, transcripts of voice comments, and the experiment log. General Data Request Forms (DRF's) requesting voice comments and experiment logs for all experiments have been submitted; therefore, a DRF requesting these data specifically for Experiment M-553 is not necessary.

SECTION VI. EXPERIMENT M-553, SPHERE FORMING ENGINEERING CHANGE REQUEST

This Engineering Change Request was written for Experiment M-551, but is also applicable for Experiment M-553. It was submitted on August 19, 1971 and was disapproved for the following reasons:

- No impact from the Product Technology Laboratory
- Not enough justification
- State-of-charge can be calculated based on ground testing.

ENGINEERING CHANGE REQUEST	DATE 8-19-71	NUMBER BGSM 0535	PAGE 1 of 1

TO: J. Waite, PM-SL-DP	THRU:	FROM: L. Vaughan, S&E-ASTN-SDI

TITLE OF CHANGE
Experiment M512 Battery Status-of-Charge Monitoring

RELATED CHANGES (ECR, ECP, CR, etc.) BY NUMBER:

PROGRAM CONTROL NO.: BT-13756.

DESCRIPTION OF CHANGE:

A state-of-charge meter is needed to monitor the M-512 battery. A qualified state-of-charge meter is used on panel 206 in the STS to monitor the PCG batteries. The part number for this meter is 61B810002-97. A similar meter should be mounted on the M-512 control panel or experiment structure.

ENCLOSURES:
- [X] ECR ONLY
- [ ] PIRN
- [ ] SCN
- [ ] DRAWING/SKETCH
- [ ] LEVEL A ICD
- [ ] LEVEL A IRN
- [ ] LEVEL B ICD
- [ ] LEVEL B IRN
- [ ] SLCN

JUSTIFICATION FOR CHANGE:

This change permits the Skylab A Mission Evaluation Working Group and Operations Support Planning Group to monitor and assess the adequacy of operating performance among the power source (M-512 battery) and the metals melting, sphere forming, and exothermic heating tasks.

INITIATED BY
- [ ] PANEL ACTION
- [X] S&E
- [ ] PM
- [ ] PD
- [ ] MSC REQUEST
- [ ] KSC REQUEST
- [ ] OTHER (Explain)

EFFECTS ON: [ ] DOCUMENTATION [X] HARDWARE [ ] SOFTWARE [ ] OPERATIONAL COMPUTER PROGRAMS [ ] OTHERS (Explain)

PROGRAM AFFECTED:
- [ ] SATURN IB
- [ ] SATURN V
- [X] SKYLAB
- [ ] HEAO
- [ ] ENGINES
- [ ] SPACE SHUTTLE
- [ ] SPACE STATION
- [ ] OTHERS (Explain)

PROJECT/STAGE AFFECTED:
- [ ] S-IB STAGE
- [ ] S-IC STAGE
- [ ] S-II STAGE
- [ ] S-IVB STAGE
- [ ] IU
- [ ] LVGSE
- [ ] OWS
- [ ] AIRLOCK
- [ ] MDA
- [ ] ATM
- [ ] PS
- [X] EXPMTS M-512
- [ ] OTHERS (Explain)

AREAS AFFECTED
- [ ] SAFETY
- [ ] AIRBORNE ELEC. SYS.
- [ ] TELEMETRY
- [ ] SINGLE POINT FAILURES
- [ ] FLIGHT TAPES
- [ ] GROUND TAPES
- [ ] RELIABILITY
- [ ] ACS
- [ ] STRESS CORROSION
- [ ] ESE
- [ ] GSE (Stage)
- [ ] MGSE
- [ ] GROUND INSTRUMENT
- [ ] QUAL STATUS
- [ ] PAYLOAD WTS
- [ ] [illegible]
- [ ] PRODUCT IMPROVEMENT
- [ ] IN PROCESS TEST
- [ ] BREADBOARD
- [ ] PROPULSION
- [ ] STRUCTURES
- [ ] TEST SCHEDULES
- [ ] CRITICAL COMPONENTS
- [ ] STOWAGE
- [ ] REDLINES
- [ ] TEST RQMTS., SPECS & CRITERIA DOC
- [ ] VEH. WEIGHTS
- [ ] SPARES
- [ ] SPACECRAFT
- [ ] LAUNCH COMPLEX
- [ ] CFE / SYSTEMS
- [ ] MISSION OPERATIONS

RECOMMENDED EFFECTIVITY
- [ ] MANDATORY FOR ______
- [ ] HIGHLY DESIRABLE FOR ______
- [ ] DESIRABLE FOR SL-1

[illegible] AFFECTED
- [ ] YES (Mrt)
- [ ] NO

PRIORITY (Explain)
- [ ] URGENT
- [ ] EMERGENCY
- [X] ROUTINE
- [ ] COMPATIBILITY

MSFC - Form [illegible]

EFFECT OF NONINCORPORATION

The state-of-charge of the M-512 battery cannot be monitored without this meter.

SCOPE OF WORK- ☐ SEE ATTACHED SKETCH AND/OR DESCRIPTION

ADDITIONAL REMARKS AND DISTRIBUTION

CONCURRENCE

SIGNATURE & ORGANIZATION	DATE	SIGNATURE & ORGANIZATION	DATE	SIGNATURE & ORGANIZATION	DATE

APPROVAL

Date	Date	
LRIP PROJECT OFFICE Date		

SECTION VII.

EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE

TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 1 of 16)

Assignments	Conditions	Requirements
Mission: • SL-1/SL-2 Orbital Assembly (OA): • MDA (M-512 Facility) Carrier: • The experiment hardware is launched in stowage location M136 (EQUIPMENT STORAGE CONTAINER).	Crew • The PLT will perform the experiment. Experiment: • The basic objective of the experiment is to demonstrate the effects of zero-g on fundamental solidification phenomena. Ground Support: N/A	Functional Objectives: • FO-1 and FO-2: Perform sphere forming operations on each of two identical specimen wheels and collect data and samples for return to earth.

Experiment Evaluation Team--Key Personnel Locator

Name	Responsibility	Office Address, Symbol, and Telephone Number
Mr. E. A. Hasemeyer	Principal Investigator (PI)	MSFC, Bldg. 4711, S&E-PE-MWM, 205-453-5088
Mr. A. D. Little	Experiment Developer (ED)	Research Institute, Cambridge, Massachusetts, 617-864-5770
Mr. E. O. Walker	MSFC Experiment Manager (EM)	MSFC, Bldg. 4201, PM-SL-DP, 205-453-3183
Mr. E. A. Hasemeyer	S&E Experiment Engineer (EE)	MSFC, Bldg. 4711, S&E-PE-MWM, 205-453-5088
Mr. W. R. Bock	Technical Discipline Manager (TDM)	MSFC, Bldg. 4610, S&E-ASTN-SDF, 205-453-3810
Mr. O. H. Thomas, Jr.	Experiment Operations Engineer (EOE)	Teledyne Brown Engineering Company, Huntsville, Alabama, ASD-SHI, 205-532-1612
Mr. R. L. Seymour	Mission Operations Design Support (MODS)	Martin Marietta Corporation, Denver, Colorado, 303-794-5211, ext. 3111
Mr. S. Buzzard	Experiment Integration Engineer (EIE)	Martin Marietta Corporation, Denver, Colorado, 303-794-5211, ext. 5451
Mr. C. Gruby	Experiment Flight Controller (EFC)	MSC, Houston, Texas, 713-483-4717

TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 2 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
P-60 GMT-TBD	PLT	Experiment Evaluation Team manned and available Contact M-553, Technical Discipline Manager, S&E-ASTN-SDF Huntsville Operation Support Center (HOSC), Telephone No 205-453-2200, Ext 311, Astronautics Labortory Telephone No 453-3810				This Test Procedure was written for the first specimen wheel Use the same procedure when performing the second specimen wheel
		Reference Refer to References 5 and 9				
P 1 0		Experiment Preparation				
P 1 1		Don triangle shoes, install M-512 foot restraint				
P 1 2		Set up Speaker Intercom (S/I) to record voice data				
P 1 3		M-512 cb - close (verify)				M512 cb and HI PWR ACC OUTLETS 1 cb are located on Panel 202 in the STS and are powered from AM BUS 1
P 1 4		HI PWR ACC OUTLETS 1 cb - close (verify)				
P 1 5		HI PWR ACCESS OUTLET 1 sw - OFF (verify)				HI PWR ACCESS OUTLET 1 sw is located in the MDA on Panel 115
P 1 6		Open control panel cover				
P 1 7		Obtain and attach checklist and logbook to clipboard and secure to control panel cover				
P 1 8		Obtain the following equipment from OWS storage lockers or last usage location				
		• 16mm DAC				Stowage location VTS

*P - Preparation
O - Operations
T - Termination
L - Lift-off (Booster)

**TP - Test Pilot (Commander)
OBS - Observer (Science Pilot)
PLT - Pilot
ALL - TP/OBS/PLT

MSFC - One Time Form 17-1 (March 1972)

TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 3 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
		• 75mm lens with extender				Stowage location F527
		• Right angle mirror for 75mm lens				Stowage location F527
		• Film XPT per PHOTO PAD				Stowage location F510
		• Vacuum cleaner				Stowage location E604
		• Vacuum cleaner power cable				Stowage location W750
		• Diagonal cutters				Stowage location E623
P 1 9		Assemble lens and mirror, and install on DAC and remove connector dust cover				
P 1 10		Install camera on bayonet mount.				
P 1 11		Verify the following				
		Work chamber vent vlv - CLOSE				
		Bulkhead vent vlv - CLOSE				
		FILAMENT CHAMBER VENT vlv - CLOSE				
		CHAMBER REPRESS vlv - CLOSED				
		WATER SYSTEM PURGE vlv - CLOSED				
		WATER ACCUMULATOR FILL vlv - CLOSED				
		WATER SPRAY vlv - CLOSED				
		Work chamber hatch closed and latched				
		M-512 BAT VENT vlv - OPEN				
		MAIN BATTERY cb (CB1) - open				
		Note The Battery DISCHARGE cb (CB6) is left open until Experiment M-552 is completed				
		BATTERY DISCHARGE cb (CB6) - open				
		Note After the M-555 package has been connected to the M-512 MPF under the EBG canister, the CRYSTAL GROWTH HEATING PAD AM BUS 1 cb (CB5) is closed to provide power to the M-555 package prior to Experiment M-555 operation				

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TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 4 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
		CRYSTAL GROWTH HEATING PAD AM BUS 1 cb (CB5) - close				
P 1 12		Verify the following control panel configuration				
		POWER CONTROL BATT cb (CB2) - open				
		POWER CONTROL AM BUS 1 cb (CB4) - open				
		POWER FIL BATT cb (CB3) - open				
		FLOOD LT sw (S19) - OFF				
		INSTRUMENTATION POWER sw (S2) - OFF				
		INSTRUMENTATION TEMP SOURCE sw (S9) - CHMBR WALL				
		ELECTRON BEAM POWER sw (S3) - OFF				
		FIL/BEAM CONT sw (S12) - OFF				
		FIL CHMBR INTLK sw (S13) - NORMAL				
		INSTRUMENTATION CSTR X3 sw (S1) - OFF				
		INSTRUMENTATION BASE + METER sw (S8) - METER X10				
		INSTRUMENTATION BASE TEMP sw (S5) - 0				
		PHOTO LT sw (S4) - OFF				
		EXP ADV sw (S16) - OFF				
		BEAM CONTROL CUR ADJ pot - TBD				
		BEAM CONTROL FOCUS ADJ pot - TBD				
		BEAM CONTROL ALIGN X pot - TBD				
		BEAM CONTROL ALIGN Y pot - TBD				
		HI VOLT/CAM sw (S14) - off (ctr)				
		EXOTHERMIC POWER sw (S15) - OFF				
		EXOTHERMIC SPECIMEN sw (S7) - OFF				
		EXOTHERMIC TRIGGER sw (S6) - OFF				
		COMPOSITE CASTING POWER sw (S25) - OFF				
		COMPOSITE CASTING THERMAL MODE sw (S26) - HEAT				
		CRYSTAL GROWTH POWER sw (S10) - OFF				
		FLAMMABILITY POWER sw (S21) - OFF				
		FLAMMABILITY SAMPLE ID sw (S20) - OFF				
		FLAMMABILITY TEST TIME sw (S22) - OFF				
		FLAMMABILITY SEQ READY sw (S18) - off (ctr)				
		FLAMMABILITY DATA sw (S17) - off (ctr)				

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TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 5 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
P 1 13		Connect power and control cables to camera				
P 1 14		Install XPT on DAC				
P 1 15		Move DAC to No 2 detent				
P 1 16		MAIN BATTERY cb (CB1) - close				
P 1 17		POWER CONTROL BATT cb (CB2) - close				
P 1 18		POWER FIL BATT cb (CB3) - close				
P 1 19		ELECTRON BEAM POWER sw (S3) - ON				
P 1 20		INSTRUMENTATION POWER sw (S2) - BATT				
P 1 21		Set the following • f 5 6 • Focus 30 ft • Shutter speed to 1/500 • Frame rate 24				
P 1 22		Push the DAC operate button and verify that the DAC operates			P122A1	
P 1 23		INSTRUMENTATION CSTR X3 sw (S1) - WORK CHMBR				
P 1 24		Verify that the INSTRUMENTATION PRESS gage (M5) reading is approximately 5 psia			P124A1	
P 1 25		CHAMBER REPRESS vlv - OPEN			P125A1	
P 1 26		Unlatch and open work chamber hatch			P126A1	
P 1 27		CHAMBER REPRESS vlv - CLOSED			P127A1	

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TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 6 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
P 1 28		Remove the dummy connector from the work chamber zero- g connector and place on the FLAMMABILITY SPECIMEN HOLDER TEMPORARY STORAGE connector Note Equipment listed in Operation Step Nos (OSN's) P 1 29 through P 1 33 is stowed in M136 (EQUIPMENT STORAGE CONTAINER)			P128A1	The FLAMMABILITY SPECIMEN HOLDER TEMPORARY STORAGE connector is located under the flammability specimen container
P 1 29		Install M553 SPHERE CATCHER 1 with M553 SPHERE CATCHER INSTALLATION TOOL in work chamber			P129A1 P129B1	
P 1 30		Install M553 CAMERA PORT SHIELD SPHERE FORMING in work chamber			P130A1	
P 1 31		Install M553 HATCH VIEW-PORT SHIELD SPHERE FORMING onto work chamber hatch			P131A1	
P 1 32		Mount M553 SPHERE FORMING MOTOR on M-479 flammability specimen container			P132A1	
P 1 33		Install M553 SPHERE FORMING SPECIMEN 1 on motor Note Inspect specimen wheel for alignment of three permanently attached specimens, visually align, if necessary			P133A1	
P 1 34		Install M553 SPHERE FORMING MOTOR with M553 SPHERE FORMING SPECIMEN 1 in work chamber and connect power cable			P134A1 P134B1 P134C1	
P 1 35		Close and latch work chamber hatch			P135A1	

