Chapter 13

AIRCREW NUTRITION

Nutrition is of basic importance to all fighting forces and has particular application in the Air Force to flight requirements for aircrews. The feeding procedures which accomplish the goals of nutrition will be considered in three parts: the *Ground Feeding Program,* as related to personnel garrisoned at Air Force bases; the *Flight Feeding Program,* unique to airborne situations; and the *Survival Feeding Program,* which attempts to nutritionally sustain the airmen isolated in hostile or primeval territory.

Ground Feeding

The ground feeding of Air Force personnel is conducted in base dining halls or cafeterias on a plan common with that of the US Army. Under this system, all ration supplies are procured and distributed through the Defense Personnel Support Center, based on the variety of complete meal menus circulated months in advance by a Joint Army-Air Force Master Menu Board. These master menus are planned in accordance with the nutritional standards prescribed in AFR 160–95. The dietary standards should be maintained when later adjustments of the menus become necessary because of local climatic, personnel, or supply conditions.

Final local changes in meal menus are authorized and should be coordinated by base menu boards on which the food service supervisor, commissary officer, and surgeon are represented. This arrangement is designed to insure satisfactory ground feeding despite the complexities and global scope of Air Force operations.

The principal standard ration for ground use, Field Ration A, is the one normally issued to Air Force units when both kitchen and refrigeration facilities are available. It includes many varieties of fresh, perishable food components, as listed in master menus and served regularly at bases in the CONUS. When such perishables cannot be stocked at oversea or field locations, usually because refrigeration facilities are lacking, the operational B Ration is supplied as the standard dining hall ration. The B Ration substitutes, canned or dehydrated, are nonperishable items of the same types as in Field Ration A, for feeding groups of approximately fifty or more men.

Smaller Air Force units, when separated from kitchen facilities for temporary periods, can subsist adequately on Ration, Small Detachment, 5-in-1. Each packaged ration of this type provides food for five men for one day and is eaten either hot or cold. Its use in the Air Force is usually limited to emergency reserves for advanced radar and weather detachments, crash crews, and search and rescue operations.

Other ground-type packaged rations, or specialized supplements, are listed and described in TO No. 00–35A–36, "Operational Rations, Food Packets, and Supplements." These include Ration Supplements for hospitals or aid stations, the Ration, Individual, Combat, and Ration Arctic Trail. The last two named are primarily intended for Army field forces under combat conditions. They are designed to provide food for one man for one day, and apply rather infrequently to Air Force requirements.

Flight Feeding

Flight feeding is considered in three categories: preflight, in-flight, and postflight. These are specialized extensions to the basic program of nutrition on the ground. All have become increasingly necessary in recent

years because of the extended ranges and performance of modern aircraft.

It is recognized that flying activities often interrupt and modify the fundamental living habits of personnel, including those of sleeping, eating, or drinking. The primary purpose behind flight feeding efforts is, accordingly, to assist aircrews and also aircraft passengers in their adjustment to these work demands.

Field observations from various sources have indicated that "nonfeeding," or irregular eating practices over an extended period, contribute to fatigue, human error, and possible aircraft accidents. The value of flight feeding with respect to general bodily comfort and morale is even more commonly recognized. To promote the best in performance, the flight feeding system should properly "refuel" the human operators with nutrients, on a careful and regular basis, just as an aircraft is refueled.

The three categories of flight feeding are regarded as consecutive phases, differing only in details of purpose and methods of accomplishment. Preflight and postflight feeding are implemented through ground-kitchen facilities. They may be readily available and effective at some Air Force bases, but not available at others. In-flight feeding is comparatively more difficult because the limitations of aircraft restrict food preparation and consumption. The two ground phases should therefore be planned to counterbalance and compensate for any in-flight periods of a marked nutritional deficit.

Food servicing is often a matter of individual responsibility. Personnel frequently obtain separate flight subsistence from Air Force supply sources, commercial stores and restaurants, or their respective homes. This means that all airmen should be trained to follow conscientiously a good dietary pattern.

Preflight Feeding

Effective preflight preparations require that each person boarding an aircraft should consume a freshly-prepared, balanced meal an hour or two before expected takeoff. This usually is a breakfast menu of fairly light proportions, even though it may be scheduled at various times of day or night. Under pleasant, unhurried eating conditions, a desirable relaxation and a regularity of digestion are encouraged.

