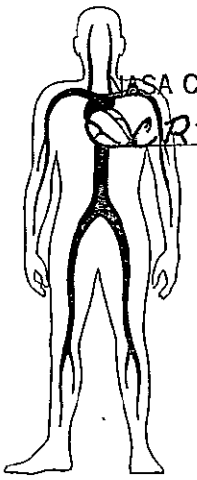

TECHNOLOGY INCORPORATED
LIFE SCIENCES DIVISION

FOOD DEPOT

FINAL REPORT

APOLLO-SOYUZ TEST PROJECT

CONTRACT NAS 9-13291

26 August 1975

17311 EL CAMINO REAL • HOUSTON, TEXAS 77058

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TABLE OF CONTENTS.

		Page
1.0	Introduction	1
1.2	ASTP Food Requirements	2
2.0	Food Depot Operations	5
2.1	Facility	5
2.2	Staff	7
2.3	Equipment	9
2.4	Procedures and Documentation	10
2.5	Quality Control	15
2.6	Microbiology	16
2.7	Cost Analysis	18
2.8	Bonded Storage	20
2.9	Inventory Control, Records and Traceability	20
3.0	ASTP Food System	22
3.1	Menu	22
3.2	ASTP Food Tray	22
3.3	Packaging	23
4.0	Discussion and Recommendations	27
	Appendix A - ASTP Food System Standards, Specifications and Drawing	
	Appendix B - ASTP Menu	
	Appendix C - Abbreviations	

LIST OF FIGURES AND TABLES

FIGURE

1	Food Depot Management Structure
2	ASTP Food System Documentation Tree
3	Food Depot Work Order
4	ASTP Food Tray
5	ASTP Beverages
6	ASTP Spoonbowl Packages
7	ASTP Bite-size Packages
8	ASTP Wet Packs
9	ASTP Canned Items
10	ASTP Bread Package
11	Evacuated Meal Overwraps
12	Food Locker A-3
13	Food Locker B-1
14	Food Locker L-3

TABLE

1	ASTP Package Material Cost
2	Cost of Typical ASTP Meal
3	Source of ASTP Food Items
4	ASTP Food Packages
5	ASTP Primary Food Packages

1.0 INTRODUCTION

The ASTP Food System was processed, packaged and assembled at the NASA-Johnson Space Center. All of these operations were performed by an in-house contractor in a specially designed area called the Food Depot in building 37. This report discusses the Food Depot operations required to produce the ASTP Food System, describes the food system and provides some analysis and recommendations related to future operations.

1.1 Background

Previous food systems for Apollo and Skylab were produced by an off-site contractor. The food production contracts were monitored by NASA-JSC personnel. At the termination of Skylab, the off-site food contractor dissolved their space food production organization and facility. While studying ways to produce the upcoming Shuttle food system, the Food Depot concept evolved. A Food Depot was envisioned to serve as a central warehouse and final assembly for both preflight and flight food. The Food Depot would store sufficient quantities of all food items to permit immediate response to all flight requirements. The Food Depot would be managed and controlled from JSC, but would have the capacity to supply foods at any launch site.

Since there was no longer a readily available source for space foods for the ASTP mission, and most of the space food technology in existence was at JSC, it was decided to produce the ASTP food system at JSC utilizing the Food Depot concept. All of the specially designed space food packaging equipment, used by the previous off-site contractor had been

transferred to JSC at the termination of the Skylab contract. An area in building 37 was modified to accommodate the Food Depot. Maximum use of existing facilities such as walk-in freezers and refrigerators was made in planning the modification. All of the equipment received from the previous food contractor was in very poor condition and required a complete overhauling in order to function properly and meet NASA safety standards. The equipment was reworked simultaneously with the construction of the facility.

In addition to providing the food system for ASTP, the Food Depot provided an in depth study and evaluation of the Food Depot concept. The guidelines, procedures, and documentation requirements for this type of organization were established and tested under rigorous operational conditions. A cost analysis was also performed utilizing actual production figures.

1.2 ASTP Food Requirements

The ASTP Food System was required to provide food and accessory hardware necessary to support a 3-man U.S. crew with an inflight functional food system for a 11.6 day mission. An additional requirement was to provide 1 meal for each Russian cosmonaut. The food provided was required to meet the energy, nutritional, psychological and physiological needs of the individual crewman.

The food system was stowed in 3 lockers aboard the spacecraft command module. The 3 food lockers were A-3, B-1, and L-3.

The ASTP Food System was similar to the previous Apollo missions. Extensive use of light weight, freeze-dried foods was made in order to conserve weight and utilize the water produced by the fuel cells. Unlike Skylab, the ASTP system did not have means for heating food or storing in freezers and refrigerators. Although the ASTP Food System was similar to Apollo, there were several differences. A food tray was provided on ASTP for meal assembly, preparation and consumption. The ASTP Food System contained many food items which had not previously been used on Apollo. Some of the food items were from Skylab and others were new items. Even though some Skylab items were used on ASTP, they required repackaging, because Skylab packaging was not compatible with the ASTP system.

Prior to packaging for flight, food items were stored in sealed metal cans under a nitrogen atmosphere. Oxygen content of the headspace in the stored cans was required to be less than 2% by volume. After the food was interim canned, it was required to meet the following microbiological specifications.

NON-THERMOSTABILIZED FOOD

Total Aerobic Plate Count	-	Not greater than 10,000/g
Escherichia coli	-	Negative in 1g
Coagulase Positive Staphylococci	-	Negative in 5g
Samonella	-	Negative in 25g
Yeast and Mold	-	Not greater than 100/g

THERMOSTABILIZED FOOD

Incubation Test (35°F and 55°C) - No flippers, springers, soft or hard swells in sample

Anaerobic Growth (35°C and 55°C) - No growth in test sample taken from incubation tested can

Aerobic Growth (35°C and 55°C) - No growth in test sample taken from incubation tested can

Packaged flight food items were also required to meet the above specifications for Total Aerobic Plate Count and Escherichia Coli. In addition to these microbiological requirements, all flight food packaging materials were required to meet the following specifications:

Total Aerobic Count - Not greater than 3,000 per square foot

Escherichia Coli - Negative per 1 square foot

Fabricated flight packages were required to meet the following specifications:

Total Aerobic Count - Not greater than 3,000 per package

Escherichia Coli - Negative in one package

Food items for the ASTP menus were restricted to the following general categories: (a) freeze dehydrated, (b) dehydrated, (c) thermostabilized, (d) intermediate moisture, (e) natural form, and (f) irradiated.

Package design for the ASTP mission was limited to packaging concepts and materials which had been previously flown in order to avoid qualification testing. A complete documentation system, including specifications, standards, and drawings, was required to produce the ASTP Food System.

Previous food system documents were not registered with the JSC Documentation Management Office or the JSC Drawing Control Center, since this had been performed by an off-site contractor. Also, the numbering system and format of many of the documents did not conform to JSC requirements. Many of the previous documents, such as the Skylab documents were also mission oriented and could not be applied to the ASTP mission.

2.0 FOOD DEPOT OPERATIONS

2.1 Facility

Original plans called for the construction of a complete Food Depot at NASA-JSC. A facility was planned and architectural drawings were completed for such a facility utilizing an existing building at JSC. The facility was planned to produce the ASTP Food System and to provide expansion room for a Shuttle Food Depot. The planned facility provided the capability to produce thermostabilized, freeze-dried, and frozen foods. Complete packaging facilities including a clean room were also planned. The facility was designed to meet all construction requirements for a food plant. However, the cost of this facility was prohibitive, therefore, it was decided to modify a portion of Building 37 to accommodate a food depot for the ASTP mission. The modifications did not include plans to meet all of the construction requirements for a food plant such as sloped floors with drains, washable walls and ceiling and separate plumbing for food processing and personnel. Deficiencies in the construction requirements were overcome with strict operational procedures and additional quality control testing.

The modified facility consisted of 7 separate areas: food processing, freeze-drying, package fabrication, final packaging, refrigerated

storage, ambient bonded storage and parts and materials storage.

Air flow in the modified facility was converted from a negative pressure to a positive pressure system. This was accomplished by adjusting existing equipment. Temperature and humidity control adjustments were also made to meet the ASTP specifications which were: temperature not to exceed 72°F and relative humidity not to exceed 55%.

The food processing area was designed to perform the minimum required processing operations for ASTP. It contained a double sink for cleaning equipment and the necessary drains and utility connections for the processing equipment. A temporary ceiling was installed over a portion of the processing area to control contamination from overhead pipes and ducts. An anteroom was equipped with hand washing facilities and lockers and served as a change area for all of the Food Depot complex except for the final packaging area.

The freeze-drying area was sealed off from the other areas within the Food Depot. It was physically located adjacent to the food processing area. The freeze-drying area was soundproofed to reduce the noise level in the other areas when the freeze dryers were being operated. Drains and other utilities were installed in the freeze-drying room for connecting to the freeze-dryers.

The package fabrication room was designed to accommodate all of the package fabrication equipment which included heated platen air presses, air presses, and package forming machines. The package fabrication room was supplied with air outlets and electricity for the various machines.

The final packaging room was completely isolated from the other Food Depot areas. The final packaging room contained one entry way with a temporary anteroom at the entrance. The anteroom served as a change area for clean room garments and a cleaning area for articles being transferred to the final packaging room. Hand washing facilities were not available in the anteroom. The anteroom to the food processing room was used for hand washing prior to entering the final packaging anteroom. The final packaging room was equipped with compressed air for the sealing machines and electrical outlets for the clean booth and clean bench. Existing refrigerator and freezer storage facilities located at the opposite end of building 37 were used by the Food Depot. This storage area consisted of a walk-in refrigerator 40°F (4.4°C), and two walk-in freezers -10°F (-23.3°C) and -40°F (-40°C). The refrigerator and freezers were modified by installing a wire cage so that bonded storage articles could be secured. An existing room in the Food Depot complex was utilized as a bonded storage room for articles stored at room temperature. This room was equipped with storage cabinets to store these articles which consisted mainly of package materials and parts. The parts and materials storage area was equipped with shelving and cabinets to store the numerous tooling, spare parts and non-bonded packaging materials.