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TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 7 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
O 1 0	PLT	Experiment operation				
O 1 1		INSTRUMENTATION CSTR X3 sw (S1) - CSTR X3				
O 1 2		Verify a minimum reading of eight on INSTRUMENTATION PRESS gage (M5)			O12A1 O12B1	
		Warning Do not operate the EBG if the INSTRUMENTATION PRESS gage (M5) reading is less than eight (EBG canister pressure less than 24 psia)				
O 1 3		INSTRUMENTATION CSTR X3 sw (S1) - WORK CHMBR				
O 1 4		Verify that the INSTRUMENTATION PRESS gage (M5) reading decreases to 5 psia			O14A1 O14B1	
O 1 5		Bulkhead vent vlv - OPEN			O15A1	
O 1 6		Work chamber vent vlv - OPEN			O16A1	
O 1 7		BEAM CONTROL CUR ADJ pot (R32) - 0 6			O17A1	
O 1 8		BEAM CONTROL FOCUS ADJ pot (R31) - 1 17			O18A1	
O 1 9		BEAM CONTROL ALIGN X pot (R58) - 1 5			O19A1	
O 1 10		BEAM CONTROL ALIGN Y pot (R57) - 2 39			O110A1	
O 1 11		Verify that the INSTRUMENTATION PRESS gage (M5) reading is 0 psia			O111A1	
O 1 12		FILAMENT CHAMBER VENT vlv - OPEN			O112A1	

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TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 8 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
		Caution Pressure must be 1 or below on the FIL CHMBR PRESS gage (M3) before filament power is applied in OSN O 1.13.				If pressure is greater than 1×10^{-4}, get in touch with ground
O 1 13		FIL/BEAM CONT sw (S12) - ON (Start Accutron timer and allow EBG filament to warm up for 2 min)				
O 1.14		Verify EBG filament glow.			O114A1	The glow can be seen on the tungsten shield at the back of the work chamber
O 1 15		Raise hatch filter			O115A1	
O 1 16		HI VOLT/CAM sw (S14) - READY/RESET (mom).				
O 1 17		Verify READY lt (L4) illuminates			O117A1 O117B1	
		Caution Perform OSN O 1 18 only after the FIL/BEAM CONT sw (S12) has been on a minimum of 2 min and READY lt (L4) is illuminating Note Refer to cue card for gun operation.				
O 1 18		HI VOLT/CAM sw (S14) - ON				
O 1 19		Verify DAC is operating.			O119A1 O119B1	
O 1 20		Verify electron beam			O120A1 O120B1	
O 1 21		Observe ELECTRON BEAM voltage gage (M1) is in the green.			O121A1	
O 1 22		Adjust BEAM CONTROL CUR ADJ pot (R32) for a 50 mA reading on the BEAM CUR gage (M2)			O122A1	

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TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 9 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
O 1 23		Adjust BEAM CONTROL FOCUS ADJ pot (R31) for optimum beam.			O123A1	
O 1 24		Adjust BEAM CONTROL ALIGN X pot (R58) and BEAM CONTROL ALIGN Y pot (R57) for alignment of electron beam on outer fourth of target specimen			O124A1 O124B1	
O 1. 25		HI VOLT/CAM sw (S14) - READY/RESET (mom)			O125A1 O125B1	
O 1 26		Verify READY lt (L4) illuminates.			O126A1	
O 1 27		FLOOD LT sw (S19) - BATT			O127A1	
O 1. 28		EXP ADV sw (S16) - MAN/RESET (mom) (Hold for 2 sec).			O128A1 O128B1	
O 1. 29		EXP ADV sw (S16) - AUTO.			O129A1 O129B1	
O 1. 30		Verify specimen disc rotates one specimen.			O130A1	
O 1. 31		EXP ADV sw (S16) - OFF.				
O 1. 32		HI VOLT/CAM sw (S14) - ON.			O132A1 O132B1 O132C1 O132D1	
O 1. 33		Allow beam to strike specimen for 6 sec				
O 1. 34		HI VOLT/CAM sw (S14) - READY/RESET (mom).				
O 1 35		Verify READY lt (L4) illuminates.			O135A1	
O 1. 36		EXP ADV sw (S16) - MAN/RESET (mom) (Hold for 2 sec).			O136A1 O136B1	

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MSFC - One Time Form 17-1 (March 1972)

TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 10 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
O 1.37		EXP ADV sw (S16) - AUTO.			O137A1 O137B1	
O 1 38		Verify specimen disc rotates one specimen			O138A1	
O 1 39		EXP ADV sw (S16) - OFF				
O 1 40		Repeat OSN's O 1.32 through O 1 39 for the two remaining fixed specimens				
O 1 41		HI VOLT/CAM sw (S14) - ON			O141A1 O141B1 O141C1 O141D1	
O 1 42		Observe ELECTRON BEAM voltage gage (M1) is in the green.			O142A1	
		Note The electron beam will automatically cut off when the specimen separates from the specimen wheel.				
O 1 43		Verify that the electron beam cuts off when the specimen separates from the specimen wheel.			O143A1	
		Note The performance of OSN's O 1.44 through O 1.49 are not necessary after melting the last specimen on the second specimen wheel.				
O 1.44		HI VOLT/CAM sw (S14) - READY/RESET (mom).				
O 1.45		Verify READY lt (L4) illuminates.			O145A1	
O 1 46		EXP ADV sw (S16) - MAN/RESET (mom) (Hold for 2 sec)			O146A1 O146B1	
O 1.47		EXP ADV sw (S16) - AUTO.			O147A1 O147B1	
O 1 48		Verify specimen disc rotates one specimen			O148A1	

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TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 11 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
O 1 49		EXP ADV sw (S16) - OFF.				
O 1 50		Repeat OSN's O 1.41 through O 1.50 for the ten remaining specimens Note OSN's O 1.44 and O 1.45 are not necessary after the last specimen on the first specimen wheel has been melted, OSN's O 1.44 through O 1.49 are not necessary after the last specimen on the second specimen wheel has been melted.				

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TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 12 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
T 1 0	PLT	Experiment termination				
T 1.1		FIL/BEAM sw (S12) - OFF.				
T 1 2		Verify that the filament glow is turned off.			T12A1	
T 1.3		FLOOD LT sw (S19) - OFF			T13A1	Leave the floodlight on, if needed.
		Note Do not close the FILAMENT CHAMBER VENT vlv for 5 min after the FIL/BEAM CONT sw (S12) has been placed in the OFF position.				
T 1 4		FILAMENT CHAMBER VENT vlv - CLOSE			T14A1	
T 1.5		Work chamber vent vlv - CLOSE.			T15A1	
T 1.6		Bulkhead vent vlv - CLOSE.			T16A1	
T 1.7		CHAMBER REPRESS vlv - OPEN.			T17A1	
T 1.8		Verify that the INSTRUMENTATION PRESS gage (M5) reading increases to approximately 5 psia.			T18A1	
		Note Do not proceed until the work chamber and the MDA pressure have equalized as indicated by the INSTRUMENTATION PRESS gage (M5)				
T 1.9		INSTRUMENTATION CSTR X3 sw (S1) - OFF			T19A1	
T 1 10		INSTRUMENTATION POWER sw (S2) - OFF.			T10A1	
T 1.11		ELECTRON BEAM POWER sw (S3) - OFF.			T111A1	
T 1 12		POWER FIL BATT cb (CB3) - OPEN.				

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TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 13 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
T 1 13		POWER CONTROL BATT cb (CB2) - open.				
T 1 14		MAIN BATTERY cb (CB1) - open.				
T 1.15		Loosen work chamber hatch fasteners.			T115A1	
T 1.16		Remove the vacuum cleaner port cover and connect vacuum cleaner			T116A1 T116B1	
T 1 17		Connect vacuum cleaner power cable to HI PWR ACCESS OUTLET 1			T117A1	The HI PWR ACCESS OUTLET 1 is located in the MDA on Panel 115.
T 1 18		HI PWR ACCESS OUTLET 1 sw - ON.				
T 1.19		Manually crack hatch.			T119A1	
T 1.20		Vacuum cleaner CIRCUIT BREAKER - close.				
T 1.21		Vacuum cleaner POWER SWITCH - ON.			T121A1	
T 1.22		Observe if there are any loose specimens that have not entered M553 SPHERE CATCHER 1.			T122A1	
T 1.23		Vacuum cleaner POWER SWITCH - OFF.			T123A1	
T 1 24		Vacuum cleaner CIRCUIT BREAKER - OPEN.				
T 1 25		HI PWR ACCESS OUTLET 1 sw - OFF.				
T 1 26		Disconnect vacuum cleaner power cable from the HI PWR ACCESS OUTLET 1			T126A1	
		Warning				
		Thirty min are required for specimens to cool down to 105 °F.				

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TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 14 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satisfactory	Anomaly		
T 1.27		Open the work chamber hatch and remove any loose spheres and place in M553 SPHERE CATCHER 1.				
T 1.28		Obtain diagonal cutters				The diagonal cutters are temporarily stored in locker M136 (EQUIPMENT STORAGE CONTAINER).
T 1.29		Cut the melted specimens from the specimen wheel and place them in M553 SPHERE CATCHER 1.				
T 1 30		Temporarily stow the diagonal cutters in locker M136 (EQUIPMENT STORAGE CONTAINER).				Place in stowage location E623 after the termination of the M553 experiment.
T 1.31		Disconnect vacuum cleaner and replace vacuum cleaner port cover			T131A1	
T 1.32		Remove M553 SPHERE FORMING MOTOR and mount on the M479 flammability specimen container.			T132A1 T132B1 T132C1	
T 1 33		Stow M553 SPHERE FORMING SPECIMEN 1 wheel in locker M136 (EQUIPMENT STORAGE CONTAINER)				
T 1.34		Remove the M553 SPHERE CATCHER INSTALLATION TOOL and the M553 SPHERE CATCHER 1 from the work chamber			T134A1	
T 1.35		Disconnect the M553 SPHERE CATCHER INSTALLATION TOOL from the M553 SPHERE CATCHER 1.			T135A1	
T 1.36		Stow the M553 SPHERE CATCHER INSTALLATION TOOL and the M553 SPHERE CATCHER 1 in the EQUIPMENT STORAGE CONTAINER.				
T 1 37		Remove the M553 SPHERE FORMING MOTOR from the M479 specimen container and stow in the EQUIPMENT STORAGE CONTAINER.			T137A1	

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TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 15 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
T 1.38		Remove the dummy connector from the FLAMMABILITY SPECIMEN HOLDER TEMPORARY STORAGE connector and connect to the work chamber zero-g connector. Note Perform OSN's T 1.39 and T 1.40 only after the specimens on the second specimen wheel have been melted.			T138A1	
T 1.39		Remove the M553 CAMERA PORT SHIELD SPHERE FORMING from the work chamber and stow in the EQUIPMENT STORAGE CONTAINER.			T139A1	
T 1.40		Remove the M553 HATCH VIEW-PORT SHIELD SPHERE FORMING from the work chamber hatch and stow in the EQUIPMENT STORAGE CONTAINER			T140A1	
T 1.41		Close and latch the work chamber hatch.				
T 1 42		CHAMBER REPRESS vlv - CLOSED.			T142A1	
T 1 43		Remove the 75mm lens and the right angle mirror from the DAC and stow.			T143A1	Stowage location: F527
T 1.44		Disconnect power and control cables from DAC and connect cables to dummy connectors provided for storage.			T144A1	
T 1.45		Remove film XPT assembly from DAC and stow.			T145A1	Stowage location· F510
T 1 46		Remove the 16mm DAC and stow.			T146A1	Stowage location VTS
T 1 47		Perform OSN's P 1 11 and P 1.12.				
T 1.48		Remove checklist, logbook, and clipboard from control panel cover and stow.				
T 1.49		Close and latch control panel cover.				

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TABLE H-III. EXPERIMENT M-553, SPHERE FORMING EVALUATION SEQUENCE (Sheet 16 of 16)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satis-factory	Anom-aly		
T 1 50		Terminate S/I voice record				
T 1 51		Stow vacuum cleaner				
T 1 52		Stow M-512 foot restraint				

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SECTION VIII.

EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE

TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 1 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
P 1.22	Push the DAC operate button and verify that the DAC operates	P122A The DAC does not operate.	P122A1 Recycle the operate button and verify that the DAC operates	If the DAC operates, this would indicate that the operate button did not make contact the first time it was pushed in.
			P122A2 Place the INSTRUMENTATION CSTR X3 sw (S1) in the CSTR X3 position and verify that the INSTRUMENTATION PRESS gage (M5) is operating	Leave the INSTRUMENTATION CSTR X3 sw (S1) in the CSTR X3 position while trouble shooting the system.
			• M5 gage operates --A decision would have to be made concerning whether to exchange the DAC now or continue the experiment and see if the DAC will operate automatically when the HI VOLT/CAM sw (S14) is placed in the ON position	This would indicate that the DAC was receiving power. The operate button on the DAC could have failed open. If so, the DAC can still be operated remotely.
			• M5 gage does not operate --Refer to Contingency Plan P122A3.	This would indicate one of the following • The INSTRUMENTATION POWER sw failed to make contact in the BATT position. • The 30 V max. - 26 V min regulator failed • ELECTRON BEAM POWER sw (S3) failed to make contact in the ON position.