Fighter pilots and some bomber crews may require further diet control to reduce the incidence of gas pains and improve crew effectiveness at high altitudes. Specific fixed diets are not entirely satisfactory because of the marked variability in food tolerances and preferences between individuals. Balanced meals containing good quality protein, as well as carbohydrate, and also free of foods producing flatulence or bulk in the colon, are considered generally acceptable. (*Note:* The High Protein, Low Residue Diet recommended for special preflight conditioning is in AFM 146–2.)

Items contraindicated, because they induce abdominal gas, include vegetables of the cabbage family, dried peas and beans, beer or carbonated drinks, turnips, rutabagas, and other raw fruits or vegetables which are fibrous. The chewing of gum is also discouraged since it promotes air swallowing. Many fresh fruits and fruit juices are permitted and may prevent depletion of Vitamin C from repeated altitude exposure. High-fat, heavily spiced, or poorly-cooked food items are less readily digested, and generally avoided by aircrews. Field reports indicate that the occurrence and severity of gastric distress in flying are quite low when moderate dietary precautions are taken.

Alert-crew feeding is a special situation of preflight feeding. When crewmen are on alert-crew status, they are restricted to the alert-crew hangar and must be ready at all times for immediate takeoff. AFM 146–2 authorizes local commanders to establish special dining facilities for this situation, both preflight and postflight. Food items authorized by AFM 145–1 and/or precooked frozen meals and food packets, individual, in-flight (IF), are authorized for alert-crew feeding.

In-flight Feeding

In-flight feeding is a rather new development in comparison with other aircraft procedures. Early aircraft had short flight

durations which did not require organized feeding in the air; but the importance and need for such provisions became apparent during World War II. The present concepts of in-flight nutrition have evolved from the increasing requirements of aircrews for longer missions, as the result of current range-extension developments. Some degree of in-flight feeding is now routine in most Air Force operations.

The factors which influence the extent and success of food servicing in an aircraft are numerous. Meals eaten aloft are often a nutritional compromise with the practical realities of limited aircraft space, equipment, and other demands of the flying situation. Accordingly, no single method of in-flight feeding or standard type of food packaging can completely fulfill all of the changing needs of fliers. The satisfactory feeding operation must feature simplicity, ease of support, and a variety of well-liked foods and beverages in attractive combinations. To some extent, this requires a different "prescription" of meal types and food servicing equipment for each model of aircraft and also for each kind of flight mission.

Air Force equipment directives plan for drinking fluids to be supplied in all aircraft capable of flying over 3 hours, in quantities of one quart per crew member or passenger for each 16 hours of flight. Flight lunch storage and heating facilities are similarly scheduled for aircraft with over 6 hours' flight duration, on the basis of one added meal for each subsequent 6 hours. This criterion serves only as a guide for the initial authorization, design, and production of feeding apparatus or food packets.

These planning figures will be much more flexible as the actual feeding practices are worked out within the operational Air Force commands. For example, the aircraft flight time has not proved a true index for in-flight feeding. The "flight duration" for this purpose should be the total time from the preflight breakfast (or last meal before takeoff) to the end of postflight debriefing or interrogation.

Field observations show trends in aircrew feeding habits that are common enough between Air Force commands to be classed as "in-flight peculiarities." The appetites of crew personnel usually decrease, especially in the final hours of long flights, and food items are regarded more critically. Features of the military aircraft environment, such as work concentration, noise, vibration, decreased oxygen, etc., all tend to reduce the digestive processes. The extreme tensions of air emergencies and active combat may completely inhibit gastric function.

The taste acceptability of certain food items may differ between ground level and altitude, for reasons other than jaded appetite, excitement, or fatigue stress. Some comparative acceptance studies indicate that potatoes, vegetables, and salads are rated about 20% lower in the air than on the ground; soups, meats, fruits, and beverages are roughly comparable in both environments; baked goods and desserts are highly palatable in all flight circumstances.

Monotony of diet is a further in-flight problem for aircrews, which does not apply to airborne troops and passengers who travel less frequently. Passenger personnel generally consume heavier meals, presumably to relieve flight strain or tedium. Their eating also prevents the "emptiness" and other gastric discomfort which seem to predispose to airsickness in certain susceptible individuals.

Approximately 6 hours are recommended between in-flight meals (AFM 146–2), but small amounts of "free choice," sugar-yielding food supplements are desirable between the meal periods. Beverages are most important and should be freely available at all times. These factors are presented as a guide to the average in-flight practices of the majority of operational personnel, rather than as arbitrary and fixed requirements.