2.2 Staff

The Food Depot staff management structure is shown in Figure 1. Management was subdivided into three functional units, production control, manufacturing and testing, and engineering with a unit leader assigned to each functional area. The unit leaders reported directly

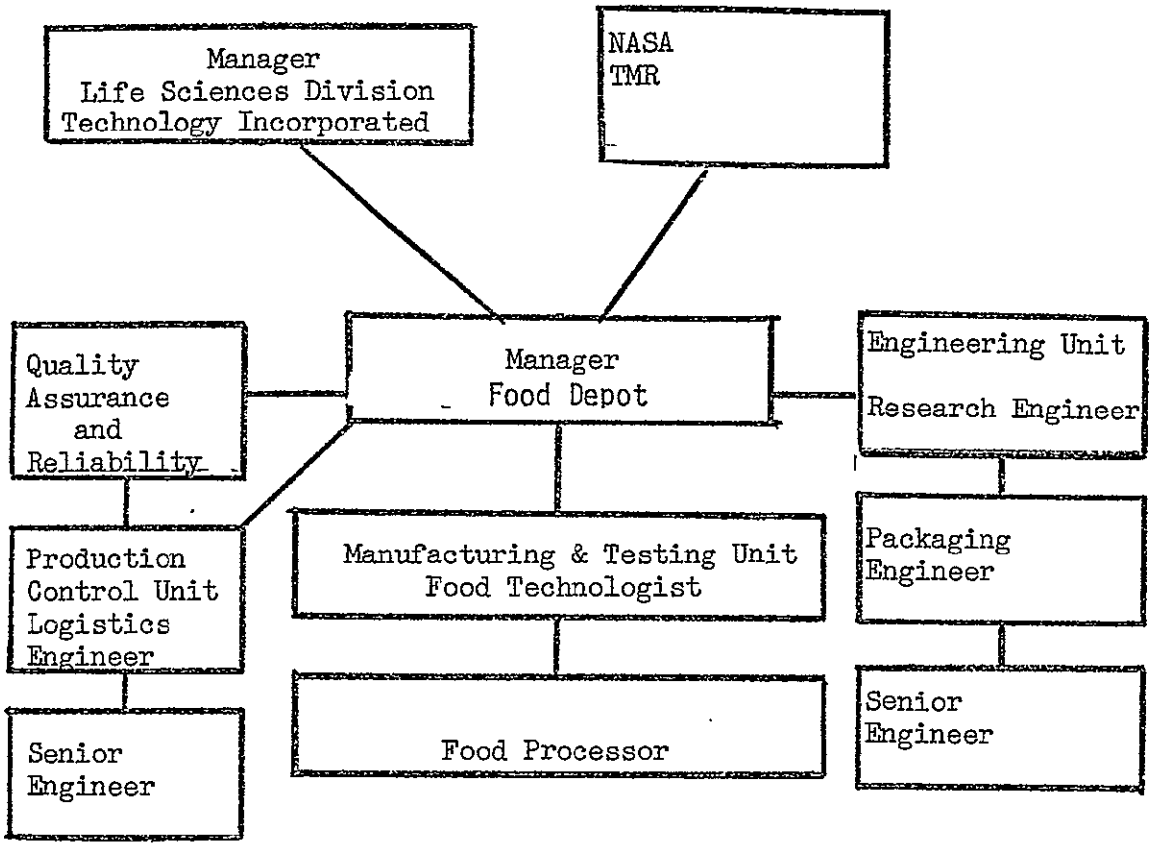


Figure 1

Food Depot Management Structure

to the Food Depot Manager who reported to the Manager of the Life Sciences Division, Technology Incorporated. Coordination and implementation of work assignments was performed by the Food Depot Manager. The Food Depot staff was an interdisciplinary team composed of engineers, food technologists and technicians.

The Food Depot Manager possessed a Ph.D. in Food Science and Nutrition with over 5 years experience in space food technology. This experience included both the Apollo and Skylab food systems.

The engineering unit was responsible for the support of required testing package fabrication, packaging and engineering coordination activities. The section leader of the engineering unit possessed a B.S. in Electrical Engineering and a Masters in Business and Administration. He had 2 years experience with the stowage, accountability and logistics of the Skylab food system.

The packaging engineer reported directly to the engineering section leader. The packaging engineer had a B.S. in Package Engineering and practical experience in food processing.

The senior engineer reported directly to the engineering unit section leader. The senior engineer was responsible for equipment maintenance and records and operating procedures. The senior engineer had a B.S. degree and 2 years experience with the stowage, accountability and logistics of the Skylab food system.

The manufacturing and testing unit was responsible for the manufacture, processing and packaging of food. The manufacturing and testing unit

was headed by a food technologist with a Master's degree in Food Technology. He had over one years experience in sampling and analytical testing of food and biological materials for the Skylab food system.

The food processor reported to the manufacturing and testing unit leader. He had over 4 years experience in freeze drying and processing and canning of Skylab analytical food samples.

The production control unit was responsible for the planning, scheduling, inventory control, work control and procurement for the food depot.

The production control unit leader had over 4 years experience performing planning, scheduling and procurement activities for the Apollo and Skylab food systems.

The senior engineer was responsible for procurement activities and inventory and reported directly to the production control unit leader. The senior engineer had over 7 years experience with the aerospace industry.

A Food Depot Management Plan was written and approved for the operation of the food depot. The management plan provided detailed responsibilities and job descriptions.

A training program was initiated at the start of the food depot operations to train food depot personnel and other Government and contractor personnel associated with the food depot. Extensive cross-training was undertaken within the food depot staff to permit efficient operations.

2.3 Equipment

Most of the food depot packaging equipment was inherited from the previous off-site contractor. Packaging equipment included 4 heated platen air presses, 2 air presses, 3 vacuum sealing machines, 1 vacuum test chamber,

Vertrod sealer, Apollo package forming machine, mold machine, and associated tooling for each of the machines. All of the equipment was refurbished prior to use so that it would meet Government safety standards. Most of the equipment required extensive refurbishing such as rewiring, replumbing and installation of safety switches and shields. While being refurbished casters were installed on all equipment to facilitate movement within the various areas of the food depot.

Two freeze dryers and two Rooney canners were received from the previous food contractor. The freeze dryers and canners were refurbished and installed in the food depot. Additional food processing equipment was purchased by the food depot. The new equipment included a range, Hobart mixer, cooker mixer, two freezers, refrigerator, two toploading balances and a dry blender. This equipment provided the food depot with the capability to produce freeze dried and dry blended foods.

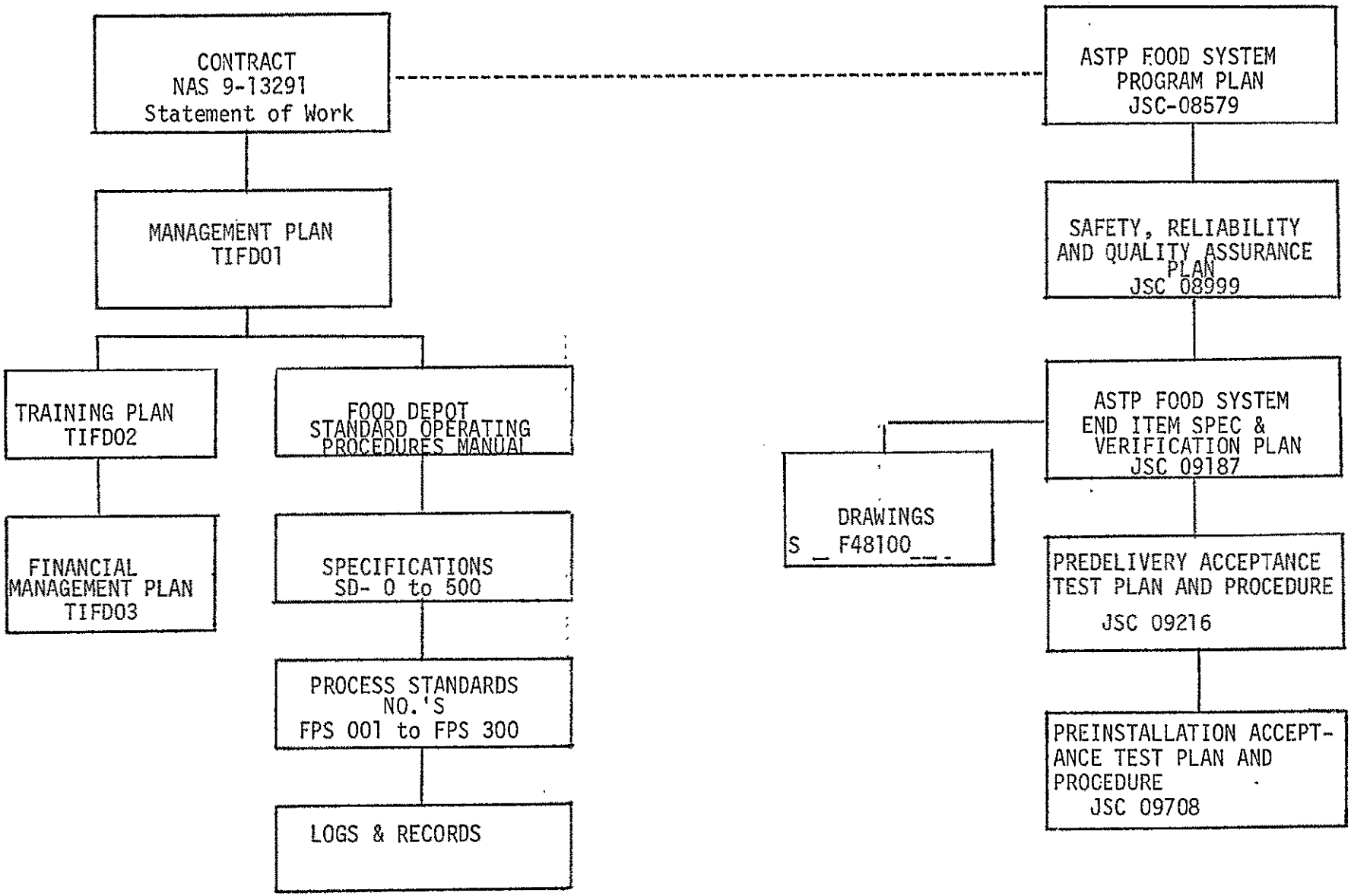
A Class 100 portable clean booth and a Class 100 clean bench were procured for the final packaging room.

An equipment record file was established for each piece of major equipment. Each file contained detailed operating instructions, utility requirements, and maintenance requirements and logs. Each piece of equipment was placed on the JSC engineering maintenance schedule. Also all gauges, regulators and readout devices were calibrated by the JSC Calibration Laboratory and maintained in current calibration throughout the Food Depot operation.

2.4 Procedures and Documentation

The Food Depot and ASTP Food System Documentation Tree is shown in Figure 2. A list of all the food documents and drawings developed and used by

FOOD DEPOT AND ASTP FOOD SYSTEM DOCUMENTATION TREE
Figure 2



the Food Depot are in Appendix A.

The Food Depot Management Plan established and defined the contractor responsibilities required for the effective management of the Food Depot. Organizational structure and responsibilities were specified and explained.

A training plan was developed and followed in order to maximize efficiency and coordinate production operations. The training plan contained scheduled classroom training as well as on the job training to familiarize all personnel with the objectives and procedures of the Food Depot operations. Training included Food Depot operations, manufacturing practices, general sanitation, particle control and safety.

A financial plan was established to provide an efficient cost effectiveness program and an end item cost on all items produced by the Food Depot. An automated cost accounting system was established and described in the financial management plan.

The Food Depot SOPM served as the basic document for all Food Depot operations. This document provided the organizational and functional responsibilities of the Life Sciences Directorate, Systems Support Branch, Food and Nutrition Branch, Support contractor, and Safety, Reliability and Quality Assurance.

Operational procedures detailed in the SOPM included inventory control, equipment control, tooling control, cost accounting, procurement procedures, package fabrication, food preparation, planning and scheduling, receiving procedures, job order and work order preparation, metrology

procedures, contamination control procedures, sanitation testing and bonded storage procedures.

Activity within the Food Depot was controlled by a job order/work order system. The job order was initiated by the contract technical monitor

The Production Control Unit issued work orders to accomplish the tasks specified in the job order. The work order form JSC 425A referenced all applicable specification, standards and drawings for the task. The work order was approved by the technical monitor, reliability engineering, quality assurance and the Food Depot manager. The work order form (Figure 3) provided space for quality assurance verification for each step.

Specifications were written and approved for all packaging materials and food items. These specifications were coordinated and filed with the JSC Documentation Management Office. The specifications were written in such a manner that they were not mission oriented like the previous Apollo and Skylab documents. A specification numbering system consistent with the NASA-JSC policy was established to permit the addition of new documents for future use. A list of the specifications developed and used on ASTP is shown in Appendix A.