P

TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 2 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				• POWER CONTROL BATT cb (CB2) failed open • MAIN BATTERY cb (CB1) failed open.
			P122A3 Recycle the INSTRUMENTATION POWER sw (S2) and verify that the INSTRUMENTATION PRESS gage (M5) is operating	
			• M5 gage operates --Continue with experiment	This would indicate that the INSTRUMENTATION POWER sw (S2) had failed to make contact in the BATT position but did make contact when recycled.
			• M5 gage does not operate --Refer to Contingency Plan P122A4	Refer to Contingency Plan P122A2, Remarks, under topic heading "M5 gage does not operate".
			P122A4 Verify if the FIL CHMBR PRESS gage (M3) is operating.	
			• M3 gage operates --Refer to Contingency Plan P122A5	This would indicate that the INSTRUMENTATION POWER sw (S2) failed to make contact in the BATT position. The DAC and INSTRUMENTATION cannot be operated using battery power
			• M3 gage not operating --Refer to Contingency Plan P122A8	This would indicate one of the following

P

TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 3 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions,corrections,results)
				• The 30 V max. - 26 V min regulator failed • ELECTRON BEAM POWER sw (S3) failed to make contact in the ON position. • POWER CONTROL BATT cb (CB2) failed open • MAIN BATTERY cb (CB1) failed open
			P122A5 Perform the following • ELECTRON BEAM POWER sw (S3) - OFF • POWER CONTROL BATT cb (CB2) - open • POWER CONTROL AM BUS 1 cb (CB4) - close • INSTRUMENTATION POWER sw (S2) - AM BUS 1 • Verify INSTRUMENTATION PRESS gage (M5) operates --M5 gage operates --Refer to Contingency Plan P122A6	This would indicate that the INSTRUMENTATION POWER sw (S2) failed to make contact in the BATT position

P

TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 4 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
			--M5 gage does not operate --Refer to Contingency Plan P122A7	This would indicate that the INSTRUMENTATION POWER sw (S2) failed in the OFF position
			P122A6 A decision will have to be made concerning whether or not to continue the experiment	The DAC would have to be powered from an external AM BUS 1 power outlet and could not be operated remotely The INSTRUMENTATION PRESS gage (M5) would have to be monitored using AM BUS 1 power It is not recommended to have battery and AM BUS 1 power on at the same time Therefore, if the EBG canister pressure is measured using AM BUS 1 power, the battery would have to be taken off the line. When the EBG is operating, the instrumentation cannot be powered using AM BUS 1 power
			• Continue experiment --Reconfigure the facility and continue the experiment, keeping in mind the comments in the Remarks column	
			• Discontinue experiment --Reconfigure the facility to its initial condition and terminate experiment	
			P122A7 A decision will have to be made concerning whether or not to continue the experiment	The DAC would have to be powered from an external AM BUS 1 power outlet and could

P

TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 5 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				not be operated remotely The INSTRUMENTATION PRESS gage (M5) could not be used and, therefore, the EBG canister pressure could not be verified
			• Continue experiment --Reconfigure the facility and continue experiment.	It was determined that the inability to monitor the EBG canister pressure when firing the EBG would not cause a crew hazard.
			• Discontinue experiment --Terminate the experiment and reconfigure the facility to its initial condition	It was determined that the inability to monitor the EBG canister pressure when firing the EBG could present a crew hazard.
			P122A8 Place the FLOOD LT sw (S19) in the BATT position and verify that the floodlight illuminates.	
			• Floodlight illuminates --Place the FLOOD LT sw (S19) in the OFF position and refer to Contingency Plan P122A9.	This would indicate one of the following • The ELECTRON BEAM POWER sw (S3) failed to make contact in the ON position. • The 30 V max. - 26 V min. regulator failed
			• Floodlight does not illuminate --Refer to Contingency Plan P122A10.	This would indicate one of the following • The POWER CONTROL

P

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TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 6 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				BATT cb (CB2) failed open • The MAIN BATTERY cb (CB1) failed open
			P122A9 Recycle the ELECTRON BEAM POWER sw (S3) and verify that the INSTRUMENTATION PRESS gage (M5) is operating	
			• M5 gage operates --Continue the experiment	This would indicate that the ELECTRON BEAM POWER sw (S3) had failed to make contact in the ON position but did make contact when recycled.
			• M5 gage does not operate --Terminate the experiment and reconfigure the facility to its initial condition.	This would indicate one of the following • The ELECTRON BEAM POWER sw (S3) failed to make contact in the ON position. • The 30 V max. - 26 V min. regulator failed.
			P122A10 Perform the following	
			• BATTERY DISCHARGE cb (CB6) - close	
			• Verify the battery DISCHARGE lt (L8) illuminates --Discharge lt (L8) illuminates --Open the BATTERY DISCHARGE cb (CB6) and refer to Contingency Plan P122A11	This would indicate that the POWER CONTROL BATT cb (CB2) failed open

P

TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 7 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
			--DISCHARGE lt (L8) does not illuminate --Open the BATTERY DISCHARGE cb (CB6) and refer to Contingency Plan P122A12.	This indicates that the MAIN BATTERY cb (CB1) failed open.
			P122A11 Recycle the POWER CONTROL BATT cb (CB2) and verify that the floodlight illuminates	
			• Floodlight illuminates --Reconfigure the facility and continue with the experiment.	This would indicate that the POWER CONTROL BATT cb (CB2) had failed open but closed when recycled.
			• Floodlight does not illuminate --Terminate the experiment and reconfigure the facility to its initial condition.	This would indicate that the POWER CONTROL BATT cb (CB2) had failed open.
			P122A12 Recycle the MAIN BATTERY cb (CB1) and verify that the floodlight illuminates.	
			• Floodlight illuminates --Reconfigure the facility and continue with the experiment.	This would indicate that the MAIN BATTERY cb (CB1) had failed open but closed when recycled
			• Floodlight does not illuminate --Terminate the experiment and reconfigure the facility to its initial condition.	This would indicate that the MAIN BATTERY cb (CB1) had failed open.

P

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TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 8 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
P 1.24	Verify that the INSTRUMENTATION PRESS gage (M5) reading is approximately 5 psia	P124A The INSTRUMENTATION PRESS gage (M5) reading is zero psia	P124A1 Tap the INSTRUMENTATION PRESS gage (M5) with finger	If the INSTRUMENTATION PRESS gage (M5) reading moves up to approximately 5 psia, the M5 gage is hung
			P124A2 Recycle the INSTRUMENTATION CSTR X3 sw (S1)	
			P124A3 Verify that the INSTRUMENTATION TEMP gage (M4) is operating	It may be difficult to determine that the INSTRUMENTATION TEMP gage (M4) is operating if the reading is on the extreme low end of the scale (two graduation marks or less on the low end of the scale) Place the INSTRUMENTATION BASE + METER sw (S8) in the BASE + METER position If the M4 gage is operating, the reading should swing upscale
			• INSTRUMENTATION TEMP gage (M4) is greater than 0 °C --Refer to Contingency Plan P124A3	This would indicate one of the following • The INSTRUMENTATION CSTR X3 sw (S1) failed to make contact in the work CHMBR position • The INSTRUMENTATION PRESS gage (M5) has malfunctioned
			• INSTRUMENTATION TEMP gage (M4) reading is 0 °C --Refer to Contingency Plan P124A5	This would indicate one of the following

P

TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 9 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				• The Power Supply Module has failed • The INSTRUMENTATION POWER sw (S2) failed to make contact in the BATT position • The 30 V max - 26 V min regulator failed • The ELECTRON BEAM POWER sw (S3) failed to make contact in the ON position • The POWER CONTROL BATT cb (CB1) has tripped or failed open • The MAIN BATTERY cb (CB1) has tripped or failed open
			P124A3 Place the INSTRUMENTATION CSTR X3 sw (S1) in the CSTR X3 position and verify that the INSTRUMENTATION PRESS gage (M5) reads the EBG canister pressure • INSTRUMENTATION PRESS gage (M5) reading is 8 psia or above --Continue with the experiment without the capability of measuring work chamber pressure with the INSTRUMENTATION PRESS gage (M5)	The INSTRUMENTATION PRESS gage (M5) reading should be 8 psia or above This would represent an EBG canister pressure of 24 psia or above. This would indicate one of the following • The INSTRUMENTATION CSTR X3 sw (S1) failed to make contact in the work CHMBR position P

TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 10 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				• The chamber pressure transducer failed
			• INSTRUMENTATION PRESS gage (M5) reading is 0 psia --Refer to Contingency Plan P124A4	This would indicate one of the following • The INSTRUMENTATION CSTR X3 sw (S1) failed to make contact in both the work CHMBR and the CSTR X3 positions. • The INSTRUMENTATION PRESS gage (M5) has malfunctioned
			P124A4 A decision will have to be made concerning whether or not to continue the experiment	The INSTRUMENTATION PRESS gage (M5) could not be used and therefore the CBG canister pressure could be verified
			• Continue experiment --Reconfigure the facility and continue the experiment without the use of the INSTRUMENTATION PRESS gage (M5).	It was determined that the inability to verify the EBG canister pressure when firing the EBG would not cause a crew hazard
			• Discontinue experiment --Terminate the experiment and reconfigure the facility to its initial condition	It was determined that the inability to monitor the EBG canister pressure when firing the EBG could present a crew hazard
			P124A5 Refer to Contingency Plan P122A3	

P

TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 11 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
P 1 25	CHAMBER REPRESS vlv - OPEN	P125A The CHAMBER REPRESS vlv will not open	P125A1 Apply a greater amount of force than is normally required to open the CHAMBER REPRESS vlv P125A2 Continue the experiment	The CHAMBER REPRESS vlv is used to repressurize the work chamber after it has been vented to space If the valve will not open, the vacuum cleaner port cover could be removed to repressurize the work chamber
P 1.26	Unlatch and open work chamber hatch	P126A One or more Calfax fasteners or cam lock latches will not release	P126A1 Apply a greater amount of force than is normally required to release the Calfax fasteners or cam lock latches P126A2 Terminate the experiment and reconfigure the MPF to its initial condition	
P 1 27	CHAMBER REPRESS vlv - CLOSED	P127A The CHAMBER REPRESS vlv will not close	P127A1 Apply a greater amount of force than is normally required to close the CHAMBER REPRESS vlv P127A2 Terminate the experiment and reconfigure the MPF to its initial condition.	If the CHAMBER REPRESS vlv will not close, a vacuum cannot be pulled on the work chamber
P 1 28	Remove the dummy connector from the work chamber zero-g connector and place on the FLAMMABILITY SPECIMEN HOLDER TEMPORARY STORAGE connector	P128A The dummy connector will not remove from the work chamber zero-g connector	P128A1 Apply a greater amount of force than is normally required to remove the dummy connector. P128A2 Terminate the experiment and reconfigure the MPF to its initial condition	If the dummy connector will not remove, power cannot be delivered to the experiment

P

TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 12 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
P 1.29	Install M553 SPHERE CATCHER 1 with M553 SPHERE CATCHER INSTALLATION TOOL in work chamber	P129A The M553 SPHERE CATCHER INSTALLATION TOOL will not install in the M553 SPHERE CATCHER 1	P129A1 Stow the M553 SPHERE CATCHER 1 and the M553 SPHERE CATCHER INSTALLATION TOOL in the EQUIPMENT STORAGE CONTAINER and continue the experiment	The spheres will have to be collected by the astronaut and physically put into the M553 SPHERE CATCHER 1
		P129B The M553 SPHERE CATCHER 1 will not install in the work chamber	P129B1 Stow the M553 SPHERE CATCHER 1 and the M553 SPHERE CATCHER INSTALLATION TOOL in the EQUIPMENT STORAGE CONTAINER and continue the experiment	The spheres will have to be collected by the astronaut and physically put into the M553 SPHERE CATCHER 1.
P 1 30	Install M553 CAMERA PORT SHIELD SPHERE FORMING in work chamber	P130A The M553 CAMERA PORT SHIELD SPHERE FORMING will not install in the work chamber	P130A1 Stow the M553 CAMERA PORT SHIELD SPHERE FORMING in the EQUIPMENT STORAGE CONTAINER and continue with the experiment	Note that the M479 CAMERA PORT SHIELD FLAMMABILITY could be mounted in the work chamber for this experiment
P 1.31	Install M553 HATCH VIEW-PORT SHIELD SPHERE FORMING onto work chamber hatch.	P131A The M553 HATCH VIEW-PORT SHIELD SPHERE FORMING will not install on the work chamber hatch	P131A1 Stow the M553 HATCH VIEW-PORT SHIELD SPHERE FORMING in the EQUIPMENT STORAGE CONTAINER and continue with the experiment	Note that the M479 HATCH VIEW-PORT SHIELD FLAMMABILITY could be mounted on the hatch for this experiment.
P 1.32	Mount M553 SPHERE FORMING MOTOR on M-479 flammability specimen container	P132A The M553 SPHERE FORMING MOTOR will not mount on the M-479 flammability specimen container.	P132A1 The astronaut can physically hold the M553 SPHERE FORMING MOTOR to mount the M553 SPHERE FORMING SPECIMEN 1 and continue with the experiment	
P 1.33	Install M553 SPHERE FORMING SPECIMEN 1 on motor.	P133A The M553 SPHERE FORMING SPECIMEN 1 wheel will not install on the motor	P133A1 Determine the reason for the malfunction. • Motor's fault --Terminate the experiment and reconfigure the MPF to its initial condition	

P

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TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 13 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
			• Specimen's wheel fault --Stow the M553 SPHERE FORMING SPECIMEN 1 in the EQUIPMENT STORAGE CONTAINER and obtain and mount the M553 SPHERE FORMING SPECIMEN 2 wheel onto the motor and continue the experiment	
P 1.34	Install M553 SPHERE FORMING MOTOR with M553 SPHERE FORMING SPECIMEN 1 in the work chamber and connect power cable.	P134A The M553 SPHERE FORMING MOTOR will not install in the work chamber	P134A1 Secure the M553 SPHERE FORMING MOTOR to the work chamber with pressure sensitive tape. Note The M553 SPHERE FORMING MOTOR should be secured as close as possible to its normal position	
		P134B Electrical connector pins are bent, preventing cable connection	P134B1 Straighten pins, connect power cable, and continue with the experiment	
		P134C Cable electrical connector will not physically connect to outlet in work chamber	P134C1 Terminate the experiment and reconfigure the MPF to its initial condition	
P 1 35	Close and latch work chamber hatch	P135A The work chamber hatch will not properly latch	P135A1 Tighten the Calfax fasteners and the cam lock latches that are operating properly and perform a vacuum integrity check on the work chamber. Note To perform a vacuum integrity check on the work chamber, refer to SEPEM, Appendix E, Table E-III, OSN's P 2 0 through O 2.13	The experiment may be terminated if the work chamber cannot hold a vacuum of 1 x 10^{-4} torr

TABLE H-IV. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P) (Sheet 14 of 14)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
			• If the vacuum integrity check proves that the work chamber is operating properly, continue with the experiment • If the vacuum integrity check proves that the work chamber cannot hold a vacuum, terminate the experiment and reconfigure the MPF to its initial condition	P

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 1 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1 2	Verify a minimum reading of eight on INSTRUMENTATION PRESS gage (M5)	O12A The INSTRUMENTATION PRESS gage (M5) reading is 0 psia	O12A1 Tap the INSTRUMENTATION PRESS gage (M5) with finger	If the INSTRUMENTATION PRESS gage (M5) reading moves up to 8 psia, this could indicate a loose connection on the gage
			O12A2 Recycle the INSTRUMENTATION CSTR X3 sw (S1).	
			O12A3 Verify that the INSTRUMENTATION TEMP gage (M4) is operating	
			• INSTRUMENTATION TEMP gage (M4) reading is greater than 0 °C. --Refer to Contingency Plan O12A4	This would indicate one of the following • The INSTRUMENTATION CSTR X3 sw (S1) failed to make contact in the CSTR X3 position. • The INSTRUMENTATION PRESS gage (M5) has malfunctioned. • The canister pressure transducer failed.
			• INSTRUMENTATION TEMP gage (M4) reading is 0 °C. --Refer to Contingency Plan P 122A3.	This would indicate one of the following: • The Power Supply Module has failed. • The INSTRUMENTATION POWER sw (S2) failed to make contact in the BATT position.

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 2 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				• The 30 V max. - 26 V min. regulator failed. • The ELECTRON BEAM POWER sw (S3) failed to make contact in the ON position • The POWER CONTROL BATT cb (CB2) failed or tripped open. • The MAIN BATTERY cb (CB1) failed or tripped open.
			O12A4 Place the INSTRUMENTATION CSTR X3 sw (S1) in the WORK CHMBR and verify that the INSTRUMENTATION PRESS gage (M5) reading is approximately 5 psia.	
			• INSTRUMENTATION PRESS gage (M5) is 5 psia --Refer to Contingency Plan O12A5	This would indicate one of the following. • The INSTRUMENTATION CSTR X3 sw (S1) failed to make contact in the CSTR X3 position. • The canister pressure transducer failed
			• INSTRUMENTATION PRESS gage reading is 0 psia --Refer to Contingency Plan O12A5	This would indicate one of the following

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 3 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				• The INSTRUMENTATION CSTR X3 sw (S1) failed in the OFF position. • The INSTRUMENTATION PRESS gage (M5) has malfunctioned.
			O12A5 A decision will have to be made concerning whether or not to continue the experiment.	There is a requirement that the EBG canister pressure must be verified before turning on the EBG.
			• Continue experiment. --Continue the experiment without verifying the EBG canister pressure.	A decision was made to continue the experiment. It was determined that turning on the EBG without verifying that the EBG canister pressure was 24 psia or above would not present a hazard to the crew.
			• Discontinue the experiment --Terminate the experiment and reconfigure the MPF to its initial condition	It was determined that turning on the EBG without being able to verify that the EBG canister pressure was 24 psia or above could present a hazard to the crew.
		O12B The INSTRUMENTATION PRESS gage (M5) remains at 5 psia.	O12B1 Tap the INSTRUMENTATION PRESS gage (M5) with finger.	If the INSTRUMENTATION PRESS gage (M5) moves up to 8 psia, this could indicate a loose connection on the gage.
			O12B2 Recycle the INSTRUMENTATION CSTR X3 sw (S1) and verify that the INSTRUMENTATION PRESS gage (M5) reading increases to 8 psia.	