Types of Meals Authorized

To avoid excessive repetition in serving similar meals, with resultant decreases in acceptability, the seven types of flight meals listed below are authorized. Other types of

flight meals may be used only when authorized by HQ USAF.

a. *Flight Meals Authorized for General Use.* These meals should be used interchangeably so far as flying schedules, special equipment, and missions permit.

(1) *Food Packet, Individual, In-Flight, (IF).* This packet contains canned items and is designed for use at bases where fresh foods are not available or cannot be stored in aircraft without spoilage. Each packet is a complete meal in itself, and ten different menus are assembled in the separate packets. Their storage stability is approximately 2 years. These in-flight food packets contain an average of 1,200 calories. They have proved very acceptable when consumed at irregular periods.

Each food packet contains four cans: one of meat, one of fruit, one of dessert, and one of juice. There are ten menus that include four varieties of fruit, ten kinds of meat items, six dessert selections, and four varieties of juice.

Specific components are:

Meats	
Beef, with spiced sauce	Ham, fried
Beefsteak	Ground meat and spaghetti
Chicken and noodles	Pork steak
Chicken	Turkey loaf
Ham and Eggs, chopped	Tuna fish
Fruits	
Apricots	Pears
Fruit cocktail	Peaches
Desserts	
Cookies	Pound cake
Fruitcake	Pecan cake roll
Orange nut roll	Chocolate nut roll
Juices	
Grapefruit-orange	Grape
Orange	Tomato

In addition, each menu contains an accessory packet with individual servings of soluble cream, coffee and tea, sugar, plus chewing gum. The food items have all been cooked and may be eaten cold; but the flavor of the meat items and date pudding is enhanced by heating. Several types of food warming devices have been authorized for use on aircraft.

This food packet is the most versatile in-flight meal. It is nonperishable and may be used in the majority of aircraft, is available on short notice through regular channels of supply (commissaries, personal equipment offices, and/or flight kitchens), and requires a minimum of aircraft servicing equipment.

(2) *Precooked Frozen Meal.* The main dishes of the precooked frozen meal are centrally procured and are issued through commissary supply channels. Supplemental items including bread, salad, beverage, and dessert are issued by the flight kitchen to the crewman.

There are 5 menus available:

Menu No.

1. Turkey, dressing and gravy, mashed sweet potatoes.
2. Swiss steak with gravy, peas, au gratin potatoes.
3. Beef steak, corn, and mashed potatoes.
4. Beef pot roast, green beans, mashed potatoes.
5. Waffles, sausage links, applesauce.

Menus 1 through 4 are dinner meals and menu 5 is a breakfast meal. A sixth meal is being added to the selection in the near future.

Aircraft ovens and refrigerators are required for storage and preparation of all menus.

These meals are procured quarterly, and the cartons are dated when the meal is produced. For best acceptability, they should be consumed within 9 months from date of manufacture.

A plastic vial, half filled with water and frozen in a vertical position, is placed in each case in a lateral postion. If the ice has melted and flowed along the axis of the tube, the meals are not to be consumed. The melted ice is evidence that the temperature has been high enough that Staphylococcal toxins may be present.

(3) *Sandwich Meal.* The Sandwich Meal is by far the most common type and is prepared as a standard Air Force package in dining halls or by special flight kitchens. It consists of fresh sandwiches, milk, canned juices, fresh fruit or desserts, plus additional items, such as celery, pickles, and hard-boiled eggs. (See illustration.) Various nutrition-

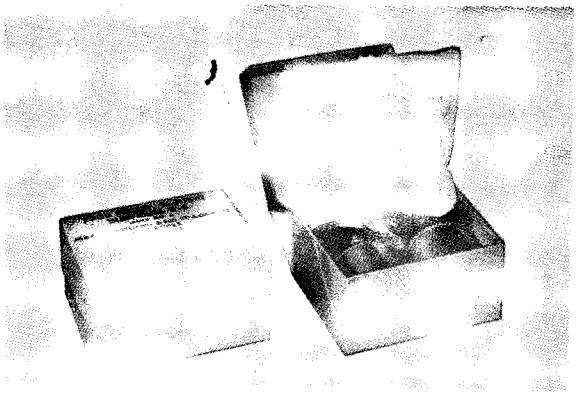

Figure 13–1. Individual In-flight Packet.