Process standards were written and approved for package fabrication, testing and manufacturing of foods. These standards (Food Process Standards) (FPS) were coordinated and filed with the JSC Documentation Management Office. A list of the FPS' developed by the Food Depot and used for the production of the ASTP Food System is shown in Appendix A. The FPS' were based upon various documents and procedures used for the

Figure 3. Food Depot Work Order

TECHNOLOGY, INC. FOOD DEPOT	WORK ORDER	1. W.O. NUMBER	2. PAGE_____ OF_____
		3. JOB ORDER NUMBER	

4. TYPE			5. SYSTEM	6. DATE	7. NEED DATE
	A	CONFIGURATION CHANGE			
	B	NON-CONFIGURATION CHANGE	8. TITLE		

9. CLASS	10. ASSIGNED TO	11. REQUESTED BY

12. REFERENCE DOCUMENTS

ITEM	DESCRIPTION *(print or type)*	DATE	NASA QA

TECH. INC. APPROVALS		NASA APPROVALS	
13. INITIATED BY	DATE	14. TECH. MGR. REP.	DATE
15. DEPOT MGR.		16. Q E REP.	
17.		18. CONCURRENCE	
19. COMPLETED BY		20. FINAL ACCEPTANCE	

JSC Form 425A (Apr 74) (OT) NASA-JSC

production of Skylab and Apollo foods. The FPS' provided detailed step-by-step procedures for the procedure or test being conducted. Operator steps and quality assurance steps were listed with a space for initials and stamping when the step was successfully completed. The FPS' were designed so that they became a part of the work order if the work order involved the production of a package or food item requiring the use of a given FPS. An FPS was written and approved for the processing of each ASTP food item and several other items which were considered for ASTP food. As with the specifications, the FPS' were not specific for ASTP and can be used without change for future missions.

An ASTP Food System Program Plan (JSC 08579) outlined and defined the responsibilities of all the organizations involved in the establishment and development of the ASTP Food System. A Safety, Reliability and Quality Assurance Plan (JSC 08999) further defined the JSC Safety, Reliability and Quality Assurance requirements to be implemented while supporting the Life Sciences Directorate in providing the ASTP Food System. Basic tasks and interfacing activities and responsibilities were established and defined in this document.

An End Item Specification (JSC 09187) was developed by the Food Depot for the ASTP Food System. The End Item Specification established the requirements for performance, design, testing and qualification of the ASTP Food System.

A Predelivery Acceptance (PDA) Test Plan and Procedure (JSC 09216) was prepared to establish the testing procedures to be used to meet the

requirements of the End Item Specification. The PDA was used to package the meals and stow the items in the spacecraft food lockers. Actual test values and verifications were recorded in the PDA. The spacecraft food lockers were tested and inspected in accordance with the Pre-Installation Acceptance Plan and Procedures for the ASTP Food System (JSC 09708) prior to installation on the spacecraft at KSC.

A drawing system was established and registered with the JSC Drawing Control Center for the ASTP Food System. Drawings from previous missions had to be updated to conform with the NASA-JSC drawing requirements and numbering system. Most of the earlier drawings were made by off-site contractors and were not part of the JSC drawing system. Many of the drawings required a comprehensive change due to new items such as the food tray, stowage sequence and menu requirements. Over 600 drawings were received from the previous space food contractor. These included both Skylab and Apollo food system drawings. These drawings were inventoried and cataloged and separated into applicable drawings and non-applicable drawings. The applicable drawings were modified to conform with JSC standards and filed with the JSC Drawing Control Center. An active drawing file was established and maintained for the ASTP Food System. The drawing numbers and titles were also stored on the computer retrieval system for easy access and cross-referencing JSC numbers with contractor drawing numbers. A list of the drawings used for the ASTP Food System is shown in Appendix A.

2.4.1 Schedules

Scheduling was a very important aspect of the Food Depot operations. Scheduling was performed by the production control unit section leader

Timely and precise schedules and extensive cross-training permitted many operations to proceed simultaneously. For example, the equipment was being reworked and checked out at the same time the Food Depot was being constructed and documentation was being prepared. Detailed schedules were prepared and maintained to show the progress of each activity. Production and food procurement schedules were also prepared and maintained by the Food Depot. Even though many of the scheduled intermediate objectives such as completion of the Food Depot construction were not accomplished on time, detailed scheduling and careful planning did result in the completion of the ASTP Food System on schedule.

2.5 Quality Control

Quality control measures for the ASTP Food System equaled and in some cases, exceeded those used on previous space food sytems. Since the ASTP Food System was produced in-house at JSC, the quality control differed slightly from previous food systems. Quality control for the ASTP Food System was monitored by NASA-JSC Safety, Reliability, and Quality Assurance personnel.

Food processing and packaging operations were performed in accordance with JSC standards specifically designed for each function. These standards designated "Food Process Standards" (FPS) utilized the Hazard Analysis Critical Control Point (HACCP) concept for quality control. The control points were established and approved by Quality Assurance, Reliability, Food and Nutrition, Systems Support, and Food Depot contractor personnel. The critical control points were monitored and verified by Quality Assurance personnel during each operational step. Each

critical control point was listed on the FPS with a space for operator signature and Quality Assurance verification.

The Food Depot SOPM defined the quality assurance system by reference to related quality assurance procedures.

Contamination control procedures not specified in the individual FPS' were detailed in the Food Depot SOPM. These procedures included clean bench-clean booth operations, humidity and temperature control, sanitation procedures, personnel health, clothing and package contamination control.

The quality control system designed for the ASTP Food System functioned smoothly. The Discrepancy Report (DR) system was implemented for items which did not comply. A Material Review Board was established to review and approve all dispositions for the DR's. A Food Depot DR file was established and maintained as permanent record of all discrepancies for the ASTP Food System.

2.6 Microbiology

Microbiological specifications and testing procedures were written for the ASTP Food System. The specifications were similar to those used on Skylab, but the sampling procedure was changed to apply to the ASTP Food System.

Microbiological testing was performed on the interim stored food prior to packaging in the final package. Additional microbiological quality tests were performed on the first and last package of each food, but the basic safety tests were performed on the interim stored food. Microbiological testing was performed by Food and Nutrition and by food vendors. U.S. Army Natick Laboratories performed all of the microbiological testing on food items supplied by them. Ingredients used in dry blended items

produced in the Food Depot were tested by Food and Nutrition prior to blending and after the item was packaged in the interim storage container. Some difficulty was encountered in meeting the microbiological specifications for ASTP food produced in the Food Depot. The excessive microbiological counts were due to spices or dried sauces which were added to the food without further food processing to destroy the microorganisms. This problem was overcome by procuring purified spices and sauces for use in these products. Purified spices and sauces have undergone treatment to destroy most of the microorganisms.

After passing the microbiological tests, all food handling was done in a clean environment (Class 100) for final packaging. Additional microbiological quality control testing was performed during food processing and final packaging operations. These sanitation tests and procedures were detailed in the Food Depot SOPM. Swab samples of equipment and packaging material were tested for total aerobic count and E. coli. Samples were taken at the beginning of each production day and work was not commenced until satisfactory results were obtained from the total aerobic count. These tests were also performed by Food and Nutrition personnel. The total aerobic count was determined using an ATP Photometer to measure the amount of ATP present which was directly correlated to the number of microorganisms present. This unique method provided results within one hour after sampling.

Final packaged food was also sampled and tested for total aerobic count and E. coli. The ATP method was used for most of the final packaged

items. Items which could not be counted in this manner were tested using conventional pour plate methods.

Total aerobic counts were also performed on 5 ft.^{3} samples of air from the clean booth during final packaging operations. The microbiological testing for the ASTP Food System as specified in the Food Depot SOPM and the microbiological specifications proved to be very adequate and satisfactory. The concept of another organization, other than the producer, performing the tests added reliability and confidence to the results. The ATP method proved to be a rapid and efficient method for sanitation testing.

An in-house microbiological capability was essential for both sanitation testing and food evaluations. Many of the food suppliers were not able to perform all of the microbiological tests specified for flight food.

2.7. Cost Analysis

A cost analysis program was included in the Food Depot Financial Management Plan. The cost analysis program was designed to determine an end item cost for each item produced by the Food Depot. The material cost of each end item was determined by including the cost of each individual part used in the production of the end item on the material control list. The material control list was part of the FPS which made up the work order. Thus the cost, for example of a valve spring, made up the cost of a valve and the cost of the valve made up the cost of the final package and the sum of the ingredients and final package cost equalled the end item cost. A system was also designed to track and inventory costs on the MEDICS computer storage and retrieval system.

Examples of ASTP package material costs are shown in Table 1.

Table 1

ASTP Package Material Cost

Package	Cost Per Package
Spoonbowl	$ 1.64
Bite-size	.45
Bread	.55
Beverage	2.25
Meal Overwrap	3.75

The meal overwrap was constructed from Kel-F, a fluorocarbon material which is considerably more expensive than the SLP-4. Cost of a typical ASTP meal is shown in Table 2.

Table 2

Cost of a Typical ASTP Meal

Item	Cost
Scrambled Eggs	$ 2.39
Sausage	2.25
Strawberries	2.70
Grapefruit Drink	2.45
Tea with Lemon and Sugar	3.22
Labor (Approx.)	12.00
Total	$ 25.01

Labor and procurement costs were charged against job orders. Monthly summaries of these costs were computed and reported. The MEDICS compute storage and retrieval system proved to be a very valuable tool for automating record keeping and accounting. However, it was not used extensively in the ASTP Food System since it was a duplication of many records required by other documentation. The bonded storage records required to be maintained contained similar information. Future systems should include a computer system for bonded storage records, thus eliminating many hand computations. Computer down time and limited hours of working time also detracted from the practicality of the computer accounting system.

2.8 Bonded Storage

A bonded storage procedure which complied with NASA-JSC regulations was included in the Food Depot SOPM. Using this procedure, a bonded storage facility was established and maintained in the Food Depot. The Production Control Unit Leader served as the bondsman for the Food Depot bonded storage. Bonded articles were stored in an ambient refrigerated and frozen storage facilities. Articles were transferred in and out of bonded storage by approved work order or TPS's.

2.9 Inventory Control, Records and Traceability

Inventory control of all equipment and materials was maintained as outlined in sections 2.7 and 2.8. Traceability was maintained by using lot numbers. Vendor lot numbers were recorded for all items received by the Food Depot. During receiving Food Depot lot numbers were assigned to the items. Food Depot lot numbers were recorded on the material control list as items were

withdrawn from bonded storage. When an item was produced from components, a new lot number was assigned to the newly produced item. This system of lot number assignment provided direct traceability back to the vendor. Procurement documents and lot number assignment records were maintained by the production control section.

3.0 ASTP FOOD SYSTEM

3.1 Menu

The ASTP menu is shown in Appendix B, along with the pantry and the Russian Cosmonaut meals. The menu and pantry contained 80 different food items. Each crewman had separate menus which cycled every 4-days. The menus were developed by the Food and Nutrition Branch from a list of 142 available flight qualified foods. Food items on the ASTP menu were obtained from the sources shown in Table 3 .

Table 3 - Source of ASTP Food Items

Source	Percentage of Total
Commercial	47.5
U.S. Army Natick Laboratories	37.5
Skylab	5
Food Depot Produced	10

Most of the food used on the ASTP mission came from commercial sources and the U.S. Army Natick Laboratories. However, food items from these sources required additional packaging operations by the Food Depot prior to use on the flight. Items produced in the Food Depot were special items which were not available through other sources. Most of these special items were freeze-dried.