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 4 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
			• INSTRUMENTATION PRESS gage (M5) reading increases to 8 psia --Continue the experiment.	This would indicate that the INSTRUMENTATION CSTR X3 sw (S1) had failed in the WORK CHMBR position but made contact in the CSTR X3 position when recycled.
			• INSTRUMENTATION PRESS gage (M5) reading remains 5 psia. --Refer to Contingency Plan O12B3.	This would indicate one of the following • The INSTRUMENTATION CSTR X3 sw (S1) failed in the CSTR X3 position • The INSTRUMENTATION PRESS gage (M5) failed.
			O12B3 Place the INSTRUMENTATION CSTR X3 sw (S2) in the OFF position and verify that the INSTRUMENTATION PRESS gage (M5) reading decreases to 0 psia.	
			• INSTRUMENTATION PRESS gage (M5) reading decreases to 0 psia. --Terminate the experiment and reconfigure the MPF to its initial condition	This would indicate that the INSTRUMENTATION PRESS gage (M5) was operating properly and that the pressure in the EBG canister was low (15 psia).
			• INSTRUMENTATION PRESS gage (M5) reading remains 5 psia. --Refer to Contingency Plan O12B4	This would indicate one of the following • The INSTRUMENTATION CSTR X3 sw (S1) failed in the WORK CHMBR position

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 5 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				• The INSTRUMENTATION PRESS gage (M5) is hung.
			O12B4 Place the INSTRUMENTATION POWER sw (S2) in the OFF position and verify that the INSTRUMENTATION PRESS gage (M5) reading decreases to 0 psia.	
			• INSTRUMENTATION PRESS gage (M5) reading decreases to 0 psia --Refer to Contingency Plan O12A5.	This would indicate that the INSTRUMENTATION CSTR X3 sw (S1) failed in the WORK CHMBR position
			• INSTRUMENTATION PRESS gage (M5) reading remains at 5 psia. --Refer to Contingency Plan O12A5.	This would indicate that the INSTRUMENTATION PRESS gage (M5) was hung.
O 1.4	Verify that the INSTRUMENTATION PRESS gage (M5) reading decreases to 5 psia.	O14A The INSTRUMENTATION PRESS gage (M5) reading remains 8 psia	O14A1 Tap the INSTRUMENTATION PRESS gage (M5) with finger.	If the INSTRUMENTATION PRESS gage (M5) reading decreases to 5 psia, the M5 gage is hung.
			O14A2 Recycle the INSTRUMENTATION CSTR X3 sw (S1) and verify that the INSTRUMENTATION PRESS gage (M5) reading decreases to 5 psia.	
			• INSTRUMENTATION PRESS gage (M5) reading decreases to 5 psia. --Continue with experiment.	This would indicate that the INSTRUMENTATION CSTR X3 sw (S1) failed in the CSTR

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 6 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				X3 position but made contact in the WORK CHMBR position when recycled.
			• INSTRUMENTATION PRESS gage (M5) reading remains 8 psia --Refer to Contingency Plan O14A3	This would indicate one of the following: • The INSTRUMENTATION CSTR X3 sw (S1) failed in the CSTR X3 position. • The INSTRUMENTATION PRESS gage (M5) was hung.
			O14A3 Place the INSTRUMENTATION POWER sw (S2) in the OFF position and verify that the INSTRUMENTATION PRESS gage (M5) reading decreases to 0 psia.	
			• INSTRUMENTATION PRESS gage (M5) reading is 0 psia. --Continue the experiment without the capability of measuring the work chamber gross pressure.	This would indicate that the INSTRUMENTATION CSTR X3 sw (S1) failed in the CSTR X3 position.
			• INSTRUMENTATION PRESS gage (M5) reading remains 8 psia --Refer to Contingency Plan O12A5	This would indicate that the INSTRUMENTATION PRESS gage (M5) was hung and unable to measure either the work chamber gross pressure or the EBG canister pressure.

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 7 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
		O14B The INSTRUMENTATION PRESS gage (M5) reading decreases to 0 psia.	O14B1 Refer to Contingency Plan P124A1	
O 1 5	Bulkhead vent vlv - OPEN	O15A The bulkhead vent vlv will not open.	O15A1 Apply a greater amount of force than is normally required to open the bulkhead vent vlv. O15A2 Terminate the experiment and reconfigure the MPF to its initial condition	If the bulkhead vent vlv will not open, a vacuum cannot be pulled on the work chamber.
O 1 6	Work chamber vent vlv - OPEN	O16A The work chamber vent vlv will not open.	O16A1 Apply a greater amount of force than is normally required to open the work chamber vent vlv. O16A2 Terminate the experiment and reconfigure the MPF to its initial condition.	If the work chamber vent vlv will not open, a vacuum cannot be pulled on the work chamber.
O 1 7	BEAM CONTROL CUR ADJ pot (R32) - 0.6	O17A The BEAM CONTROL CUR ADJ pot (R32) will not adjust	O17A1 Apply a greater amount of force than is normally required to the BEAM CONTROL CUR ADJ pot (R32). O17A2 Continue the experiment with the electron beam current available and see if the specimens can be melted.	If the BEAM CONTROL CUR ADJ pot (R32) cannot be turned, the desired electron beam current cannot be obtained.
O 1.8	BEAM CONTROL FOCUS ADJ pot (R31) - 1 17.	O18A The BEAM CONTROL FOCUS ADJ pot (R31) will not adjust	O18A1 Apply a greater amount of force than is normally required to adjust the BEAM CONTROL FOCUS ADJ pot (R31).	If the BEAM CONTROL FOCUS ADJ pot (R31) cannot be turned, the desired electron beam cannot be obtained.

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 8 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
			O18A2 Continue the experiment with the electron beam available and see if the specimens can be melted.	
O 1 9	BEAM CONTROL ALIGN X pot (R58) - 1 5	O19A The BEAM CONTROL ALIGN X pot (R58) will not adjust.	O19A1 Apply a greater amount of force than is normally required to adjust the BEAM CONTROL ALIGN X pot (R58).	The BEAM CONTROL ALIGN X pot (R58) was set on 1 5 to run the M-551 Experiment and may be in the correct position.
			O19A2 Continue the experiment and see if the electron beam will strike the specimen If the beam does not strike the specimen, a combination of rotating the specimen wheel and adjusting the BEAM CONTROL ALIGN Y pot (R57) may enable the electron beam to impinge on the specimens.	
O 1.10	BEAM CONTROL ALIGN Y pot (R57) - 2 39	O110A The BEAM CONTROL ALIGN Y pot (R57) cannot be adjusted	O110A1 Apply a greater amount of force than is normally required to adjust the BEAM CONTROL ALIGN Y pot (R57)	If the BEAM CONTROL ALIGN Y pot (R57) cannot be adjusted, the proper alignment of the electron beam cannot be obtained.
			O110A2 Continue the experiment and see if the electron beam will strike the specimen If the beam does not strike the specimen, a combination of rotating the specimen wheel and adjusting the BEAM CONTROL ALIGN X pot (R58) may enable the electron beam to impinge on the specimen	

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 9 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.11	Verify that the INSTRUMENTATION PRESS gage (M5) reading is 0 psia.	O111A The INSTRUMENTATION PRESS gage (M5) reading did not decrease	O111A1 Tap the INSTRUMENTATION PRESS gage (M5) with finger.	If the INSTRUMENTATION PRESS gage (M5) reading decreases to 0 psia, this would indicate that the M5 gage is hung.
			O111A2 Place the INSTRUMENTATION CSTR X3 sw (S1) in the CSTR X3 position and monitor the INSTRUMENTATION PRESS gage (M5) for an increase in pressure	
			• INSTRUMENTATION PRESS gage (M5) reading does not increase. --Refer to Contingnecy Plan O12A5	This would indicate that the INSTRUMENTATION PRESS gage (M5) has malfunctioned.
			• INSTRUMENTATION PRESS gage (M5) reading increases to 8 psia or above. --Refer to Contingency Plan O111A3.	
			O111A3 Place the INSTRUMENTATION CSTR X3 sw (S1) in the WORK CHMBR position and monitor the INSTRUMENTATION PRESS gage (M5) for a decrease in pressure to 0 psia	
			• INSTRUMENTATION PRESS gage (M5) reading decreases to 0 psia. --Continue the experiment.	This would indicate that the INSTRUMENTATION PRESS gage (M5) was hung and the reading would not decrease in pressure, when the

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 10 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				INSTRUMENTATION CSTR X3 sw (S1) was placed in the CSTR X3 position, the gage was released
			• INSTRUMENTATION PRESS gage (M5) reading does decrease --Refer to Contingency Plan O12A5	This would indicate that the INSTRUMENTATION PRESS gage (M5) has malfunctioned.
O 1.12	FILAMENT CHAMBER VENT vlv - OPEN.	O112A The FILAMENT CHAMBER VENT vlv will not open.	O112A1 Apply a greater amount of force than is normally required to open the FILAMENT CHAMBER VENT vlv.	If the FILAMENT CHAMBER VENT vlv will not open, the EBG will not be used
			O112A2 Terminate the experiment and reconfigure the MPF to its initial condition.	
O 1.14	Verify the EBG filament glow.	O114A The EBG filament does not glow.	O114A1 Verify that the FIL CHMBR PRESS gage (M3) is operating	
			• FIL CHMBR PRESS gage (M3) is operating --Refer to Contingency Plan O114A2.	This would indicate one of the following • The EBG filament is burned out. • The relay K1 coil is open • The POWER FIL BATT cb (CB3) has tripped open or failed to make contact in the closed position

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 11 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				• Pole 1-2-3 of the FIL BEAM/CONT sw (S12) failed to make contact in the ON position.
			• FIL CHMBR PRESS gage (M3) is not operating. --Refer to Contingency Plan O114A4.	This would indicate one of the following: • The 30 V max. - 26 V min regulator has failed. • The ELECTRON BEAM POWER sw (S3) failed to make contact in the ON position • The POWER CONTROL BATT cb (CB2) has tripped open or failed to make contact in the closed position. • The MAIN BATTERY cb (CB1) has tripped open or failed to make contact in the closed position.
			O114A2 Verify that the POWER FIL BATT cb (CB3) is closed.	
			• POWER FIL BATT cb (CB3) has tripped open. --Close the POWER FIL BATT cb (CB3) and continue the experiment.	
			• POWER FIL BATT cb (CB3) is closed. --Refer to Contingency Plan O114A3.	This would indicate one of the following:

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 12 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				• The EBG filament is burned out. • The relay K1 coil is open. • The POWER FIL BATT cb (CB3) has failed to make contact in the closed position. • Pole 1-2-3 of the FIL BEAM/CONT sw (S12) failed to make contact in the ON position
			O114A3 Recycle the POWER FIL BATT cb (CB3) and the FIL BEAM CONT sw (S12) and verify that the EBG filament glows. • EBG filament glows --Continue the experiment	This would indicate that the POWER FIL BATT cb (CB3) had failed open and made contact in the closed position when recycled or that the FIL BEAM/CONT sw (S12) failed to make contact in the ON position but did make contact when recycled.
			• EBG filament does not glow --Terminate the experiment and reconfigure the MPF to its initial condition.	Refer to Contingency Plan O114A2, remarks, under title "POWER FIL BATT cb (CB3) is closed".

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 13 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
			O114A4 Place the FLOOD LT sw (S19) in the BATT position and verify that the floodlight illuminates.	
			• Floodlight illuminates --Refer to Contingency Plan O114A5	This would indicate one of the following: • The ELECTRON BEAM POWER sw (S3) failed to make contact in the ON position. • The 30 V max. - 26 V min. regulator failed.
			• Floodlight does not illuminate --Refer to Contingency Plan O114A6.	This would indicate one of the following: • The MAIN BATTERY cb (CB1) has tripped open or failed to make contact in the closed position. • The POWER CONTROL BATT cb (CB1) has tripped open or failed to make contact in the closed position. NOTE Leave the PHOTO LT sw (S19) in the BATT position while trouble shooting.

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 14 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
			O114A5 Recycle the ELECTRON BEAM POWER sw (S3) and verify that the EBG filament glows	
			• EBG filament glows --Continue with the experiment	This would indicate that the ELECTRON BEAM POWER sw (S3) had failed to make contact in the ON position but did make contact when recycled
			• EBG filament does not glow --Terminate the experiment and reconfigure the MPF to its initial condition	This would indicate one of the following: • The ELECTRON BEAM POWER sw (S3) failed to make contact in the ON position • The 30 V max - 26 V min regulator failed
			O114A6 Verify that the POWER CONTROL BATT cb (CB2) is closed	
			• POWER CONTROL BATT cb (CB2) has tripped open --Close the POWER CONTROL BATT cb (CB2) and continue the experiment	
			• POWER CONTROL BATT cb (CB2) is closed --Refer to Contingency Plan O114A7	This would indicate one of the following • The POWER CONTROL BATT cb (CB2) failed to make contact in the ON position

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 15 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				• The MAIN BATTERY cb (CB1) has tripped open or failed to make contact in the closed position.
			O114A7 Verify that the MAIN BATTERY cb (CB1) is closed.	
			• MAIN BATTERY cb (CB1) has tripped open --Close the MAIN BATTERY cb (CB1) and continue the experiment.	
			• MAIN BATTERY cb (CB1) is closed --Refer to Contingency Plan O114A8.	This would indicate one of the following: • The MAIN BATTERY cb (CB1) failed to make contact in the closed position. • The POWER CONTROL BATT cb (CB2) failed to make contact in the closed position.
			O114A8 Close the BATTERY DISCHARGE cb (CB6) and verify that the battery DISCHARGE lt (L8) illuminates.	After the verification has been made, open the BATTERY DISCHARGE cb (CB6).
			• Battery DISCHARGE lt (L8) illuminates --Refer to Contingency Plan O114A9.	This would indicate that the POWER CONTROL BATT cb (CB2) failed to make contact in the closed position

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 16 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
			• Battery DISCHARGE (L8) does not illuminate. --Refer to Contingency Plan O114A10	This would indicate that the MAIN BATTERY cb (CB1) failed to make contact in the closed position.
			O114A9 Recycle the POWER CONTROL BATT cb (CB2) and verify that the floodlight illuminates	
			• Floodlight illuminates --Place the FLOOD LT sw (S19) in the OFF position and continue the experiment	This would indicate that the POWER CONTROL BATT cb (CB2) had failed to make contact in the closed position but did make contact when recycled.
			• Floodlight does not illuminate. --Terminate the experiment and reconfigure the MPF to its initial condition	This would indicate that the POWER CONTROL BATT cb (CB2) had failed to make contact in the closed position
			O114A10 Recycle the MAIN BATTERY cb (CB1) and verify that the floodlight illuminates	
			• Floodlight illuminates. --Place the FLOOD LT sw (S19) in the OFF position and continue the experiment	This would indicate that the MAIN BATTERY cb (CB1) had failed to make contact in the closed position but did make contact when recycled
			• Floodlight does not illuminate. --Terminate the experiment and reconfigure the MPF to its initial condition.	This would indicate that the MAIN BATTERY cb (CB1) had failed to make contact in the closed position

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 17 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1 15	Raise hatch filter	O115A The hatch filter will not raise	O115A1 Apply a greater amount of force than is normally required to raise the hatch filter.	
			O115A2 Continue the experiment	The experiment can be performed with the hatch filter down
O 1. 17	Verify READY lt (L4) illuminates.	O117A The READY lt (L4) does not illuminate	O117A1 Recycle the HI VOLT/CAM sw (S14) and verify that the READY lt (L4) illuminates	
			• READY lt (L4) illuminates. --Continue the experiment	This would indicate that the HI VOLT/CAM sw (S14) had failed to make contact in the READY/RESET position but did make contact when recycled
			• READY lt (L4) does not illuminate --Refer to Contingency Plan O117A2	This would indicate one of the following: • The HI VOLT/CAM sw (S14) failed to make contact in the READY/RESET position. • The K7 relay coil failed open. • The K7 contact 4-6 failed to make contact when closed.