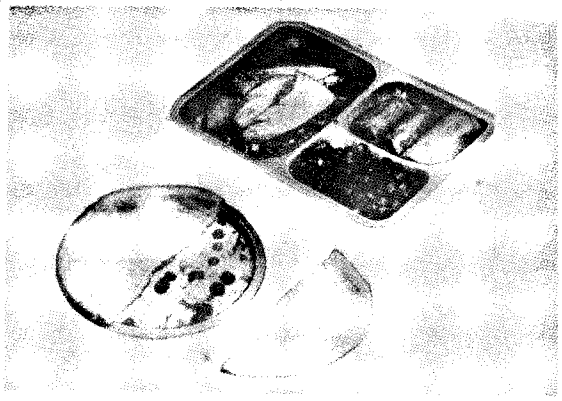

Figure 13–2. Casserole and Tray Type Precooked Frozen Meals.

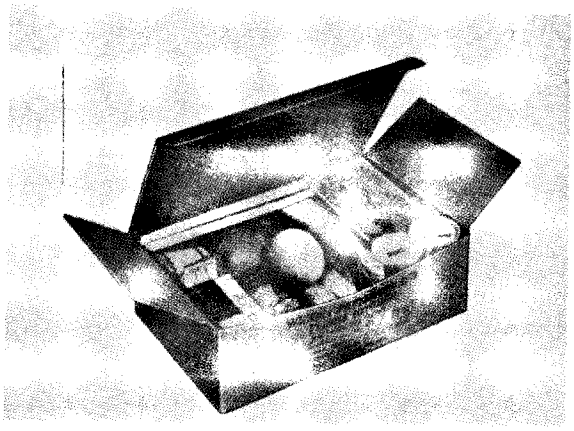

Figure 13–3. A Typical Sandwich Meal.

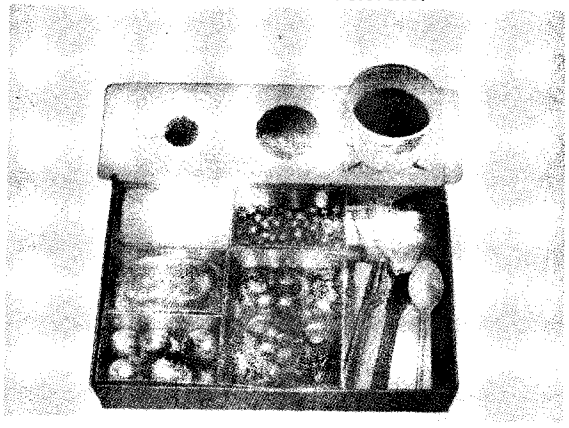

Figure 13–4. Foil-Pack Meal.

ally-balanced combinations are in AFM 146–2; but their essential freshness, appearance, and appetite appeal depend on the resourcefulness of the kitchen personnel.

The most acceptable sandwiches are those containing sliced meats, chicken, or turkey; with bone, bone splinters, and inedible gristle removed. The sandwiches should be wrapped immediately after preparation in waxed paper sandwich bags, and refrigerated below 40° F until issued to crew members. No gravy, chopped egg, or chopped meat fillings should be issued because of the increased danger of bacterial food poisoning. (See AFM 161–6 for recommended refrigeration and consumption procedures.)

After 5 or more hours at room temperatures, most types of sandwiches or other perishables can become unsafe for consumption through toxin production resulting from bacterial growth. Therefore, all sandwich components not consumed within 5 hours of preparation or issue will be destroyed. The sandwich lunch is most useful in that it requires no installed aircraft equipment and is generally well liked if not too frequently repeated. It is usually limited to short flights or as the first meal of long missions.

(4) *Precooked Hot Meal and Breakfast Meal.* AFM 146–2 authorizes the use of both the precooked hot meal and the breakfast meal. These meals are rarely used in-flight, however. The precooked hot meal is prepared as a hot meal on the ground and is placed aboard the aircraft in an insulated container or warming oven. The meal is kept heated until consumed. This meal has poor keeping qualities. It is unpalatable if held too long, so it cannot be used in the later hours of a long flight. The meal is also unsatisfactory if takeoff time is delayed greatly.