3.2 ASTP Food Tray

A food tray was designed, developed and used on ASTP. The tray (figure 4) served as a meal assembly station and a receptacle for the food during consumption. The tray consisted of an aluminum plate with velcro and springs for holding food items in place. The tray was equipped with

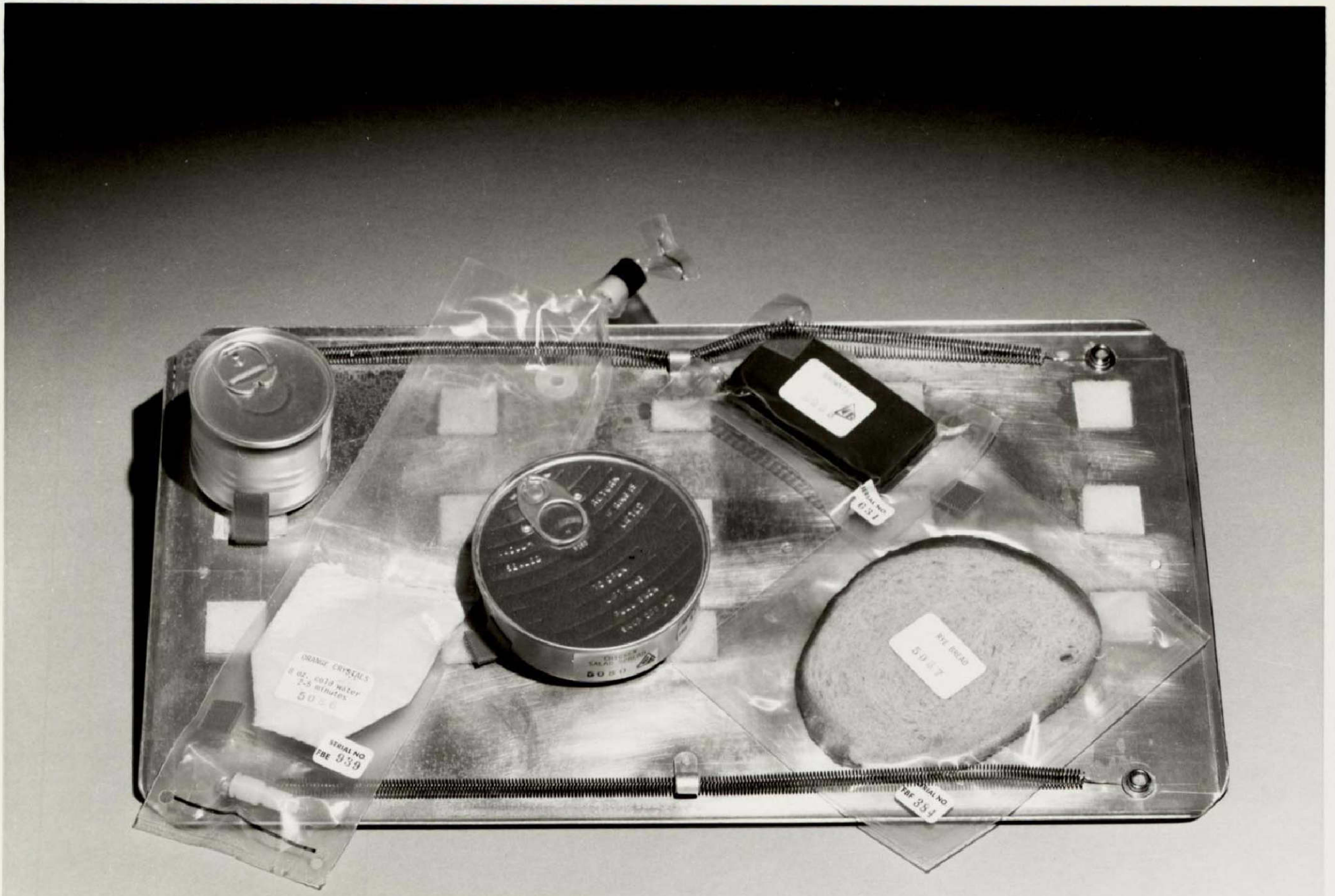


Figure 4 ASTP Food Tray

a strap which attached to the crewman's leg to secure it during meal consumption.

3.3 Packaging

Packages used on the ASTP food system are shown in Table 4.

Table 4 - ASTP Food Packages

Package	Drawing Number
(1) Apollo Spoonbowl	SEF48100072
(2) Bite-size Package	SEF48100079
(3) Apollo Beverage	SEF48100071
(4) Apollo Wet Packs	SEB39104127
(5) Skylab Drawn Aluminum Cans	
(208 X 203)	SEF48100076
(208 X 105)	SEF48100074
(401 X 105)	SEF48100073
(6) Skylab Beverage	SEF48100070
(7) Bi-metallic Cans	SEB39106344
(8) Bread Package	SEB39104483
(9) Overwrap, One Man Meal	SEF48100067
(10) Overwrap, Three Man Meal Packet	SEF48100068
(11) Breakfast Roll	SEF48100075
(12) High Density Bar	SEF 48100077

The 80 food items contained in the ASTP menu were packaged in the primary package shown in Table 5.

Table 5 - ASTP Primary Food Packages

Type of Package	Number of Items
Can	12
Bite-size	11
Wet Pack	18
Spoonbowl	24
Bread	2
Beverage	13
Total	80

The Apollo spoonbowl, Apollo beverage, bite-size, bread package and the Skylab beverage package were fabricated in the Food Depot. The Apollo beverage package was modified for ASTP. The modification consisted of replacing the drinking tube with the Skylab pontube. This permitted consumption of the beverage through the rehydration valve. A portable holder was also attached to the rehydration valve to hold the pontube when not in use. Beverages used on ASTP are shown in Figure 5.

Only one Skylab beverage package was used on ASTP. This package contained salt which was rehydrated inflight and applied to the food with a special syringe which was developed for Skylab.

Figure 6 displays the spoonbowl package used on ASTP. This package was similar to those used on the Apollo missions and for resupply of the Skylab food. The spoonbowl package was fabricated and assembled in the Food Depot. Bite-size packages are shown in Figure 7. These packages were also fabricated from SLP-4 by the Food Depot.

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Figure 5 ASTP Beverages

Figure 6 ASTP Spoonbowl Package

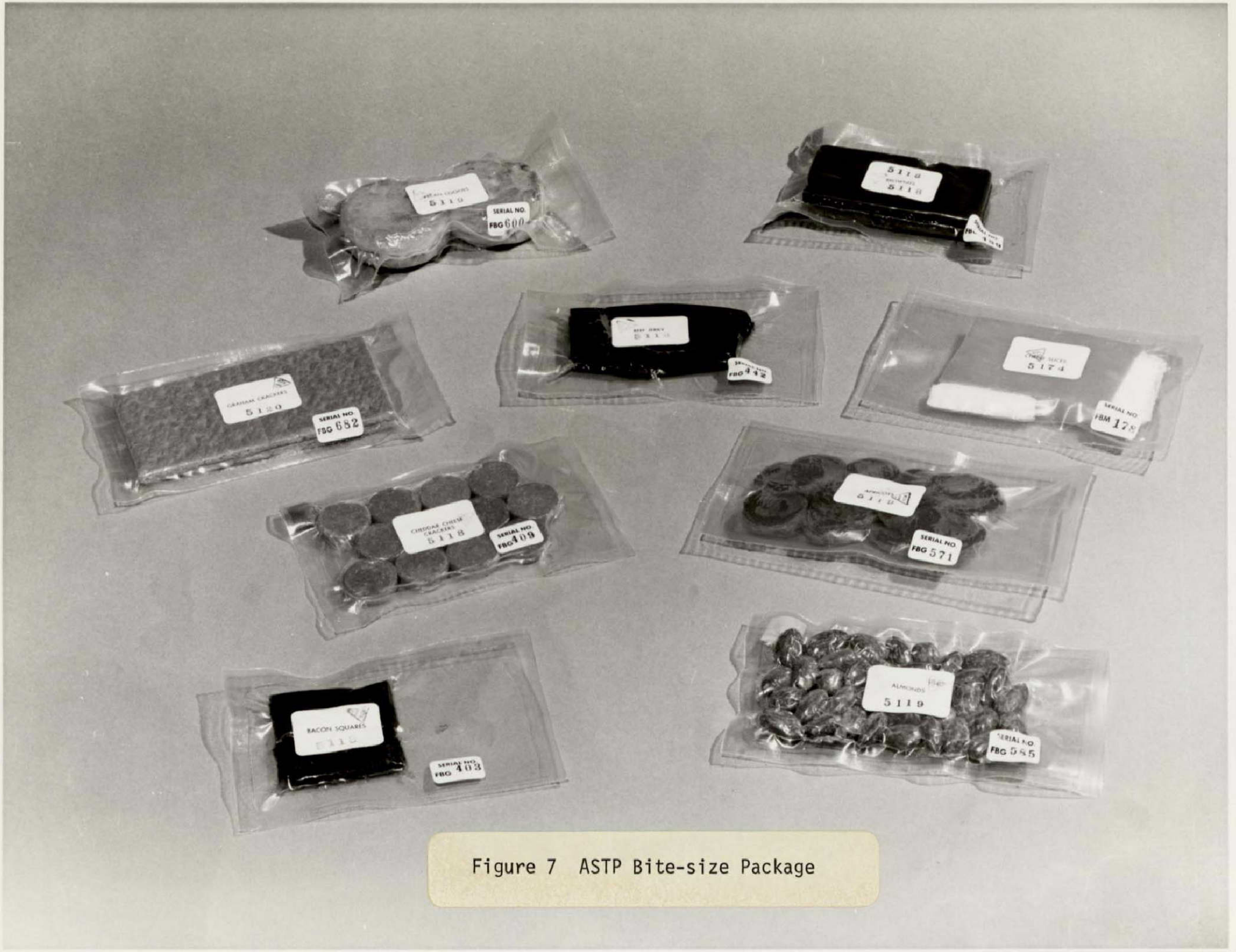

Figure 7 ASTP Bite-size Package

Over half of the items obtained from Natick Laboratories were packaged in thermostabilized flexible foil pouches. The flexible pouches (wet packs) shown in Figure 8 were used without further packaging. Packaging operations consisted of removing the cardboard containers, cleaning, and the application of labels and velcro and placing in a meal overwrap.

Seven different size cans were used on ASTP. The canned items are shown in Figure 9. Commercial labels were removed from the cans and each can was cleaned to spacecraft specifications prior to application of labels and velcro. Cans were overwrapped prior to stowing in the spacecraft food locker. Some of the cans had a full panel pull out lid for opening. Can openers were supplied for opening the cans without pull out lids.

Bread and breakfast rolls were packaged in the bread package (Figure 10). The bread, breakfast rolls, and cheddar cheese were packaged last since these items were semi-perishable. They were shipped separately to KSC and stowed immediately prior to launch.