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 18 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				• The 4-5-6 pole of the FIL/BEAM CONT sw (S12) failed to make contact in the ON position. • The Filament Chamber Interlock sw (S27) failed to make contact when the FILAMENT CHAMBER VENT vlv was opened. • The 30 V max. - 26 V min. regulator failed. • The ELECTRON BEAM POWER sw (S3) failed to make contact in the ON position • The POWER CONTROL BATT cb (CB2) has tripped open or failed to make contact in the closed position. • The MAIN BATTERY cb (CB1) has tripped open or failed to make contact in the closed position
			O117A2 Verify that there is still a filament glow • Filament glows --Refer to Contingency Plan O117A3.	This would indicate one of the following O

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 19 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				• The HI VOLT/CAM sw (S14) failed to make contact in the READY/RESET position • Relay coil K7 failed open. • Relay K7 contact 4-6 failed to make contact when closed. • Pole 4-5-6 of the FIL BEAM/CONT sw (S12) failed to make contact in the ON position • The Filament Chamber Interlock sw (S27) failed to make contact when the FILAMENT CHAMBER VENT vlv was opened.
			• Filament does not glow --Refer to Contingency Plan O114A4	This would indicate one of the following: • The 30 V max. - 26 V min. regulator failed • The ELECTRON BEAM POWER sw (S3) failed to make contact in the ON position.

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 20 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
				• The POWER CONTROL BATT cb (CB2) has tripped open or failed to make contact when closed. • The MAIN BATTERY cb (CB1) has tripped open or failed to make contact in the closed position
			O117A3 Place the HI VOLT/CAM sw (S14) in the ON position and verify that the electron beam comes on	
			• Electron beam comes on. --Continue the experiment	This would indicate one of the following • The K8 relay contact 1-2 failed to make contact in the closed position • The diode CR52 opened This could indicate that both bulbs in the READY lt (L4) are burned out. This would be a double failure and is not considered in this analysis.
			• ELECTRON BEAM does not come on. --Place the HI VOLT/CAM sw (S14) in the READY/RESET position and refer to Contingency Plan O117A4	Refer to Contingency Plan O117A2, remarks, under heading "Filament glows"

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 21 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
			O117A4 Place the PHOTO LT sw (S14) in the ON position and verify that the photo lt illuminates	
			• Photo lt illuminates --Refer to Contingency Plan O117A5.	This would indicate one of the following • The HI VOLT/CAM sw (S14) failed to make contact in the READY/RESET position • The relay coil K7 failed open. • The relay K7 contact 4-6 failed to make contact when closed • Pole 4-5-6 failed to make contact in the ON position
			• Photo lt does not illuminate --Place the FIL CHMBR INTLK sw (S13) in the OVERRIDE position and continue the experiment Note Place the PHOTO LT sw (S4) in the OFF position	This would indicate that the Filament Chamber Interlock sw (S27) failed to make contact when the FILAMENT CHAMBER VENT vlv was opened.
			O117A5 Recycle the FIL/BEAM CONT sw (S12), place the HI VOLT/CAM sw (S14) in the READY/RESET position, and verify that the READY lt (L4) illuminates.	

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 22 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
			• READY lt (L4) illuminates --Continue the experiment.	This would indicate that pole 4-5-6 of the FIL/BEAM CONT sw (S12) had failed to make contact in the ON position but did make contact when recycled
			• READY lt (L4) does not illuminate --Terminate the experiment and reconfigure the MPF to its initial condition.	Refer to Contingency Plan O117A4, remarks, under heading "Photo lt illuminates".
		O117B The READY lt (L4) goes out when the HI VOLT/CAM sw (S14) is released from the READY/RESET position.	O117B1 Recycle the HI VOLT/CAM sw (S14) and verify that the READY lt (L4) illuminates after the S14 sw is released from the READY/RESET position.	
			• READY lt (L4) remains on. --Continue the experiment	This would indicate that the K7 contact 1-3 had failed to make contact in the closed position but did make contact when the HI VOLT/CAM sw (S14) was recycled.
			• READY lt (L4) does not remain on --Continue the experiment.	This would indicate that the K7 contact 1-3 failed to make contact in the closed position.

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 23 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1 19	Verify DAC is operating	O119A The DAC is not operating	O119A1 Verify that the electron beam is on	
			• Electron beam is on --Refer to Contingency Plan O119A2	This would indicate one of the following • The K8 relay coil failed open • The K8 contact 4-6 failed open • The DAC malfunctioned • The INSTRUMENTATION POWER sw (S2) did not make contact in the BATT position
			• Electron beam is not on --Refer to Contingency Plan O119A8.	This would indicate that the HI VOLT/CAM sw (S14) failed to make contact in the ON or No. 6 position
			O119A2 Verify that the READY lt (L4) is illuminating	
			• READY lt (L4) is illuminating --Operate DAC manually and continue the experiment	This would indicate that the K8 relay coil failed open and the DAC could not be remotely operated
			• READY lt (L4) is not illuminating --Refer to Contingency Plan O119A3	This would indicate one of the following • The DAC malfunctioned • The K8 relay contact 4-6 failed open • The INSTRUMENTATION POWER sw (S2) did not make contact in the BATT position

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O)
(Sheet 24 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1 19 (Continued)			O119A3 Verify that the INSTRUMENTATION TEMP gage (M4) is operating	
			• INSTRUMENTATION TEMP gage (M4) is operating --Refer to Contingency Plan O119A4	This would indicate one of the following • The DAC has malfunctioned • The K8 relay contact 4-6 failed open
			• INSTRUMENTATION TEMP gage (M4) is not operating --Refer to Contingency Plan O119A6.	This would indicate that the INSTRUMENTATION POWER sw (S2) failed to make contact in the BATT position
			O119A4 Push the DAC operate button and verify that the DAC operates	
			• DAC operates --Operate the DAC manually and continue the experiment	This would indicate that the K8 relay contact 4-6 failed open and the DAC could not be operated remotely
			• DAC does not operate --Refer to Contingency Plan O119A5	This would indicate that the DAC malfunctioned
			O119A5 A decision will have to be made concerning whether or not to film the experiment	
			• Film the experiment --Exchange DAC's and continue the experiment	A decision was made to obtain another DAC, assemble the photographic equipment on the new DAC, and film the experiment
			• Do not film the experiment --Continue the experiment without photography	A decision was made not to exchange DAC's and film the experiment

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O)
(Sheet 25 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1 19 (Continued)			O119A6 Recycle the INSTRUMENTATION POWER sw (S2) and verify that the INSTRUMENTATION TEMP gage (M4) is operating	
			• INSTRUMENTATION TEMP gage (M4) is operating --Continue the experiment	This would indicate that the INSTRUMENTATION POWER sw (S2) was not making contact in the BATT position but did make contact when recycled
			• INSTRUMENTATION TEMP gage (M4) is not operating --Refer to Contingency Plan O119A7.	This would indicate that the INSTRUMENTATION POWER sw (S2) is not making contact in the BATT position Note that the INSTRUMENTATION PRESS gage (M5) could not be used to measure the work chamber or EBG canister pressure The EBG pressure had already been verified to be 24 psia or greater in OSN O 1 2 If the EBG canister needs verification again, refer to Contingency Plan P122A6
			O119A7 A decision will have to be made concerning whether or not to film the experiment The DAC will have to be powered from an external power source and manually operated by the astronaut	
			• Film the experiment --Connect the DAC to an external power source, continue the experiment, and operate the DAC manually	A decision was made to connect the DAC to an external power source and operate the DAC manually

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O)
(Sheet 26 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions,corrections,results)
O 1.19 (Continued)			• Do not film the experiment --Continue the experiment without photography	A decision was made not to film the experiment
			O119A8 Recycle the HI VOLT/CAM sw (S14 to READY/RESET and ON position and verify that electron beam comes on.	
			• Electron beam comes on --Continue the experiment	This would indicate that the HI VOLT/CAM sw (S14) had failed to make contact in the ON or No 6 position but did make contact when recycled
			• Electron beam does not come on --Terminate the experiment and reconfigure the MPF to its initial condition	This would indicate that the HI VOLT/CAM sw (S14) failed to make contact in the ON position
		O119B The DAC does not continue to operate when the HI VOLT/CAM sw (S14) is released	O119B1 Recycle the HI VOLT/CAM sw (S14) to the ON position and verify that the DAC continues to operate when the S14 sw is released	
			• DAC continues to operate --Continue the experiment	This would indicate that the K3 relay contact B1-B2 failed to make contact but did make contact when the HI VOLT/CAM sw (S14) was recycled

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 27 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.19 (Concluded)			• DAC does not operate. --Hold the HI VOLT/CAM sw (S14) in the ON position and continue the experiment.	The K3 relay contact B1-B2 failed to make contact. Note that the electron beam will cut off when the HI VOLT/CAM sw is released.
O 1.20	Verify electron beam	O120A The electron beam is not operating.	O120A1 Verify that the DAC is operating	
			• DAC is operating. --Refer to Contingency Plan O120A2.	This would indicate that the K3 relay contact A1-A2 did not make contact.
			• DAC is not operating. --Refer to Contingency Plan O119A8	This would indicate that the HI VOLT/CAM sw (S14) did not make contact in the ON or No 6 position
			O120A2 Recycle the HI VOLT/CAM sw (S14) to READY/RESET and to the ON position Verify that the electron beam operates.	
			• Electron beam operates --Continue the experiment.	This would indicate that K3 relay contact A1-A2 had failed to make contact but did make contact when the HI VOLT/CAM sw (S14) was recycled.
			• Electron beam does not operate. --Terminate the experiment and reconfigure the MPF to its initial condition.	This would indicate that K3 relay contact A1-A2 failed to make contact.

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 28 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.20 (Concluded)		O120B The electron beam does not continue to operate when the HI VOLT/CAM sw (S14) is released.	O120B1 Recycle the HI VOLT/CAM sw (S14) to the ON position and verify that the electron beam continues to operate after the S14 sw is released.	
			• Electron beam continues to operate --Continue the experiment.	This would indicate that K3 relay contact B1-B2 had not made initial contact but did make contact when the HI VOLT/CAM sw (S14) was recycled.
			• Electron beam does not continue to operate. --Hold the HI VOLT/CAM sw (S14) in the ON position and continue the experiment.	The K3 relay contact B1-B2 failed to make contact. Note that the DAC will cut off when the HI VOLT/CAM sw (S14) is released.
O 1 21	Observe that ELECTRON BEAM voltage gage (M1) reading is in the green.	O121A The ELECTRON BEAM voltage gage (M1) reading is not in the green.	O121A1 Continue the experiment and verify that the electron beam will melt the specimens.	
O 1.22	Adjust BEAM CONTROL CUR ADJ pot (R32) for a 50 mA reading on the BEAM CUR gage (M2).	O122A Rotating the BEAM CONTROL ADJ pot (R32) does not change the BEAM CUR gage (M2) reading.	O122A1 Tap the BEAM CUR gage (M4) with finger.	If the BEAM CUR gage (M4) operates, the M4 gage is hung or has a loose connection.
		NOTE: The Contingency Plans written for this malfunction are for the sphere forming specimens and not the target. If this malfunction occurs on the target specimen, perform only Contingency Plan O122A1 and continue the experiment. Perform the other Contingency Plans on the first specimen.	O122A2 Adjust the BEAM CONTROL FOCUS ADJ pot (R31) for an optimum beam and verify that the electron beam melts the specimens.	
			• Electron beam melts the specimen. --Continue the experiment.	This would indicate one of the following: • The BEAM CUR gage (M4) malfunctioned

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 29 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.22 (Concluded)				• The BEAM CONTROL CUR ADJ pot (R32) failed in a position that would allow sufficient current to melt the specimens.
			• Electron beam does not melt the specimen. --Refer to Contingency Plan O122A3.	This would indicate that the electron beam was not of sufficient magnitude to melt the specimens.
			O122A3 Adjust the BEAM CONTROL CUR ADJ pot (R32) for an increase in electron beam current and verify that the electron beam melts the specimen.	
			• Electron beam melts the specimens --Continue the experiment.	This would indicate that the BEAM CUR gage (M2) has malfunctioned.
			• Electron beam does not melt the specimens --Terminate the experiment and reconfigure the MPF to its initial condition.	This would indicate that the BEAM CONTROL CUR ADJ pot (R32) failed in a position that would not allow sufficient electron beam current to melt the specimens.
O 1.23	Adjust BEAM CONTROL FOCUS ADJ pot (R31) for optimum beam.	O123A Rotating the BEAM CONTROL FOCUS ADJ pot (R32) does not change the beam.	O123A1 Verify that the electron beam melts the specimen.	This would indicate that the BEAM CONTROL FOCUS ADJ pot (R32) has malfunctioned.
		NOTE The Contingency Plans written for this malfunction are for the sphere forming specimens and not the target. Continue the experiment and perform these Contingency Plans on the first specimen.	• Electron beam melts specimen --Continue the experiment.	This would indicate that the beam was focused well enough to perform the experiment.