The breakfast meal consists of ready-to-

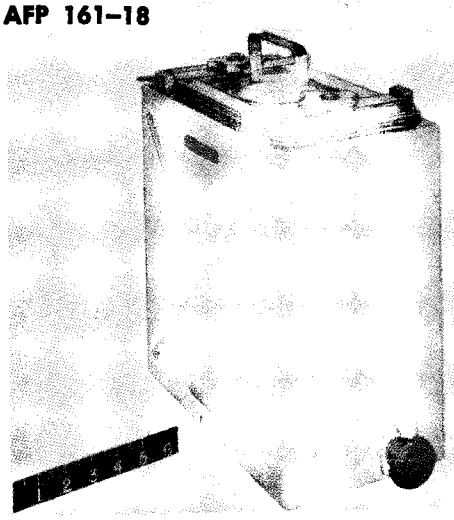

Figure 13–5. Insulated Jug With Capacity of Two Gallons.

Figure 13–6. Experimental Can-Piercing Drinking Device Showing "Closed System" Looped Drinking Tube for Equalizing Pressure Within Can.

Figure 13–7. Experimental Can-Piercing Drinking Device Showing Disposable Mouthpiece, Proposed for Air Evacation Patients.

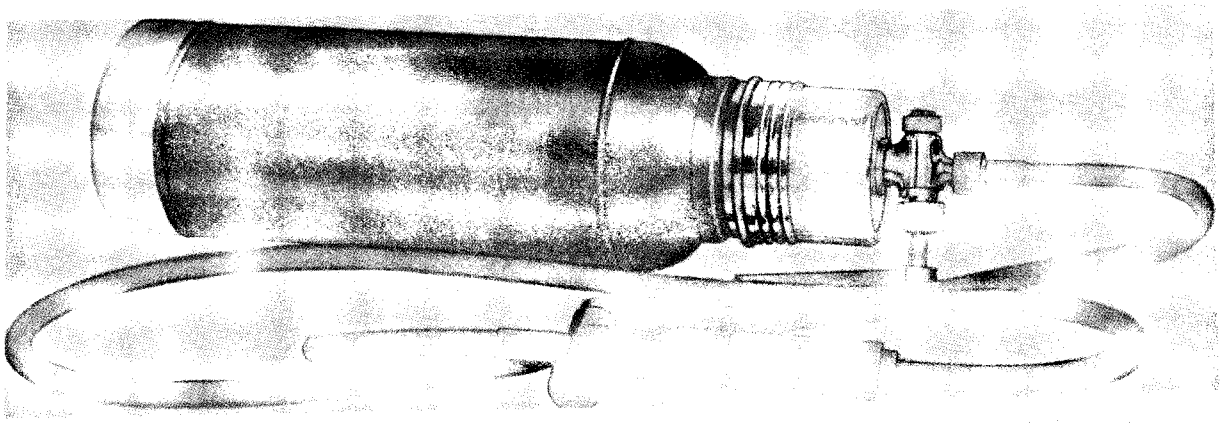

Figure 13–8. Crew Position Water Bottle Assembly.

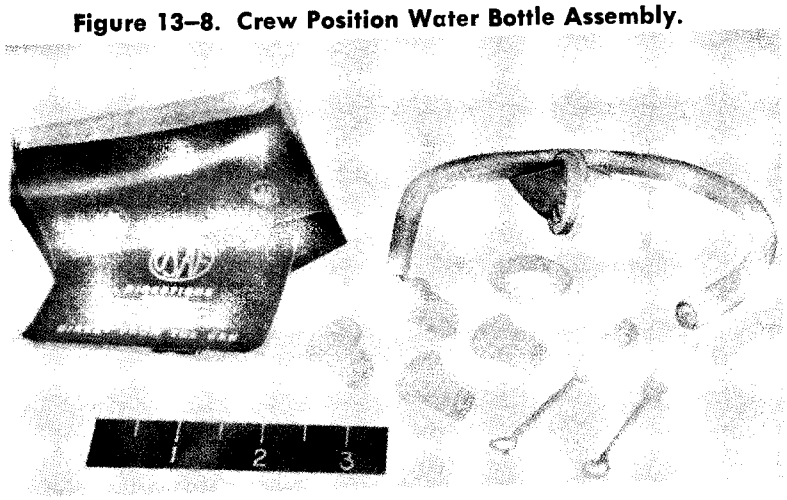

Figure 13–9. Experimental Can-Piercing Drinking Device, Complete Kit Assembly.

eat breakfast items taken aboard for assembly in-flight. Breakfast meals are rarely required in-flight, since most passengers and crewmen desire heavier food by the time they are airborne, even on early morning flights.

The precooked hot meal and breakfast meal should not ordinarily be considered for flight feeding except under unusual circumstances.