Food items were assembled into crew meal units and overwrapped prior to stowage in the spacecraft locker. Components of crew meals were overwrapped in an evacuated or non-evacuated package. Evacuated packages contained items such as beverages and dehydrated foods while the non-evacuated overwraps contained wet packs and fragile items such as cookies and crackers. Specific packaging instructions for evacuated and non-evacuated packages were included in the PDA. An evacuated meal overwrap is shown in figure 11. Meal units were stowed in sequence in the spacecraft food lockers (figures 12, 13 and 14). Locker B1 contained meals 1C through 4C; locker A3 contained meals 5A through 8A and locker L3 meals

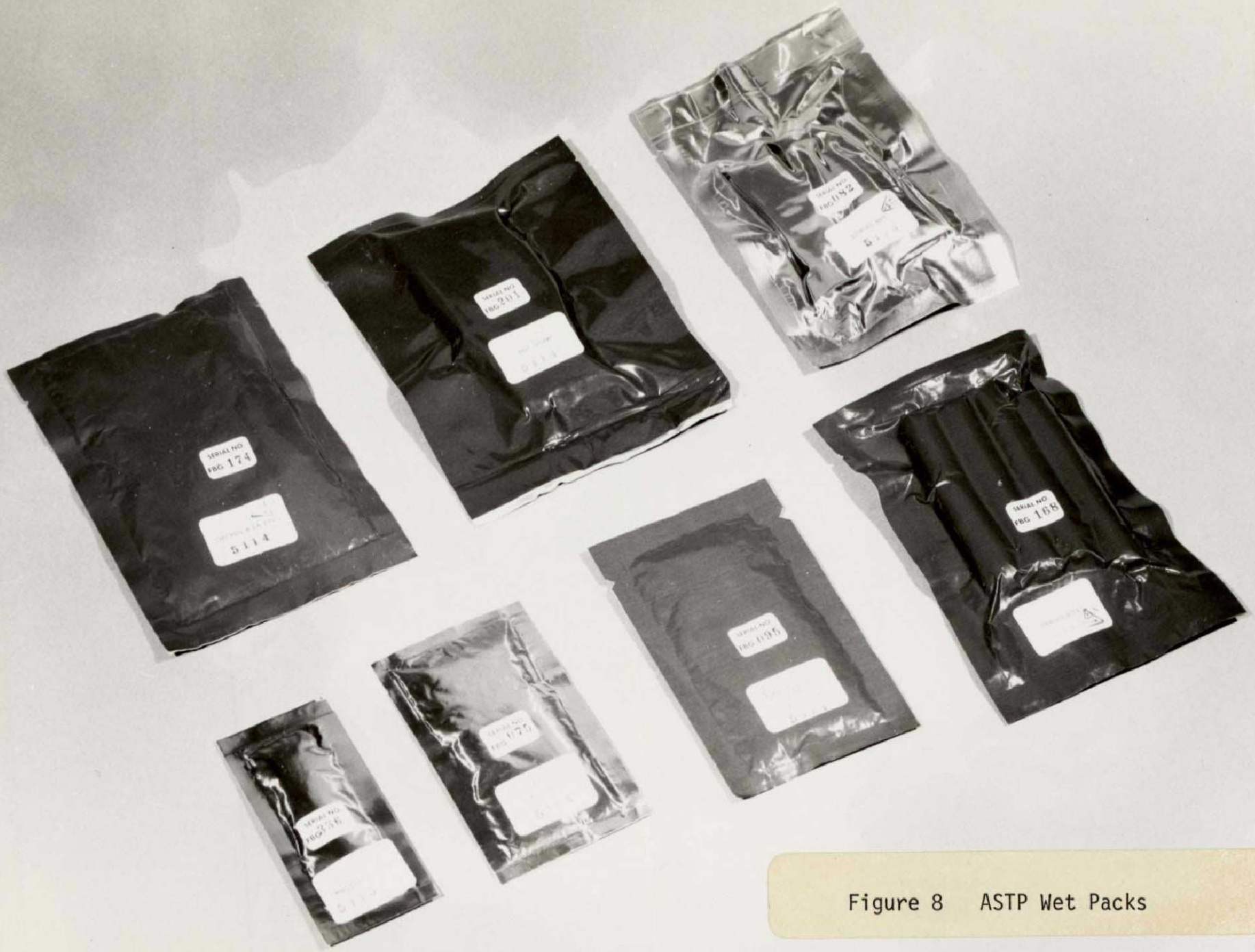

Figure 8 ASTP Wet Packs

Figure 9 ASTP Canned Items

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Figure 10 ASTP Bread Package