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 30 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.23 (Concluded)			• Electron beam does not melt specimens --Refer to Contingency Plan O123A.	This would indicate that the electron beam was not focused enough to melt the specimen at the present current reading.
			O123A2 Adjust the BEAM CONTROL CUR ADJ pot (R32) for an increase in current and verify that the electron beam melts the specimens	
			• Electron beam melts the specimens --Continue the experiment.	This would indicate that the specimens could be melted if the electron beam were not focused and the electron beam current were increased.
			• Electron beam will not melt the specimens. --Terminate the experiment and reconfigure the MPF to its initial condition.	This would indicate that the electron beam was not focused well enough to melt the specimen, even with an increase in electron beam current.
O 1.24	Adjust BEAM CONTROL ALIGN X pot (R58) and BEAM CONTROL ALIGN Y pot (R57) for alignment of electron beam on outer fourth of target specimen.	O124A Adjusting the BEAM CONTROL ALIGN X pot (R58) does not move the electron beam.	O124A1 Verify that the electron beam is impinging on the target.	This would indicate that the BEAM CONTROL ALIGN X pot (R58) has malfunctioned.
			• Electron beam impinges on the target --Continue the experiment.	This would indicate that the alignment of the electron beam was sufficient to perform the experiment.
			• Electron beam does not impinge on the target. --Refer to Contingency Plan O124A2.	This would indicate that further adjustments must be made to continue the experiment.

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 31 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.24 (Continued)			O124A2 Verify that the electron beam can impinge on the target by using the EXP ADV sw (S16) to slightly rotate the specimen wheel and by adjusting the BEAM CONTROL ALIGN Y pot (R57) to move the electron beam in the Y direction.	
			• Electron beam can impinge on target. --Continue the experiment.	This would indicate that adjustments can be made to allow the experiment to be performed. Note that after each specimen has automatically been rotated into position, the EXP ADV sw (S16) will have to be used to slightly rotate the specimen wheel and allow the electron beam to impinge on the specimen.
			• Electron beam cannot impinge on target. --Terminate the experiment and reconfigure the MPF to its initial condition.	This would indicate that these adjustments would not allow the electron beam to impinge on the specimen.
		O124B Adjusting the BEAM CONTROL ALIGN Y pot (R57) does not move the electron beam.	O124B1 Verify that the electron beam is impinging on the target.	This would indicate that the BEAM CONTROL ALIGN Y pot (R57) malfunctioned.
			• Electron beam impinges on the target. --Continue the experiment.	This would indicate that the alignment of the electron beam was sufficient to perform the experiment.
			• Electron beam does not impinge on the target. --Refer to Contingency Plan O124B2.	This would indicate that further adjustments must be made to continue the experiment.

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 32 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.24 (Concluded)			O124B2 Verify that the electron beam can impinge on the target by using the EXP ADV sw (S16) to slightly rotate the specimen wheel and by adjusting the BEAM CONTROL ALIGN X pot (R58) to move the electron beam in the X direction.	
			• Electron beam can impinge on target. --Continue the experiment.	This would indicate that adjustments can be made to allow the experiment to be performed. Note that after each specimen has automatically been rotated into position, the EXP ADV sw (S16) will have to be used to slightly rotate the specimen wheel and allow the electron beam to impinge on the specimen.
			• Electron beam cannot impinge on target. --Terminate the experiment and reconfigure the MPF to its initial condition.	This would indicate that these adjustments would not allow the electron beam to impinge on the specimen.
O 1 25	HI VOLT/CAM sw (S14) - READY/RESET (mom).	O125A The electron beam does not cut off.	O125A1 Recycle the HI VOLT/CAM sw (S14).	If the electron beam cuts off, this would indicate that pole 4-5-6 of the HI VOLT/CAM sw (S14) has failed in the No. 6 position but did release when recycled.
			O125A2 Verify that the READY lt (L4) is illuminating.	
			• READY lt (L4) is illuminating. --Refer to Contingency Plan O125A3.	This would indicate that the K3 contact A1-A2 failed closed. O

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 33 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.25 (Continued)			• READY lt (L4) is not illuminating. --Refer to Contingency Plan O125A4.	This would indicate that pole 4-5-6 of the HI VOLT/CAM sw (S14) had failed in the No. 6 position.
			O125A3 A decision will have to be made concerning whether or not to continue the experiment.	If K3 contact A1-A2 failed closed, the electron beam could not be cut off unless all power was removed from the EBG filament. Once the electron beam was cut off, only high voltage could be applied to the EBG filament when activated again.
			• Continue the experiment.	A decision was made to continue the experiment. The experiment will probably be continued by allowing the electron beam to run continuously and by rotating the specimens in front of the electron beam. If this failure occurs while melting the specimens on the first specimen wheel, the second specimen wheel probably will not be run.
			• Terminate the experiment. --Terminate the experiment and reconfigure the MPF to its initial condition.	A decision was made to terminate the experiment. The electron beam can be cut off by placing the ELECTRON BEAM POWER sw (S3) in the OFF position
			O125A4 A decision will have to be made concerning whether or not to continue the experiment.	If pole 4-5-6 of the HI VOLT/CAM sw (S14) failed in the No 6 position, the electron beam could not be cut back, once it had been cut off.

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 34 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.25 (Continued)			• Continue the experiment. --Continue the experiment without cutting off the electron beam.	A decision was made to continue the experiment by allowing the electron beam to run continuously and by rotating the specimens into the path of the electron beam. If this failure occurs while performing the first specimen wheel, the second specimen wheel cannot be run
			• Terminate the experiment and reconfigure the MPF to its initial condition.	A decision was made to terminate the experiment and not allow the electron beam to run continuously
		O125B The DAC does not cut off	O125B1 Recycle the HI VOLT/CAM sw (S14) to the READY/RESET position.	If the DAC stops, this would indicate that pole 4-5-6 of the HI VOLT/CAM sw (S14) has failed in the No. 6 position but did release when recycled.
			O125B2 Verify that the READY lt (L4) is illuminating	
			• READY lt (L4) is illuminating --Refer to Contingency Plan O125B3.	This would indicate that K8 relay contact 4-6 failed closed.
			• READY lt (L4) is not illuminating. --Refer to Contingency Plan O125A4.	This would indicate that pole 4-5-6 of the HI VOLT/CAM sw (S14) failed in the No. 6 position. This will cause a problem with the EBG.
			O125B3 A decision would have to be made concerning whether or not to film the experiment.	If K8 contact 4-6 failed closed, the DAC would continue to run as long as power was applied to the power supply module.

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 35 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.25 (Concluded)			• Film the experiment --Use the INSTRUMENTATION POWER sw (S2) to turn the DAC off and on, continue the experiment.	A decision was made to film the experiment by using the INSTRUMENTATION POWER sw (S2) to turn the DAC off and on. When the S2 sw is placed in the BATT position, the DAC will operate.
			• Terminate the filming. --Place the INSTRUMENTATION POWER sw (S2) in the OFF position and continue the experiment.	A decision was made not to manually control the DAC.
O 1.26	Verify READY lt (L4) illuminates.	O126A The READY lt (L4) does not illuminate.	O126A1 Recycle the HI VOLT/CAM sw (S14) to the READY/RESET position.	If the READY lt (L4) illuminates, this would indicate that pole 4-5-6 of the HI VOLT/CAM sw (S14) has either failed in the No 6 position but did release when recycled or that the K8 contact 1-2 has failed open but closed when the S14 sw was recycled.
			O126A2 Verify that the electron beam is off.	
			• Electron beam is off. --Continue the experiment.	This would indicate that the K8 relay contact 1-2 failed open.
			• Electron beam is ON. --Refer to Contingency Plan O125A4.	This would indicate that pole 4-5-6 of the HI VOLT/CAM sw (S14) failed in the No. 6 position.
O 1.27	FLOOD LT sw (S19) - BATT.	O127A The floodlight does not illuminate.	O127A1 Recycle the FLOOD LT sw (S19) to the BATT position	If the floodlight illuminates, this would indicate that the FLOOD LT sw (S19) has failed to make contact in the BATT position but does make contact when recycled.

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 36 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.27 (Concluded)			O127A2 Continue the experiment without the floodlight.	This would indicate one of the following: • The FLOOD LT sw (S19) failed to make contact in the BATT position. • The floodlight has burned out. The photography for the experiment may be degraded because of a lack of illumination.
O 1.28	EXP ADV sw (S16) - MAN/RESET (mom) (Hold for 2 sec).	O128A The M553 SPHERE FORMING MOTOR does not rotate.	O128A1 Recycle the EXP ADV sw (S16) to the MAN/RESET position.	If the M553 SPHERE MOTOR rotates, this would indicate that the EXP ADV sw (S16) has failed to make contact in the MAN/RESET position but does make contact when recycled.
			O128A2 Terminate the experiment and reconfigure the MPF to its initial condition. NOTE: These Contingency Plans assume that the cam operated sw in the M553 SPHERE FORMING MOTOR was properly positioned initially. Before terminating the experiment, place the EXP ADV sw (S16) in the AUTO position, then in the MAN/RESET position. If the M553 SPHERE FORMING MOTOR rotates and properly aligns the sphere forming specimen, continue the experiment. If not, continue the termination.	If the M553 SPHERE FORMING MOTOR does not rotate, this would indicate one of the following: • The EXP ADV sw (S16) failed to make contact in the MAN/RESET position. • The M553 SPHERE FORMING MOTOR cam operated sw failed. • The M553 SPHERE FORMING MOTOR failed

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 37 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.28 (Continued)				• The EXP ADV sw (S16) failed in the AUTO position (Note: this should not be an indication until after the S16 sw has been placed in the AUTO position.) It is assumed that the S16 sw did not fail in the AUTO position until after being placed there.
		O128B The M553 SPHERE FORMING MOTOR continues to rotate as long as the EXP ADV sw (S16) is held in the MAN/RESET position.	O128B1 A decision will have to be made concerning whether or not to continue the experiment	This would indicate that the cam operated sw in the M553 SPHERE FORMING MOTOR had failed in such a position that allowed the motor to rotate when the EXP ADV sw (S16) was placed in the MAN/RESET position. If this is the problem, the M553 SPHERE FORMING MOTOR will not rotate when the EXP ADV sw (S16) is placed in the AUTO position.
			• Continue the experiment. --Place the EXP ADV sw (S16) in the MAN/RESET position and visually align the sphere forming specimen.	A decision was made to continue the experiment. The sphere forming specimens will have to be aligned manually by placing the EXP ADV sw (S16) in the MAN/RESET position, visually observe the rotating specimens, and release the S14 sw when a specimen is properly aligned.

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 38 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1 28 (Concluded)			• Terminate the experiment. --Terminate the experiment and reconfigure the MPF to its initial condition.	A decision was made not to try and visually align the sphere forming specimens.
O 1.29	EXP ADV sw (S16) - AUTO	O129A The M553 SPHERE FORMING MOTOR does not rotate	O129A1 Recycle the EXP ADV sw (S16) to the AUTO position	If the M553 SPHERE FORMING MOTOR rotates, this would indicate that the EXP ADV sw (S16) has failed to make contact in the AUTO position but does make contact when recycled.
			O129A2 Terminate the experiment and reconfigure the MPF to its initial condition.	This would indicate one of the following • The EXP ADV sw (S16) failed to make contact in the AUTO position. • The EXP ADV sw (S16) failed in the MAN/RESET position. • The cam operated sw, in the M553 SPHERE FORMING MOTOR, failed to make contact to allow electrical continuity when the EXP ADV sw (S16) was placed in the AUTO position.
		O129B The M553 SPHERE FORMING MOTOR continues to rotate as long as the EXP ADV sw (S16) is held in the AUTO position.	O129B1 A decision will have to be made concerning whether or not to continue the experiment.	This would indicate that the cam operated sw in the M553 SPHERE FORMING MOTOR had failed in a position that allowed the motor to rotate when the EXP ADV sw (S16) was placed in the O

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 39 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1 29 (Concluded)				AUTO position. If this is the problem, the M553 SPHERE FORMING MOTOR will not rotate when the EXP ADV sw (S16) is placed in the MAN/ RESET position.
			• Continue the experiment. --Place the EXP ADV sw (S16) in the AUTO position and visually align the sphere forming specimens.	A decision was made to continue the experiment. The sphere forming specimens will have to be aligned manually by placing the EXP ADV sw (S16) in the AUTO position, visually observing the rotating specimens, and placing the S16 sw in the OFF position when a specimen is properly aligned.
			• Terminate the experiment. --Terminate the experiment and reconfigure the MPF to its initial condition.	A decision was made not to try and visually align the sphere forming specimens.
O 1.30	Verify specimen disc rotates one specimen	O130A The specimen disc did not rotate one specimen	O130A1 Refer to Contingency Plans O128A1 and O129A1.	Do not terminate the experiment until after the EXP ADV sw (S16) has been recycled in both the MAN/RESET and AUTO position and the specimen wheel does not rotate one specimen.
O 1.32	HI VOLT/CAM sw (S14) - ON.	O132A The DAC is not operating.	O132A1 Refer to Contingency Plan O119A1.	
		O132B The DAC does not continue to operate when the HI VOLT/CAM sw (S14) is released.	O132B1 Refer to Contingency Plan O119B1.	
		O132C The electron beam is not operating.	O132C1 Refer to Contingency Plan O120A1.	

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 40 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions,corrections,results)
O 1.32 (Concluded)		O132D The electron beam does not continue to operate when the HI VOLT/CAM sw (S14) is released.	O132D1 Refer to Contingency Plan O120B1.	
O 1.35	Verify READY lt (L4) illuminates.	O135A The READY lt (L4) does not illuminate.	O135A1 Refer to Contingency Plan O126A1.	
O 1.36	EXP ADV sw (S16) - MAN/RESET (mom) (Hold for 2 sec).	O136A The M553 SPHERE FORMING MOTOR does not rotate.	O136A1 Refer to Contingency Plan O128A1.	
		O136B The M553 SPHERE FORMING MOTOR continues to rotate as long as the EXP ADV sw (S16) is held in the MAN/ RESET position.	Refer to Contingency Plan O128B1.	
O 1.37	EXP ADV sw (S16) - AUTO.	O137A The M553 SPHERE FORMING MOTOR does not rotate.	O137A1 Refer to Contingency Plan O129A1.	
		O137B The M553 SPHERE FORMING MOTOR continues to rotate as long as the EXP ADV sw (S16) is held in the AUTO position.	O137B1 Refer to Contingency Plan. O129B1.	
O 1.38	Verify specimen disc rotates one specimen.	O138A The specimen disc did not rotate one specimen.	O138A1 Refer to Contingency Plans O128A1 and O129A1.	
O 1.41	HI VOLT/CAM sw (S14) - ON.	O141A The electron beam does not operate.	O141A1 Verify that the DAC is operating. • DAC is operating --Refer to Contingency Plan O120A2.	This would indicate that K3 relay contact A1-A2 did not make contact.

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 41 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.41 (Continued)			• DAC is not operating --Refer to Contingency Plan O141A2.	This would indicate one of the following: • The pole 4-5-6 of the HI VOLT/CAM sw (S14) failed to make contact in the No. 6 position. • The HI VOLT/CAM sw (S14) failed to make contact in the ON position.
			O141A2 Verify that the READY lt (L4) illuminates. • READY lt (L4) illuminates. --Refer to Contingency Plan O141A3.	This would indicate one of the following: • The pole 4-5-6 of the HI VOLT/CAM sw (S14) failed to make contact in the No. 6 position. • The HI VOLT/CAM sw (S14) failed to make contact in the ON position.
			• READY lt (L4) is not illuminating. --Refer to Contingency Plan O141A4.	This would indicate that the electrical contacts in the specimen were open.
			O141A3 Recycle the HI VOLT/CAM sw (S14) to the READY/RESET and then to the ON position and verify that the electron beam operates.	