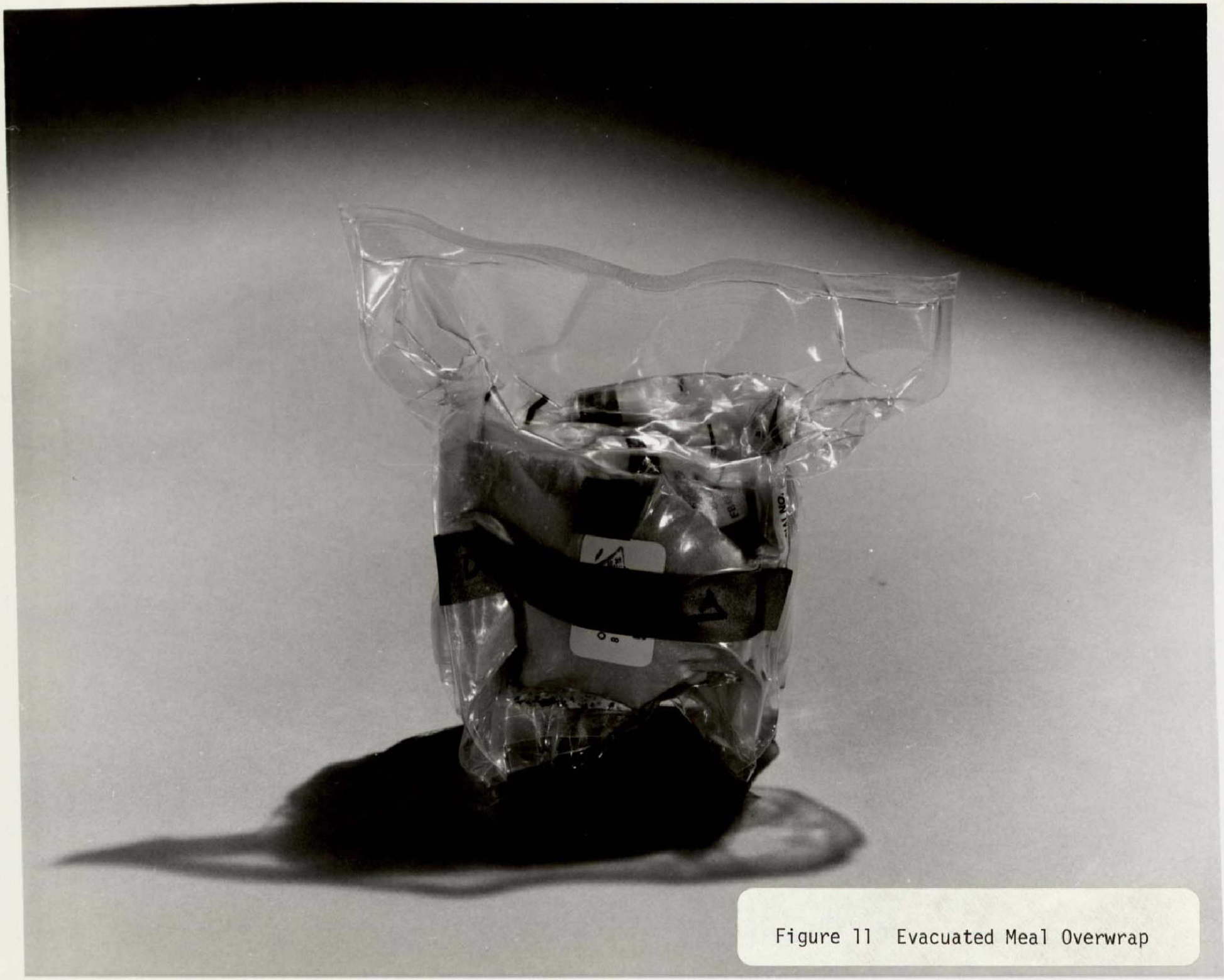

Figure 11 Evacuated Meal Overwrap

Figure 12 Food Locker A-3

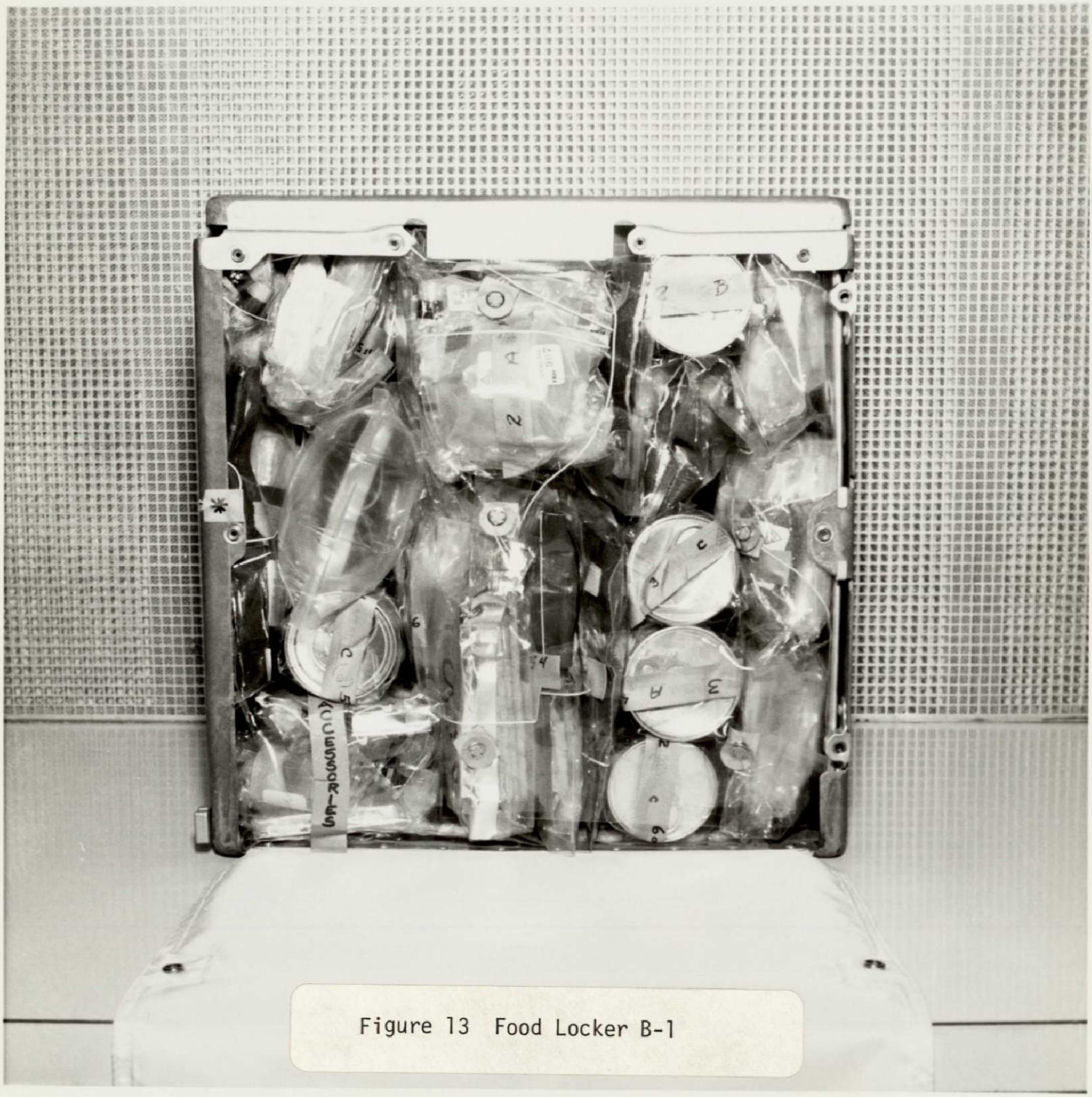

Figure 13 Food Locker B-1

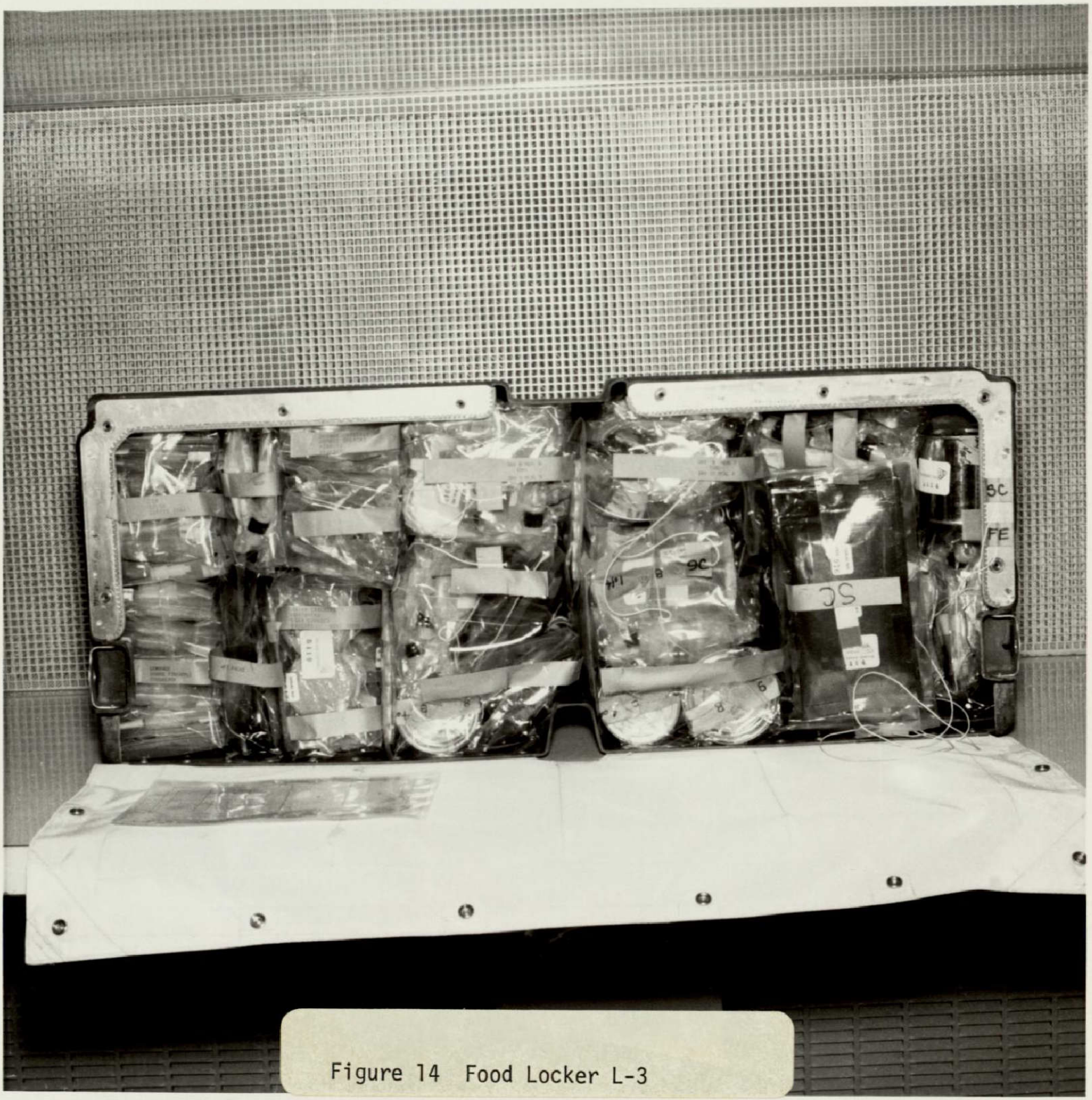

Figure 14 Food Locker L-3

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8B through 10A. Meals 4B white and 3C red and blue were stowed in locker L3 instead of B1. Meals 10B and 11A were stowed in the UVA cable bag. Lockers B1 and L3 were stowed at JSC by the Food Depot and shipped to KSC for stowage aboard the spacecraft. Food for locker A3 was shipped to KSC for packing and stowage.

4.0 Discussion and Recommendations

Newer packaging materials for space food should be investigated. The basic material, SLP-4, used for Apollo and the ASTP mission has been used over 10 years. Several new materials with better physical properties have been developed and should be investigated for use with space food. The SLP-4 has several inherent disadvantages. It is difficult to obtain a good heat seal if the material has not been laminated properly. SLP-4 is very expensive and difficult to produce. There is only one known source. The quality of the SLP-4 is not consistent due to the lamination process. Some difficulty was experienced during the fabrication of the packages for ASTP. The lot of material used for ASTP tended to delaminate at the heat seal after storage even though it passed all of the required tests in the specification. This particular problem was with the lot procured for ASTP, however, the same type of problems have been experienced in the past with other lots.

Package fabrication operations need to be simplified. The ASTP packages, particularly the Apollo beverage and spoonbowl package, have too many failure points in the production. There were numerous inspection points in the production of these packages, but all failure points were not inspected. The numerous and monotonous steps in the production of the packages could be eliminated by package design and newer and more efficient equipment.

The equipment used for the production of the packages was developed and modified over the years as changes were implemented. The equipment was designed for small production lots and is not readily adaptable to automation. Most of the production steps are tedious hand operations. The

hand operations coupled with the inspection points make package fabrication operations very slow and costly. Modern packaging equipment is available which will cut, seal and fill packages automatically. Application of this type of equipment in space food packaging should be investigated.

Relative humidity was specified as not to exceed 55% during the production of Apollo, Skylab and ASTP food. This number was apparently chosen arbitrarily. It was further defined for ASTP by specifying the dew point, however, a lower limit was not established. Lower humidity creates static electricity problems in the package filling operations. An upper and lower limit for relative humidity should be specified. These limits should be specified as dew points and the upper limit should be related to an exposure time. These limits should be established using scientific data.

Oxygen content of the headspace of interim canned dry food was specified at 2% or less for space food. In most cases, this level was easily obtainable by flushing 3 times with nitrogen and sealing in a vacuum. However, there were a few cases in which the 2% or less could not be obtained using this method. The problem was apparently associated with the oxygen content of the food and/or the flushing capacity of the food. Oxygen scavenger systems are presently available which will reduce the oxygen level significantly more than the nitrogen flushing method. The oxygen scavenger systems should be investigated for long term storage of interim storage and final packaged foods. Complete removal of oxygen in the final package may permit use of many freeze dried items such as beef steak which succumbs to oxidative rancidity in current packages.

A considerable savings could be realized in future food systems by relaxing the total aerobic count requirement. This would not jeopardize safety, because the food is tested for all known food-borne pathogens. The organisms constituting the total aerobic count can be considered harmless. The level established in the past (less than 10,000 per gram) is near sterility in practice. This count was waived for cheddar cheese on ASTP, since cheddar cheese is a fermented product and naturally contains more than 10,000 organisms per gram. Although the near sterility diet has proved to be successful in the past, there is no evidence that an increase in the level of microorganisms consumed through the food is harmful. In fact, an increased level of intake may be beneficial. The low total aerobic counts are very difficult to obtain with many food products. Some food products cannot even be considered for flight use because of their inherent microorganisms; therefore, special processing is required to meet the level for space flight use. This expense of this special processing and handling could be eliminated by relaxing the total aerobic count.

Vacuum levels of the ASTP food packages were set at the maximum level in which the particular food would tolerate. These levels ranged from 18 to 29 inches of mercury vacuum. However, some of the food such as breakfast rolls, cookies and bread were damaged at the specified level. This problem was overcome in Skylab by packaging the primary package at

the spacecraft pressure and placing it in a cannister to protect it at higher vacuum levels. The Skylab concept using larger food containers should be investigated for future space food systems. If this concept is not acceptable, the limits of the vacuum level for primary packages should be established using scientific data.

During ASTP food production there was much concern about the vacuum tolerance of canned items. Since this is directly related to the amount of headspace in the canned item, perhaps headspace should be defined and specified for canned items, rather than vacuum testing.

A considerable saving to the Government could be realized on future space food system by contracting to a company which has the packaging expertise and the food technology capability to supply the food. The packaged end item should be supplied to the Government without any Government assistance, other than the requirements and specifications. End item specifications and requirements should be established and supplied by the Government. This method would utilize the talents of the commercial company's quality personnel who are familiar with the latest state-of-the-art of food packaging and food technology. A commercial company has highly trained individuals on their staff who are capable of performing these functions.

The Government should demand statistically valid samples and verify that they do meet the specifications. However, the Government should not specify how these specifications shall be met. Traceability and related documentation should be maintained by the contractor until

delivery to the Government. This approach would result in a considerable savings to the Government, since industry can perform these functions efficiently. It would encourage new ideas and concepts and improved methods instead of relying on the historical methods which may or may not be applicable. This would allow room for ingenuity by the specialists in each given area, since they would not be constrained by step-by-step procedures. The contractor should not receive payment until the Government is satisfied that all of the specifications and requirements are met.

In the past, food items have been treated as hardware for the spacecraft. This is misleading, because food cannot be truly classified and recognized as hardware. The certificates of compliances required from the food manufacturer are meaningless when applied to food. The specifications describe the food adequately and the certificate should reference the specification, or be incorporated into the specification. Due to the recent increase in Government regulations concerning food, many of the commercial suppliers were hesitant to sign a certificate of compliance. Food systems in the past have been designed with an extremely long shelf life. By doing this, qualified food lots can be used for a long time by maintaining them in an interim storage condition. Some of the foods used on the Apollo missions were at least 6 years old at the time of consumption. The requirement for long-shelf life items imposes unnecessary restraints on the food system. Storage facilities are also overstocked with items which are flight qualified, but may never be used for

flight. If the items are used for flight, they must be re-evaluated prior to use.

Future food systems should have an established shelf life for each item with a throw-away date given at the time of manufacture. The shelf life requirements should be shortened considerably to allow the introduction of more food items. The extended shelf life items will not be required until long-term manned missions are undertaken. By having a throw-away date and replenishment schedule, an adequate supply of qualified food items could be maintained at all times with a corresponding efficient storage system.

The recommendations outlined above for future space food systems will require extensive research and development. If an improved system for the Space Shuttle is to be developed, the research should begin immediately. Package design, packaging equipment and food items must be developed or modified and tested for flight use. Sufficient lead time must be allocated in order to develop an efficient and satisfactory food system.