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 42 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.41 (Continued)			• Electron beam operates. --Continue the experiment.	This would indicate that the pole 4-5-6 of the HI VOLT/CAM sw (S14) had failed to make contact in the No. 6 position but did make contact when recycled or that the S14 sw had failed to make contact in the ON position but did make contact when recycled.
			• Electron beam does not operate. --Terminate the experiment and reconfigure the MPF to its initial condition.	This would indicate one of the following: • The pole 4-5-6 of the HI VOLT/CAM sw (S14) failed to make contact in the No. 6 position. • The HI VOLT/CAM sw (S14) failed to make contact in the ON position.
			O141A4 Perform the following: • EXP ADV sw (S16) - MAN/RESET (mom) (Hold for 2 sec) • EXP ADV sw (S16) - AUTO • Verify specimen disc rotates one specimen • HI VOLT/CAM sw (S14) - READY/RESET (mom) • HI VOLT/CAM sw (S14) - ON and continue the experiment.	If the electrical contacts in the specimen wheel are open, power cannot be applied to the HI VOLT/CAM sw to operate the electron beam or the DAC. The specimen wheel is rotated to the next specimen and the experiment continued.

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 43 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.41 (Concluded)		O141B The electron beam does not continue to operate when the HI VOLT/CAM sw (S14) is released.	O141B1 Refer to the Contingency Plan O120B1.	
		O141C The DAC does not operate.	O141C1 Verify that the electron beam is on.	
			• Electron beam is on. --Push the DAC operate button and operate the DAC manually while continuing the experiment.	This would indicate that the K8 relay contact 4-6 failed open and the DAC could not be operated remotely.
			• Electron beam is not on. --Refer to Contingency Plan O141A2.	This would indicate one of the following: • The pole 4-5-6 of the HI VOLT/CAM sw (S14) failed to make contact in the No. 6 position. • The HI VOLT/CAM sw (S14) failed to make contact in the ON position. • The electrical contacts in the specimen wheel are open.
		O141D The DAC does not continue to operate when the HI VOLT/CAM sw (S14) is released.	O141D1 Refer to Contingency Plan O119B1.	

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 44 of 46)

Operation Step Number	*Experiment/Crew Tasks*	*Possible Malfunction*	*Contingency Plan*	Remarks (malfunctions, corrections, results)
O 1 42	Observe ELECTRON BEAM voltage gage (M1) reading is in the green	O142A The ELECTRON BEAM voltage gage (M1) reading is not in the green.	O142A1 Continue the experiment and verify that the electron beam will melt the specimens	It is assumed that the electron beam is still adjusted to produce an optimum beam If the beam will not melt the specimens, terminate the experiment.
O 1 43	Verify that the electron beam cuts off when the specimen separates from the specimen wheel	O143A The electron beam does not cut off when the specimen separates from the specimen wheel.	O143A1 Place the HI VOLT/CAM sw (S14) in the READY/RESET position and continue the experiment. (This is the next step in the test procedures).	This would indicate that the electrical contacts in the specimen wheel failed to open when the specimen separated from the specimen wheel. The electron beam will cut off when the HI VOLT/CAM sw (S14) is placed in the READY/RESET position
O 1.45	Verify READY lt (L4) illuminates.	O145A The READY lt (L4) does not illuminate	O145A1 Recycle the HI VOLT/CAM sw (S14) and verify that the READY lt (L4) illuminates	
			• READY lt (L4) illuminates. --Continue the experiment.	This would indicate that the HI VOLT/CAM sw (S14) had failed to make contact in the READY/RESET position but did make contact when recycled.
			• READY lt (L4) does not illuminate. --Refer to Contingency Plan O145A2.	This would indicate one of the following • The HI VOLT/CAM sw (S14) failed to make contact in the READY/RESET position. • The K7 relay coil failed open. • The K7 contact 4-6 failed to make contact when closed

TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 45 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1 45 (Concluded)				• The electrical contacts in the specimen wheel are open.
			O145A2 Place the HI VOLT/CAM sw (S14) in the ON position and verify that the electron beam comes on.	
			• Electron beam comes on. --Continue the experiment.	This would indicate one of the following • The K8 relay contacts 1-2 failed to make contact in the closed position. • The diode CR52 opened. This could also indicate that both bulbs in the READY lt (L4) are burned out. This would be a double failure and is not considered in this analysis.
			• Electron beam does not come on. --Refer to Contingency Plan O141A4.	This would indicate that the electrical contacts in the specimen wheel are open.
O 1.46	EXP ADV sw (S16) - MAN/RESET (mom) (Hold for 2 sec).	O146A The M553 SPHERE FORMING MOTOR does not rotate	O146A1 Refer to Contingency Plan O128A1.	
		O146B The M553 SPHERE FORMING MOTOR continues to rotate as long as the EXP ADV sw (S16) is held in the MAN/RESET position.	O146B1 Refer to Contingency Plan O128B1	

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TABLE H-V. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O) (Sheet 46 of 46)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1 47	EXP ADV sw (S16) - AUTO	O147A The M553 SPHERE FORMING MOTOR does not rotate	O147A1 Refer to Contingency Plan O129A1	
		O147B The M553 SPHERE FORMING MOTOR continues to rotate as long as the EXP ADV sw (S16) is held in the AUTO position.	O147B1 Refer to Contingency Plan O129B1	
O 1.48	Verify specimen disc rotates one specimen	O148A The specimen disc did not rotate one specimen	O148A1 Refer to Contingency Plans O128A1 and O129A1.	Do not terminate the experiment until after the EXP ADV sw (S16) has been recycled in both the MAN/RESET and AUTO position and the specimen wheel does not rotate one specimen.

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TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 1 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.2	Verify that the filament glow is turned off.	T12A The filament glow is not turned off.	T12A1 Recycle the FIL/BEAM CONT sw (S12).	If the electron beam turns off, this would indicate that the FIL BEAM CONT sw (S12) had failed in the ON position, but did release when recycled.
			T12A2 Perform the following: • ELECTRON BEAM POWER sw (S3) - OFF • POWER FIL BATT cb (CB3) - open • ELECTRON BEAM POWER sw (S3) - ON and continue the experiment termination	These steps are performed to remove power from the EBG filament without using the POWER FIL BATT cb (CB3) as a sw. Note that in Table H-III, the CB3 cb is open in OSN T 1.13
T 1.3	FLOOD LT sw (S19) - OFF.	T13A The floodlight does not turn off.	T13A1 Recycle the FLOOD LT sw (S19).	If the floodlight goes out, this would indicate that the FLOOD LT sw (S19) had failed in the BATT position, but did release when recycled.
			T13A2 Continue the experiment termination.	The experiment termination will be continued whether the floodlight is on or off
T 1.4	FILAMENT CHAMBER VENT vlv - CLOSE	T14A The FILAMENT CHAMBER VENT vlv will not close.	T14A1 Apply a greater amount of force than is normally required to close the FILAMENT CHAMBER VENT vlv.	If the FILAMENT CHAMBER VENT vlv will not close, the EBG will be exposed to the MDA atmosphere when the work chamber is repressurized. This may shorten the lifetime of the EBG filament because of oxidation.
			T14A2 Continue the experiment termination	

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TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 2 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.5	Work chamber vent vlv - CLOSE	T15A The work chamber vent vlv will not close	T15A1 Apply a greater amount of force than is normally required to close the work chamber vent vlv T15A2 Continue the experiment termination	
T 1.6	Bulkhead vent vlv - CLOSE	T16A The bulkhead vent vlv will not close.	T16A1 Apply a greater amount of force than is normally required to close the bulkhead vent vlv T16A2 Continue the experiment termination.	
T 1.7	CHAMBER REPRESS vlv - OPEN	T17A The CHAMBER REPRESS vlv will not open	T17A1 Apply a greater amount of force than is normally required to close the CHAMBER REPRESS vlv. T17A2 Unscrew the vacuum cleaner port cover from the vacuum cleaner housing assembly, wait an appropriate length of time for the work chamber to pressurize, screw the vacuum cleaner port cover back onto the vacuum cleaner housing assembly, and continue the experiment termination.	
T 1.8	Verify that the INSTRUMENTATION PRESS gage (M5) reading increases to approximately 5 psia.	T18A The INSTRUMENTATION PRESS gage (M5) reading is 0 psia	T18A1 Verify that the INSTRUMENTATION CSTR X3 sw (S1) is still in the WORK CHMBR position If so, continue with this Contingency Plan T18A2 Tap the INSTRUMENTATION PRESS gage (M5) with finger T18A3 Place the INSTRUMENTATION CSTR X3 sw (S1) in the CSTR X3	If the INSTRUMENTATION PRESS gage (M5) reading increases to 5 psia, this would indicate that the M5 gage has a loose connection

TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 3 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.8 (Concluded)			position and verify that the INSTRUMENTATION PRESS gage (M5) reading is 8 psia.	
			• INSTRUMENTATION PRESS gage (M5) reading is 8 psia --Wait an appropriate length of time for the work chamber to pressurize and continue the experiment termination.	This would indicate that the work chamber pressure transducer has failed.
			• INSTRUMENTATION PRESS gage (M5) reading is 0 psia. --Wait an appropriate length of time for the work chamber to pressurize and continue the experiment termination	This would indicate that the INSTRUMENTATION PRESS gage (M5) has failed. If the second specimen wheel has been melted, this will not affect the experiment. If the second specimen wheel has not been melted, the EBG would have to be activated again, the EBG canister pressure could not be verified. A decision would have to be made concerning whether or not to melt the second specimen wheel.
T 1.9	INSTRUMENTATION CSTR X3 sw (S1) - OFF.	T19A The INSTRUMENTATION PRESS gage (M5) reading remains at 5 psia	T19A1 Tap the INSTRUMENTATION PRESS gage (M5) with finger.	If the INSTRUMENTATION PRESS gage (M5) reading decreases to 0 psia, this would indicate that the M5 gage has a loose connection.
			T19A2 Recycle the INSTRUMENTATION CSTR X3 sw (S1) and verify that the INSTRUMENTATION PRESS gage (M5) reading is 0 psia.	
			• INSTRUMENTATION PRESS gage (M5) reading is 0 psia. --Continue the experiment termination.	This would indicate that the INSTRUMENTATION CSTR X3 sw (S1) had failed in the

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TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 4 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.9 (Concluded)				WORK CHMBR position, but did release when recycled.
			• INSTRUMENTATION PRESS gage (M5) reading is 5 psia. --Refer to Contingency Plan T19A3.	This would indicate one of the following: • The INSTRUMENTATION CSTR X3 sw (S1) failed in the WORK CHMBR position • The INSTRUMENTATION PRESS gage (M5) was hung
			T19A3 Place the INSTRUMENTATION POWER sw (S2) in the OFF position and verify that the INSTRUMENTATION PRESS gage (M5) reading is 0 psia. Note The INSTRUMENTATION POWER sw (S2) is normally placed in the OFF position in OSN T 1.10.	If the second specimen wheel has not been melted, a decision will have to be made concerning whether or not to continue the experiment and melt the second specimen wheel because the EBG canister pressure cannot be measured
			• INSTRUMENTATION PRESS gage (M5) reading is 0 psia. --Continue the experiment termination.	This would indicate that the INSTRUMENTATION CSTR X3 sw (S1) failed in the WORK CHMBR position.
			• INSTRUMENTATION PRESS gage (M5) reading remains 5 psia --Continue the experiment termination.	This would indicate that the INSTRUMENTATION PRESS gage (M5) was hung.

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TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 5 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.10	INSTRUMENTATION POWER sw (S2) - OFF.	T110A The INSTRUMENTATION TEMP gage (M4) continues to read upscale of 0 °C	T110A1 Tap the INSTRUMENTATION TEMP gage (M4) with finger.	If the INSTRUMENTATION TEMP gage (M4) reading decreases to 0 °C, this would indicate that the M4 gage is hung but did release when tapped with the finger.
			T110A2 Recycle the INSTRUMENTATION POWER sw (S2) and verify that the INSTRUMENTATION TEMP gage (M4) reading decreases to 0 °C.	
			• INSTRUMENTATION TEMP gage (M4) reading decreases to 0 °C. --Continue the experiment termination.	This would indicate that the INSTRUMENTATION POWER sw (S2) failed in the BATT position, but did release when recycled.
			• INSTRUMENTATION TEMP gage (M4) reading remains upscale of 0 °C. --Refer to Contingency Plan T110A3.	This would indicate one of the following: • The INSTRUMENTATION POWER sw (S2) failed in the BATT position. • The INSTRUMENTATION PRESS gage (M5) failed.
			T110A3 Place the ELECTRON BEAM POWER sw (S3) in the OFF position and verify that the INSTRUMENTATION TEMP gage (M4) reading decreases to 0 °C. Note: The ELECTRON BEAM POWER sw (S3) is normally placed in the OFF position in OSN T 1.12.	T

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TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 6 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.10 (Concluded)			• INSTRUMENTATION TEMP gage (M4) reading decreases to 0 °C. --Continue the experiment termination	This would indicate that the INSTRUMENTATION POWER sw (S2) failed in the BATT position.
			• INSTRUMENTATION TEMP gage (M4) continues to read upscale of 0 °C. --Continue the experiment termination.	This would indicate that the INSTRUMENTATION TEMP gage (M4) was hung.
T 1.11	ELECTRON BEAM POWER sw (S3) - OFF	T111A The FIL CHMBR PRESS gage (M3) is not reading full scale	T111A1 Tap the FIL CHMBR PRESS gage (M3) with finger	If the FIL CHMBR PRESS gage (M3) reading increases to full scale, this would indicate that the FIL CHMBR PRESS gage (M3) is hung.
			T111A2 Recycle the ELECTRON BEAM POWER sw (S3) and verify that the FIL CHMBR PRESS gage (M3) reading increases to full scale.	
			• FIL CHMBR PRESS gage (M3) reading increases to full scale --Continue the experiment termination.	This would indicate that the ELECTRON BEAM POWER sw (S3) had failed in the ON position, but did release when recycled
			• FIL CHMBR PRESS gage (M3) reading is not full scale. --Refer to Contingency Plan T111A3.	This would indicate one of the following: • The ELECTRON BEAM POWER sw (S3) failed in the ON position. • The FIL CHMBR PRESS gage (M3) failed

TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 7 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1 11 (Concluded)			T111A3 Open the POWER CONTROL BATT cb (CB2) and verify that the FIL CHMBR PRESS gage (M3) reading is full scale. Note: The POWER CONTROL BATT cb (CB2) is normally opened in OSN T 1 13.	
			• FIL CHMBR PRESS gage (M3) reading is full scale. --Continue the experiment termination.	This would indicate that the ELECTRON BEAM POWER sw (S3) failed in the BATT position.
			• FIL CHMBR PRESS gage (M3) reading is not full scale. --Continue the experiment termination.	This would indicate that the FIL CHMBR PRESS gage (M3) failed.
T 1.15	Loosen the work chamber hatch fasteners	T115A The Calfax fasteners and/or cam lock latches will not loosen.	T115A1 Apply a greater amount of force than is normally required to loosen the fasteners and/or latches T115A2 Obtain appropriate tool to loosen fasteners and/or latches. T115A3 Terminate the experiment and reconfigure the MPF to its initial condition.	
T 1.16	Remove the work chamber vacuum cleaner port cover and connect vacuum cleaner	T116A The vacuum cleaner port cover will not remove.	T116A1 Apply a greater amount of force than is normally required to open the vacuum cleaner port. T116A2 Obtain appropriate tool to loosen the vacuum cleaner port. T116A3 Open the work chamber hatch, collect spheres, use vacuum cleaner to vacuum out the residue, and continue the experiment termination	T

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TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 8 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.16 (Concluded)		T116B The vacuum cleaner will not connect to the vacuum cleaner port	T116B1 Open the work chamber hatch, collect spheres, use vacuum cleaner to vacuum out the residue, and continue with experiment termination	
T 1.17	Connect the vacuum cleaner power cable to HI PWR ACCESS OUTLET 1.	T117A The vacuum cleaner power cable will not connect to HI PWR ACCESS OUTLET 1.	T117A1 Determine if the trouble is caused by either the vacuum cleaner connector or HI PWR ACCESS OUTLET 1. • Vacuum cleaner connector --Continue the experiment termination without the use of the vacuum cleaner. • HI PWR ACCESS OUTLET 1 --Verify that the HI PWR ACC OUTLETS 2 cb is open. --Verify that the HI PWR ACCESS OUTLET 2 sw is off --Connect vacuum cleaner connector to the HI PWR ACCESS OUTLET 2 and continue the experiment termination.	The HI PWR ACC OUTLETS 2 cb is located on panel 202 in the STS.
T 1.19	Manually crack hatch.	T119A The hatch will not crack.	T119A1 Apply a greater amount of force than normally required to crack the hatch. T119A2 Obtain appropriate tool to crack hatch and continue the experiment termination.	

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TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 9 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.21	Vacuum cleaner POWER sw - ON.	T121A The vacuum cleaner will not operate.	T121A1 Recycle the following. • Vacuum cleaner POWER sw • Vacuum cleaner CIRCUIT BREAKER • HI PWR ACCESS OUTLET 1 sw • HI PWR ACC OUTLETS 1 cb. T121A2 Perform the following • Vacuum cleaner POWER switch - OFF. • Vacuum cleaner CIRCUIT BREAKER - OPEN. • HI PWR ACCESS OUTLETS 1 sw - OFF • HI PWR ACC OUTLETS 1 cb - close • HI PWR ACC OUTLETS 2 cb - close (verify) • HI PWR ACCESS OUTLETS 2 sw - OFF (verify)	The HI PWR ACC OUTLETS 1 cb is located on Panel 202 in the STS. If the vacuum cleaner operates, this would indicate that one of the following had failed to make contact, but did make contact when recycled • Vacuum cleaner POWER sw • Vacuum cleaner CIRCUIT BREAKER • HI PWR ACCESS OUTLET 1 sw • HI PWR ACC OUTLETS 1 cb. T

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TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 10 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.21 (Continued)			• Plug vacuum cleaner power cable into HI PWR ACCESS OUTLET 2 • HI PWR ACCESS OUTLETS 2 sw - ON • Vacuum cleaner CIRCUIT BREAKER - close • Vacuum cleaner POWER SWITCH - ON. and verify that the vacuum cleaner operates	
			• Vacuum cleaner operates. --Continue the experiment termination.	This would indicate one of the following. • The HI PWR ACC OUTLETS 1 cb did not make contact in the closed position • The HI PWR ACCESS OUTLETS 1 sw failed to make contact in the ON position
			• Vacuum cleaner does not operate --Refer to Contingency Plan T121A3.	This would indicate one of the following • The vacuum cleaner CIRCUIT BREAKER failed to make contact when closed

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TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 11 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.21 (Concluded)				• The vacuum cleaner POWER SWITCH failed to make contact in the ON position • The vacuum cleaner blower unit failed.
			T121A3 A decision will have to be made concerning whether or not to replace the vacuum cleaner blower unit.	
			• Replace vacuum cleaner blower unit --Obtain spare vacuum cleaner blower unit and install in vacuum cleaner, continue the experiment termination.	A decision was made to replace the blower unit and see if the vacuum cleaner will operate. The spare blower unit is stowed in a spare parts stowage compartment in the OWS forward dome.
			• Do not replace the vacuum cleaner blower unit --Continue the experiment termination without the vacuum cleaner.	A decision was made not to replace the vacuum cleaner blower unit but continue the experiment termination by manually collecting the spheres.
T 1.22	Observe if there are any loose specimens that have not entered M553 SPHERE CATCHER 1.	T122A All the spheres have not gone into M553 SPHERE CATCHER 1.	T122A1 Wait 30 min and continue the experiment termination by manually collecting the spheres.	Thirty minutes are required for specimens to cool down to 105 °F.
T 1.23	Vacuum cleaner POWER SWITCH - OFF	T123A The vacuum cleaner continues to run.	T123A1 Recycle the vacuum cleaner POWER SWITCH.	
			T123A2 Open the vacuum cleaner CIRCUIT BREAKER and continue the experiment termination, keeping in mind that the vacuum cleaner POWER SWITCH has failed to break contact in the ON position.	This would indicate that the vacuum cleaner POWER SWITCH had failed in the ON position. T

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TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 12 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.26	Disconnect vacuum cleaner power cable from HI PWR ACCESS OUTLET 1	T126A The vacuum cleaner power cable will not disconnect from HI PWR ACCESS OUTLET 1.	T126A1 Apply a greater amount of force than is normally required to disconnect the vacuum cleaner power cable from HI PWR ACCESS OUTLET 1 T126A2 Leave the vacuum cleaner power cable connected to HI PWR ACCESS OUTLET 1 and continue the experiment termination.	
T 1.31	Disconnect vacuum cleaner and replace vacuum cleaner port cover.	T131A The vacuum cleaner will not disconnect from the vacuum cleaner port.	T131A1 Apply a greater amount of force than is normally required to disconnect the vacuum cleaner from the vacuum cleaner port. T131A2 Leave the vacuum cleaner connected to the vacuum cleaner port and continue the experiment termination.	Note that if the second specimen wheel has not been melted, this failure would probably prevent it from being melted.
T 1.32	Remove M553 SPHERE FORMING MOTOR and mount on the M479 flammability specimen container	T132A One or more of the Calfax fasteners will not unscrew to remove the M553 SPHERE FORMING MOTOR from the work chamber.	T132A1 Apply a greater amount of force than is normally required to unscrew the Calfax fasteners. T132A2 Obtain appropriate tool to unscrew fasteners. T132A3 Leave the M553 SPHERE FORMING MOTOR mounted in the work chamber and continue the experiment termination.	If the second specimen wheel has not been melted, it can be mounted onto the M553 SPHERE FORMING MOTOR inside the work chamber
		T132B The M553 SPHERE FORMING MOTOR electrical cable connector will not disconnect from the work chamber connector.	T132B1 Apply a greater amount of force than is normally required to disconnect the M553 SPHERE FORMING MOTOR electrical cable connector from the work chamber connector.	If the second specimen wheel has not been melted, it can be mounted onto the M553 SPHERE FORMING MOTOR in the work chamber.

TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 13 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.32 (Concluded)			T132B2 Leave the M553 SPHERE FORMING MOTOR mounted in the work chamber and continue the experiment termination.	
		T132C The specimen wheel will not remove from the M553 SPHERE FORMING MOTOR	T132C1 Apply a greater amount of force than is normally required to remove the specimen wheel from the M553 SPHERE FORMING MOTOR.	If the second specimen wheel has not been melted, it cannot be mounted onto the M553 SPHERE FORMING MOTOR.
			T132C2 Leave the specimen wheel on the M553 SPHERE FORMING MOTOR and continue the experiment termination	
T 1.34	Remove the M553 SPHERE CATCHER INSTALLATION TOOL and the M553 SPHERE CATCHER 1 from the work chamber.	T134A The sphere catcher will not remove from the work chamber.	T134A1 Apply a greater amount of force than is normally required to remove the sphere catcher from the work chamber.	
			T134A2 Remove the spheres from the sphere catcher, put spheres in debris bag, and temporarily stow in the EQUIPMENT STORAGE CONTAINER, continue the experiment termination.	The debris bags are located in locker F520.
T 1.35	Disconnect the M553 SPHERE CATCHER INSTALLATION TOOL from the M553 SPHERE CATCHER 1.	T135A The M553 SPHERE CATCHER INSTALLATION TOOL will not disconnect from the sphere catcher.	T135A1 Apply a greater amount of force than is normally required to remove the M553 SPHERE CATCHER INSTALLATION TOOL from the sphere catcher.	If the second specimen wheel has not been melted and this failure occurs, the sphere catcher with the M553 SPHERE CATCHER INSTALLATION TOOL can be used to collect the spheres for the second specimen wheel
			T135A2 Refer to Contingency Plan T134A2.	

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TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 14 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.37	Remove the M553 SPHERE FORMING MOTOR from the M479 specimen container and stow in the EQUIPMENT STORAGE CONTAINER.	T137A The M553 SPHERE FORMING MOTOR will not remove from the M479 specimen container.	T137A1 Apply a greater amount of force than is normally required to unscrew the Calfax fasteners and remove the M553 SPHERE FORMING MOTOR from the M479 specimen container. T137A2 Obtain appropriate tool to unscrew Calfax fasteners. T137A3 Leave the M553 SPHERE FORMING MOTOR mounted on the M479 specimen container and continue the experiment termination.	If the second specimen wheel has not been melted when this failure occurs, it will not be melted.
T 1.38	Remove the dummy connector from the FLAMMABILITY SPECIMEN HOLDER TEMPORARY STORAGE connector and connect to the work chamber zero-g connector.	T138A The dummy connector will not disconnect from the FLAMMABILITY SPECIMEN TEMPORARY STORAGE connector	T138A1 Apply a greater amount of force than is normally required to remove the dummy connector from the FLAMMABILITY SPECIMEN TEMPORARY STORAGE connector. T138A2 Leave the dummy connector on the FLAMMABILITY SPECIMEN HOLDER TEMPORARY STORAGE connector and continue the experiment termination.	
T 1.39	Remove the M553 CAMERA PORT SHIELD SPHERE FORMING from the work chamber.	T139A The M553 CAMERA PORT SHIELD SPHERE FORMING will not remove from the work chamber	T139A1 Apply a greater amount of force than is normally required to remove the M553 CAMERA PORT SHIELD SPHERE FORMING from the work chamber T139A2 Leave the M553 CAMERA PORT SHIELD SPHERE FORMING mounted in the work chamber and continue the experiment termination.	

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TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 15 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.40	Remove the M553 HATCH VIEW-PORT SHIELD SPHERE FORMING from the work chamber hatch and stow in the EQUIPMENT STORAGE CONTAINER	T140A The M553 HATCH VIEW-PORT SHIELD SPHERE FORMING will not remove from the work chamber hatch	T140A1 Apply a greater amount of force than is normally required to remove the M553 HATCH VIEW-PORT SHIELD SPHERE FORMING from the work chamber hatch T140A2 Leave the M553 HATCH VIEW-PORT SHIELD SPHERE FORMING mounted on the work chamber hatch and continue the experiment termination.	
T 1.42	CHAMBER REPRESS vlv - CLOSED	T142A The CHAMBER REPRESS vlv will not close	T142A1 Apply a greater amount of force than is normally required to close the CHAMBER REPRESS vlv. T142A2 Continue the experiment termination	If the second specimen wheel has not been melted when this failure occurs, a vacuum cannot be pulled on the work chamber
T 1.43	Remove the 75mm lens and the right angle mirror from the DAC and stow	T143A The 75mm lens and the right angle mirror will not remove from the DAC	T143A1 Apply a greater amount of force than is normally required to remove the 75mm lens and the right angle mirror from the DAC T143A2 Leave the 75mm lens and right angle mirror on the DAC and continue the experiment termination	
T 1 44	Disconnect power and control cables from DAC and connect cables to dummy connectors provided for storage	T144A The power and control cables will not disconnect from the DAC	T144A1 Apply a greater amount of force than normally required to remove the power and control cables from the DAC T144A2 Leave the power and control cables connected to the DAC and continue the experiment termination	The DAC can remain mounted on the camera mount

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TABLE H-VI. EXPERIMENT M-553, SPHERE FORMING MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T) (Sheet 16 of 16)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
T 1.45	Remove film XPT assembly from DAC and stow	T145A The film XPT will not remove from the DAC	T145A1 Apply a greater amount of force than is normally required to remove the film XPT assembly from the DAC T145A2 Remove the DAC from the camera mount, stow DAC with film XPT assembly in the film vault, and continue the experiment termination	
T 1.46	Remove the 16mm DAC and stow.	T146A The 16mm DAC will not remove from the camera mount	T146A1 Apply a greater amount of force than is normally required to remove the DAC from the camera mount T146A2 Leave the DAC mounted on the camera mount and continue the experiment termination.	

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SECTION J

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SECTION X. CONCLUSIONS AND RECOMMENDATIONS

1. The following vlv failures will result in termination of the M-553 experiment:
   - Bulkhead vent vlv fails closed: if the bulkhead vent vlv fails closed, a vacuum cannot be pulled on the work chamber
   - Work chamber vent vlv fails closed: if the work chamber vent vlv fails closed, a vacuum cannot be pulled on the work chamber
   - CHAMBER REPRESS vlv fails open: if the CHAMBER REPRESS vlv fails open, a vacuum cannot be pulled on the work chamber
   - FILAMENT CHAMBER VENT vlv fails closed: if the FILAMENT CHAMBER VENT vlv fails closed, the electron beam cannot impinge on the metal specimens.
2. The following sw failures will result in termination of the M-553 experiment:
   - FIL/BEAM CONT (S12) sw fails off: if the S12 sw fails off, power cannot be applied to the EBG
   - ELECTRON BEAM POWER (S3) sw fails off: if the S12 sw fails off, power cannot be applied to the EBG
   - HI VOLT/CAM (S14) sw fails in the READY/RESET position: if the S14 sw fails in the READY/RESET position, high voltage cannot be applied to the EBG
   - EXP ADV (S16) sw fails off: if the S16 sw fails off, power cannot be applied to the sphere forming motor to advance the sphere forming specimen disc.
3. The following cb failures will prevent power from being applied to the EBG and result in termination of the M-553 experiment:
   - MAIN BATTERY (CB1) fails open: if the CB1 cb fails open, power cannot be applied to perform the experiment
   - POWER CONTROL BATT (CB2) fails open: if the CB2 cb fails open, power cannot be applied to perform the experiment.

- POWER FIL BATT (CB3) fails open: if the CB3 cb fails open, power cannot be applied to the EBG.

4. The failure of the INSTRUMENTATION PRESS gage (M5) could result in termination of the M-553 experiment; the EBG canister pressure could not be verified at 24 psia or above.

5. The following preflight test activity is recommended:

   - Determine if the vacuum cleaner port cover can be removed while the work chamber is in a vacuum condition. If the vacuum cleaner port cover can be removed, this will serve as a backup procedure to repressurize the work chamber if the CHAMBER REPRESS vlv fails closed. The analysis performed in this document assumed that this task could be accomplished.

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