APPENDIX A

ASTP FOOD SYSTEM STANDARDS, SPECIFICATIONS AND DRAWINGS

PROCESSING AND TESTING STANDARDS AND SPECIFICATIONS

Number		Title
FPS-151	Rev. A	Leak Testing of Valve Installation on Rehydratable Food Packages
FPS-153		Interim Packaging of Aerospace Food
FPS-156		Seal Strength Testing of Plastic Laminate Food Packages
FPS-157		Organoleptic Test Procedures for Flight Food
FPS-158		Headspace Oxygen Analysis
FPS-159	Rev. A, Rev. B	Fabrication, Assembly and Inspection for Apollo Rehydratable Spoonbowl Package
FPS-160	Rev. B	Fabrication, Assembly and Inspection of Apollo Beverage Package
FPS-161		Fabrication, Assembly and Inspection for Skylab Beverage Package
FPS-162		Fabrication, Assembly and Inspection for Spoon and Pouch Assembly
FPS-163		Fabrication, Assembly and Inspection for Bite-size Food Package
FPS-164		Fabrication, Assembly and Inspection of 208 X 105 Wafer Can
FPS-165		Flight Food Weighing and Recording
SD-M-0301	Rev. A	Food Package Plastic Film Laminate (SLP-4)
SD-M-0302		Heat Sterilizable, Heat Sealable Laminated Plastic Film (SLP-6)
SD-M-0306		Cleaning and Passivation of Corrosion Resisting Steels
SD-M-0303		Methylcellulose Film (SLP-12)
SD-M-0304		Kel-F-82 Plastic Film Water Quenched (SLP-14)
SD-T-0251	Rev. A	Microbiological Specification and Testing Procedure for Foods which are not Thermostabiliz
SD-T-0252		Microbiological Specification and Testing Procedure for Thermostabilized Food

ASTP

24 April 1975

FOOD PROCESSING STANDARDS

Number	Food Item
FPS-001	Compressed Bacon Squares
FPS-002	Coffee
FPS-003	Sandwich Spreads
FPS-004	Pecans
FPS-005	Chocolate Flavored Instant Breakfast
FPS-006	Cashews
FPS-007	Cocoa
FPS-008 Rev. A	Canned Fruit
FPS-009	Mints
FPS-010	Dry Roasted Peanuts
FPS-011	Fruit Bars
FPS-012	Bread
FPS-013	Graham Crackers
FPS-014	Scrambled Eggs, Dehydrated
FPS-015	Dried Fruit
FPS-016	Canned Seafood
FPS-017	Potato Soup
FPS-018	Sandwiches
FPS-019	Stewed Tomatoes
FPS-021	Freeze-Dried Soup
FPS-022	Peanut Butter Flavored Chocolate Bars
FPS-023	Jellied Cranberry Sauce
FPS-024	Peach Ambrosia with Pecans, Dehydrated
FPS-025	Almonds

Number	Food Item
FPS-026	Natural Fruit Flavored Powdered Drink
FPS-027	Beef Jerky
FPS-028	Macaroni and Cheese
FPS-029	Crackers
FPS-030	Tea
FPS-031	Grapefruit and Orange Crystals
FPS-032	Tea with Lemon and Sugar
FPS-033	Chocolate Candy Bars
FPS-034	Puddings, Thermostabilized
FPS-035	Pecan Cookies
FPS-036	Shrimp
FPS-037	Shrimp Cocktail Sauce
FPS-038	Lemonade
FPS-039	Shortbread Cookies
FPS-040 Rev. A	Cheddar Cheese
FPS-041	Fruit Flavored Drink
FPS-042	Cereal
FPS-043	Breakfast Rolls
FPS-044	Government Furnished Foods
FPS-045	Flexible Wet Packages
FPS-046	Onion Soup and Spinach with onion sauce

ASTP

24 April 1975

FOOD MANUFACTURING SPECIFICATION

Number	Food Item
SD-F-0401	Bacon Squares, Compressed
SD-F-0402	Coffee
SD-F-0403	Sandwich Spread
SD-F-0404	Pecans
SD-F-0405	Chocolate Flavored Instant Breakfast
SD-F-0406	Cashews
SD-F-0407	Cocoa
SD-F-0408	Canned Fruit
SD-F-0409	Mints
SD-F-0410	Dry Roasted Peanuts
SD-F-0411	Fruit Bars
SD-F-0412	Bread
SD-F-0413	Graham Crackers
SD-F-0414	Scrambled Eggs, Dehydrated
SD-F-0415	Dried Fruit
SD-F-0416	Canned Seafood
SD-F-0417	Potato Soup
SD-F-0418	Precooked Sliced Meat and Poultry Products
SD-F-0419	Stewed Tomatoes, Thermostabilized
SD-F-0420	Margarine
SD-F-0421	Freeze-Dried Soup
SD-F-0422	Peanut Butter Flavored Chocolate Bars
SD-F-0423	Jellied Cranberry Sauce
SD-F-0424	Peach Ambrosia with Pecans, Dehydrated

Number	Food Item
SD-F-0425	Almonds
SD-F-0426	Drink, Natural Fruit Flavored, Powdered
SD-F-0427	Beef Jerky
SD-F-0428	Macaroni and Cheese
SD-F-0429	Crackers
SD-F-0430	Tea
SD-F-0431	Grapefruit and Orange Crystals
SD-F-0432	Tea with Lemon and Sugar
SD-F-0433	Chocolate Candy Bars
SD-F-0434	Puddings, Thermostabilized
SD-F-0435	Pecan Cookies
SD-F-0436	Shrimp
SD-F-0437	Shrimp Cocktail Sauce
SD-F-0438	Lemonade
SD-F-0439	Shortbread Cookies
SD-F-0440	Cheddar Cheese
SD-F-0441	Fruit Flavored Drink
SD-F-0442	Cereal
SD-F-0443	Breakfast Rolls
SD-F-0444	Onion Soup and Spinach with Onion Sauce

ASTP FOOD SYSTEM DRAWING

Computer ID Number	JSC Number	Whirlpool Number	Title
8002	SEF48100002		LABEL, CONTENTS
8003	SDF48100003	14-181	LABEL-SERIAL NO.
8004	SEF48100004	14-182	BITE-SIZE FOOD PACKAGE
8005	SDF48100005	14-184	MOUTHPIECE-APOLLO BEVERAGE PACKAGE
8006	SDF48100006	14-206	STABILIZATION TABLET
8007	SEF48100007	14-211	VALVE BODY
8008	SDF48100008	14-212	RETAINER
8009	SDF48100009	14-213	POPPET
8010	SDF48100010	14-214	SPRING
8011	SDF48100011	14-216	VALVE WASHER
8013	SEF48100013	14-356	SNAP FASTENER
8014	SDF48100014	14-386	SHRINK TUBE
8015	SDF48100015	14-402	BODY BLANK-APOLLO REHY. SPOONBOWL P
8016	SDF48100016	14-403	FINGER LOOP-APOLLO REHY. PACKAGE
8017	SEF48100017	14-405	BODY BLANK, APOLLO BEV. PACKAGE
8019	SEF48100019	14-407	ZIPPER ASSEMBLY
8020	SDF48100020	14-409	ZIPPER CLOSURE
8021	SDF48100021	14-410	LABEL-GERMICIDE TABLET PACKAGE
8022	SDF48100022	14-411	SKIN CLEANING SOLUTION
8023	SEF48100023	14-0227	VALVE FOOD PACKAGE- APOLLO
8024	SEF48100024	14-02041	APOLLO FOOD PACKAGE CHART
8025	SEF48100025	14-02091	APOLLO REHYDRATABLE SPOONBOWL PACKA
8026	SEF48100026	14-02092	APOLLO BEVERAGE PACKAGE ASSY
8027	SEF48100027		SPOON & POUCH ASSY
8028	SEF48100028	14-02165	SPOON POUCH
8029	SEF48100029	14-02166	GERMICIDE POUCH ASSEMBLY (42)
8030	SDF48100030	24-111	LID, WAFER CAN
8031	SDF48100031	24-134	BODY, BEVERAGE PACK.
8032	SDF48100032	24-138	LABEL, BEVERAGE PACKAGE
8033	SDF48100033	24-189	LABEL
8034	SDF48100034	24-197	WAFER CAN CUSHION
8035	SDF48100035	24-201	BUTTON
8036	SDF48100036	24-269	PONTUBE
8037	SDF48100037	24-270	VALVE BODY
8038	SEF48100038	24-274	LID, LARGE CAN
8039	SEF48100039	24-0222	SKYLAB FOOD LIST
8041	SEF48100041	24-0234	PACKAGE WAFER
8042	SDF48100042	24-108	CAN, LARGE
8044	SEF48100044	24-0283	LID & DIAPHRAGM
8045	SDF48100045	24-110	CAN, WAFER
8046	SEF48100046	24-02010	DISPENSER VALVE ASSY-SKYLAB BEV
8047	SEF48100047	24-02011	VALVE ASSY, SKYLAB BEVERAGE BEVERA

ASTP FOOD SYSTEM DRAWING Cont'd.

Computer ID Number	JSC Number	Whirlpool Number	Title
8048	SEF48100048	24-02016	BODY ASSEMBLY BEVERAGE PACKAGE
8049	SEF48100049	24-02025	CAM SPOON AND POUCH ASSEMBLY
8054	SDF48100054	SDS-46	O-RING
8055	SDF48100055	SDS-54	VELCRO
8056	SDF48100056	SDS-59	O-RING
8058	SDF48100058	SDS-96	PRINTING INK
8059	SDF48100059	SDS-97	PIGMENT, BLACK
8060	SDF48100060	SDS-107	POLYLEN TAPE
8061	SDF48100061	SDS-112	MAGIC MARKER
8062	SDF48100062	SDS-121	TYPEWRITER RIBBON
8063	SDF48100063	SDS-122	FELT TIP MARKER
8066	SEF48100066		SPOON PACKET ASS'Y
8067	SEF48100067	14-204	OVERWRAP, ONE MAN MEAL
8070	SEF48100070		SKYLAB BEVERAGE PACK. ASS'Y
8071	SEF48100071		APOLLO BEVERAGE PACKAGE ASSEMBLY
8072	SEF48100072		SPOONBOWL PACKAGE ASS'Y
8073	SEF48100073		FOOD CAN ASS'Y (401X105)
8074	SEF48100074		FOOD CAN ASS'Y (208X105)
8075	SEF48100075		BREAKFAST ROLL PACKAGE
8076	SEF48100076		FOOD CAN ASSEMBLY (208 X 203)
8077	SEF48100077		HIGH DENSITY FOOD BAR ASS'Y
8078	SDF48100078		LABEL,FOOD PACKAGE
8079	SEF48100079		BITE-SIZE PACKAGE ASS'Y
8080	SEF48100080		VITAMIN PILL DISPENSER ASS'Y
8081	SEF48100081		SPICE KIT
8082	SEF48100082	14-0141	ORAL HYGIENE ASS'Y SET
8083	SDF48100083		GUM PACK ASS'Y
8084	SEF48100084		APOLLO BEVERAGE PACKAGE ASS'Y
8085	SDF48100085	14-379	TOOTHPASTE TUBE
8086	SDF48100086	14-380	SPOOL
8087	SDF48100087	14-381	DENTAL FLOSS
8088	SDF48100088	14-383	LABEL - TOOTHPASTE
8089	SDF48100089	14-384	TOOTHPASTE
8090	SEF48100090	14-0132	TOOTHBRUSH PACKET ASS'Y
8091	SEF48100091	14-0137	ORAL HYGIENE ACCESSORIES ASS'Y
8092	SEF48100092	14-02042	TOOTHBRUSH PACKAGE ASS'Y
8093	SEF48100093	14-02058	ORAL HYGIENE POUCH
8094	SEF48100094	14-02059	DENTAL FLOSS ASS'Y
8095	SEF48100095	14-02060	TOOTHPASTE ASS'Y
8096	SEF48100096		DAY MEAL STAMP
8097	SDF48100097		PONTUBE HOLDER
8098	SEF48100098		CRACKER PACKAGE
8099	SEF48100099		FOOD CAN ASS'Y (COMMERCIAL)

ASTP FOOD SYSTEM DRAWING Cont'd.

Computer ID Number	JSC Number	Whirlpool Number	Title
8100	SEC42100351		CAN OPENER ASSY - IMSS
8101	SEB39106345		CANNED PUDDING
8102	SEB39106344		FOOD CAN ASSY (208X203)
8103	SEB39104483		PACKAGE, BREAD
8104	SEC39109513		LIQUID CONDIMENT DISPENSER SKYLAB 4
8105	SDC39109514		NOZZLE LIQUID CONDIMENT DISPENSER S
8106	SDC39109515		VALVE LIQUID CONDIMENT DISPENSER
8107	SDC39109516		HANDLE LIQUID CONDIMENT DISPENSER
8108	SDC39109534		SALT SOLUTION DISPENSER ASSY
8109	SDC39109535		NOZZLE, SALT SOLUTION DISPENSER
8110	SDC39109517		LABEL LIQUID CONDIMENT DISPENSER
8111	SDB39106333		CABLE END - CAN OPENER
8112	SDC42100352		CAN OPENER-IMSS (ALTERED ITEM DRAWI
8113	SDC42100353		MAGNET ASSY-CAN OPENER, IMSS
8114	SEC42100206		CONTAINER ASSY, DRUG-IMSS
8115	SDC42100207		PISTON - DRUG CONTAINER
8116	SDC42100208		BODY - DRUG CONTAINER, IMSS
8117	SDC42100209		CAP - DRUG CONTAINER IMSS
8118	SEB39104127		PACKAGE, FOOD - WET PACK
8120	SEF48100120	14-336	RETAINING ROD - L.E.B.
8121	SDF48100121		RETAINING BRACKET - L.E.B.
8122	SDF48100122	14-343	FRAME L.E.B.
8123	SEF48100123		FRONT PARTITION CLOSURE L.E.B.
8124	SDF48100124	14-348	PARTITION - L.E.B.
8125	SEF48100125	14-02075	PARTITION ASSY L.E.B.
8126	SDF48100126	14-350	SNAP FASTENERS - PARTITION
8127	SDF48100127	14-353	REINFORCEMENT PATCH

APPENDIX B

ASTP MENU

REV A
~~11-22-74~~
4-18-75

ASTP FLIGHT MENU — Thomas P. Stafford, AC - RED VELCRO

MEAL	DAY 1*, 5, 9		DAY 2, 6, 10		DAY 3, 7, 11**		DAY 4, 8	
A	Breakfast Roll (I)	NF	Scrambled Eggs	R	Granola	R	Scrambled Eggs	R
	Raisin & Spice Cereal	R	Bacon Wafers (4)	NF	Beef Patties	R	Sausage Patties	R
	Peaches	R	Strawberries	R	Dried Peaches	C	Pineapple	TC
	Orange Drink w/Ca	R	Grapefruit Drink w/Ca	R	Cocoa w/Ca	R	Orange Drink w/Ca	R
	Coffee, Cream & Sugar	R	Tea w/Lemon & Sugar	R			Coffee, Cream & Sugar	R
B	Pea Soup	R	Chicken Salad	TC	Turkey-Rice Soup	R	Potato Soup	R
	Salmon	TC	Rye Bread (I)	NF	Cheese Crackers	NF	Beef Slices/BBQ Sauce	TP
	Rye Bread (I)	NF			Peanut Butter	TP	Cheese Spread	TP
	Dried Apricots	C	Applesauce	TC	Strawberry Jam	TP	Rye Bread (I)	NF
	Coffee, Cream & Sugar	R	Orange Drink w/Ca	R	Rye Bread (I)	NF	Peach Ambrosia	R
					Tea w/Lemon & Sugar	R	Strawberry Drink	R
C	Shrimp Cocktail	R	Seafood-Mushroom Soup	R	Shrimp Cocktail	R	Seafood-Mushroom Soup	R
	Beef Steak (I)	TP	Meatballs/BBQ Sauce	TP	Chicken ala King	TP	Turkey & Gravy	TP
	Shortbread Cookies (4)	NF			Peas	R	Cranberry Sauce	TC
	Vanilla Pudding	TC	Stewed Tomatoes	TC			Brownies	NF
	Orange-Pineapple Drink w/Ca	R	Cherry-Nut Cake	TP	Chocolate-Nut Cake	TP	Grapefruit Drink w/K	R
	Almonds	NF	Strawberry Drink	R	Orange-Pineapple Drink w/Ca	R	Peanuts	NF

* Day 1 consists of Meal C only
** Day 11 consists of Meals A and B only

10 day food supply

NF - Natural form
C - Can
TP - Thermostabilized, pouch
TC - Thermostabilized, can
R - Rehydratable

Thomas P. Stafford
Approved

REV A
~~11-22-74~~
4-18-75

ASTP FLIGHT MENU

Vance D. Brand, CP - WHITE VELCRO

MEAL	DAY 1*, 5, 9		DAY 2, 6, 10		DAY 3, 7, 11**		DAY 4, 8	
A	Breakfast Roll X2 (I)	NF	Natural Cereal	R	Breakfast Roll X2 (I)	NF	Natural Cereal	R
	Peaches	R	Strawberries	R	Bran Flakes	R	Strawberries	R
	Orange Drink w/Ca	R	Grapefruit Drink w/Ca	R	Dried Peaches	C	Orange Drink w/Ca	R
	Coffee	R	Coffee	R	Orange Drink w/Ca	R	Coffee	R
	Grapefruit Drink (S)	R	Strawberry Drink (S)	R	Coffee	R	Lemonade (S)	R
					Grapefruit Drink (S)	R		
B	Salmon X2	TC	Ham (I)	TP	Beef Slices/BBQ Sauce	TP	Tuna	TC
	Rye Bread (I)	NF	Applesauce	TC	Rye Bread (I)	NF	Rye Bread (I)	NF
	Dried Apricots	C	Peanut Butter	TP	Shortbread Cookies (4)	NF	Cheese Slice	NF
			Graham Crackers (8)	NF	Applesauce	TC	Pecan Cookies (4)	NF
	Cocoa	R	Orange Drink w/Ca	R	Cocoa w/Ca	R	Grapefruit Drink w/K	R
C	Beef & Gravy	TP	Seafood-Mushroom Soup	R	Romaine Soup	R	Pea Soup	R
	Creamed Corn	R	Beef Steak (I)	TP	Turkey & Gravy	TP	Beef Steak (I)	TP
	Shortbread Cookies (4)	NF	Mashed Potatoes	R	Cranberry Sauce	TC	Mashed Potatoes	R
	Applesauce	TC	Cranberry Sauce	TC	Cheese Slice	NF	Pineapple	TC
	Cheese Slice	NF	Pecan Cookies (4)	NF	Chocolate Pudding	TC	Peach Ambrosia	R
	Coffee	R	Coffee	R	Coffee	R	Coffee	R

* Day 1 consists of Meal C only

** Day 11 consists of Meals A and B only

10 day food supply

IF - Natural form
C - Can
P - Thermostabilized, pouch
C - Thermostabilized, can
R - Rehydratable
S - Snack

Vance D. Brand
Approved

B-2

REV A
~~11-22-74~~
4-18-75

ASTP FLIGHT MENU

Donald K. Slayton, DP - BLUE VELCR(

MEAL	DAY 1*, 5, 9		DAY 2, 6, 10		DAY 3, 7, 11**		DAY 4, 8	
A	Granola	R	Scrambled Eggs	R	Granola	R	Scrambled Eggs	R
	Pears	R	Sausage Patties	R	Bacon (4)	NF	Beef Patties	R
	Cheese Slice	NF	Strawberries	R	Pineapple	TC	Peaches	R
	Orange Drink w/Ca	R	Grapefruit Drink w/Ca	R	Cocoa w/Ca	R	Orange Drink w/Ca	R
	Tea w/Lemon & Sugar	R	Tea w/Lemon & Sugar	R	Tea w/Lemon & Sugar	R	Tea w/Lemon & Sugar	R
B	Turkey & Rice Soup	R	Potato Soup	R	Pea Soup	R	Meatballs w/Sauce	TP
	Frankfurters	TP	Salmon	C	Corned Beef	TP	Macaroni & Cheese	R
	Catsup	TP	Rye Bread (I)	F	Cheese Spread	TP	Rye Bread (I)	NF
	Rye Bread (I)	NF	Beef Jerky	F	Rye Bread (I)	NF	Vanilla Pudding	TC
	Dried Apricots	C	Peach Ambrosia	R	Dried Apricots	C	Almonds	NF
	Cocoa w/Ca	R	Orange Drink W/Ca	R	Brownies	NF	Grapefruit Drink	R
					Grape Drink	R		
C	Pea Soup	R	Seafood-Mushroom Soup	R	Shrimp Cocktail	R	Romaine Soup	R
	Beef Steak (I)‡	TP	Beef Steak (I)	TP	Turkey & Gravy	TP	Beef Slices/BBQ Sauce	TP
	Potato Pattie	R	Macaroni & Cheese	R	Cranberry Sauce	TC	Potatoes (Potato soup)	R
	Stewed Tomatoes	TC	Spinach w/Sauce	R	Peas	R	Stewed Tomatoes	TC
	Fruit Cocktail	R	Vanilla Pudding	TC	Choc. Cov. Cookies(2)	NF	Peach Ambrosia	R
	Peanuts	NF	Chocolate Nut Cake	TP	Grapefruit Drink w/K	R	Cherry-Nut Cake	TP
	Grape Drink	R	Strawberry Drink	R			Orange-Pineapple Drink w/Ca	R

‡Tuna (Day 5 & 9)

* Day 1 consists of Meal C only
** Day 11 consists of Meals A and B only

10 day food supply

NF - Natural form
C - Can
TP - Thermostabilized, pouch
TC - Thermostabilized, can
R - Rehydratable

B-3

Approved

2-26-75

ASTP FLIGHT MENU

Aleskey A. Leonov - SC - RED/WHITE VELCRO

Potato Soup	R
Beef Steak (I)	TP
Rye Bread	NF
Cheese Spread	TP
Almonds	NF
Strawberries	R
Tea w/Lemon & Sugar	R

Valeriy N. Kubasov - FE - BLUE/WHITE VELCRO

Seafood Mushroom Soup	R
Beef Steak (T)	TP
Rye Bread	NF
Cheese Spread	TP
Almonds	NF
Strawberries	R
Tea w/Lemon & Sugar	R

NF - Natural form
R - Rehydratable
TP - Thermostabilized, pouch
TC - Thermostabilized, can

APPROVED: _____
Aleskey A. Leonov

APPROVED: _____
Valeriy N. Kubasov

B-4

ASTP FOOD SYSTEM

REV. 1

PANTRY FOOD ITEMS

FOOD NO	ITEM	QTY	ACCESSORY ITEMS
104	Coffee (B)	10	Spoon Assemblies
132	Coffee w/Cream & Sugar	10	Can Opener
117	Tea w/Lemon & Sugar	10	Chewing Gum
110	Lemonade	5	Spice Kit (Salt & Pepper)
115	Strawberry Drink	10	Oral Hygiene Kit
114	Orange-Pineapple Drink	10	Germicidal Tablets
103	Cocoa	5	Food Trays
106	Grapefruit Drink	5	Vitamin Tablets
	Orange Crystals	5	
4	Corn Beef	2	
*138	Beef Steak (I)	2	
97	Turkey (I)	2	
35	Cheese Slice	5	
8	Beef Jerky	5	
96	Tuna Salad Spread	1	
24	Catsup	3	
64	Mustard	3	
59	Jam, Peach	3	
60	Jam, Strawberry	3	
*70	Dried Peaches	6	
*2	Dried Apricots	6	
48	Graham Crackers (4)	4	Please note: No beverages in the pantry are fortified.
43	Pecan Cookies	6	
44	Shortbread Cookies	6	
67	Peanuts	3	
99	Turkey-Rice Soup	2	
80	Potato Soup	4	

DB3:1/15/75
DB3:1/20/75 Corrected Food Numbers
DB3:4/18/75 Rev. B

APPENDIX C

ABBREVIATIONS

APPENDIX C

ABBREVIATIONS

ASTP - Apollo-Soyuz Test Project

ATP - Adenosine Triphosphate

DR - Discrepancy Report

EIS - End Item Specification

E. coli - *Escherichia coli*

FPS - Food Process Standards

HACCP - Hazard Analysis Critical Control Point

JSC - Johnson Space Center

KSC - Kennedy Space Center

PDA - Predelivery Acceptance Test Plan

PIA - Pre-Installation Acceptance Plan

SOPM - Standard Operating Procedures Manual

TPS - Test Preparation Sheet