(5) *Bulk Issue for Preparation Aloft.* Authority is granted to issue, in bulk, the food components authorized in addition to those normally stocked by the flight kitchen. For other types of flights, meals will be procured directly from the commissary store by the aircraft commander or his designated representative.

b. *Flight Meals Authorized for Specific Use.*

(1) *Bite-Size Meal.* The bite-size meal is authorized for jet aircraft when the serving of any other type of flight meal is not practical. All components must be "bite-size" and suitable for eating by hand. Each package will be clearly marked with the date and time limit of safe consumption. This meal will be consumed no later than 5 hours after preparation. The bite-size meal consists of the following components:

Beverage Unit: Milk or juice.

Meat Component: Cubes of cooked steak or other lean, tender meats.

Dessert Component: Cookies or pieces of fruit, and candy.

Optional Items: Gum, relishes, nuts, coffee.

(2) *Foil-Pack Meal.* The foil-pack feeding system has been authorized for use at certain bases supporting particular type operations, such as radar picket patrol missions. This system is designed primarily for large aircraft where space and power are available and where weight is not a limiting factor. The Strategic Air Command first demonstrated the possibilities of this procedure, using the type B–4 oven supplied with B–36 aircraft. In their preliminary trials, a number of fresh-chilled food ingredients were prepared and cooked with marked success in hand-assembled, aluminum-foil packages.

This foil-pack meal at present consists of five menu items in separate containers: meat, two vegetables (potato and another vegetable), hot roll, and dessert. Four breakfast menus are available from the total of sixty-eight menus that have been developed. Except for the packaging of rolls, pies, cakes, and the searing of meat in ground kitchens, all items are packaged uncooked in separate, rectangular foil containers. These are sealed with a top cover, combined as a meal on single trays, and refrigerated (37° F) until the time of final cooking.

The system utilizes three special articles of equipment: aluminum foil packs and crimp-closure device, aircraft refrigerator, and oven. The meals, packaged very simply in ground-support kitchens, are composed of the common, lower cost, dining hall subsistence supplies, and require minimum training and effort of aircrews. This meal has very high acceptability and is very popular at the installations using them.

Beverages

Dehydration of the human body results in lowered efficiency and is a serious factor for flight operations in hot climates or at high altitude. Cool water, coffee, tea, chocolate milk, tomato juice and fruit juices are all popular. Cool water should always be available, and other beverages should be available on missions of more than a few hours. Beverages should also be included with flight meals. However, gratuitous issue of Government beverages to passengers and crews between meals is not authorized.

The following liquid-feeding equipment is available. One or 2-gallon containers are usually used in passenger, cargo, and bomber aircraft where large numbers of people must be served and where mobility of crew members is permitted. The recommended 2-gallon capacity container is the "Jug, Insulated, type CNU-2/C"; standard, specification MIL–J–25718, as illustrated. It is rectangular in shape and is fabricated of stainless steel, has an electrical element which will operate on

either 28 Volts DC or 115 Volts AC, and is designed to keep liquids between the temperatures of 170° and 190° F as long as power is supplied.

The jug can also be charged with wet ice to keep beverages cool. With an initial full charge of ice, at an ambient temperature of 90° F, the liquid temperature can be kept below 45° F for a period of from 16 to 25 hours. The type CNU-2/C jug replaces the type J-1 container with dry ice well, which is now limited standard.

An alternate 2-gallon container, which can be used when electrical power is not available or where a cylindrical shape is desired, is the type III, Grade A, Class 2 Insulated Jug described by specification MIL-C-3164. The construction of this container is also of stainless steel and is available in the 1-gallon as well as the 2-gallon size. The jugs are designed to keep beverages above an acceptably warm temperature for a period of at least 6 hours at an ambient temperature of 68-76° F. This type jug replaces the old type F-1 liquid containers which are now limited standard.

Special equipment is available for fighter aircraft and for situations where the crew member must remain in a fixed position for an extended period of time. Crew position water bottle assemblies, here illustrated, of the 1-quart horizontally installed, and 2-quart vertically installed types are now standard-issue items. Each assembly consists of a stainless steel vacuum bottle with cap, sealing gasket, and spigot equipped with a vent tube to allow liquid to drain from the bottle.

The liquid outlet of the spigot is attached to a length of silicone rubber tubing, having a teflon drinking probe. A handset valve is used to govern the flow of fluid. The container is mounted so that the liquid will flow

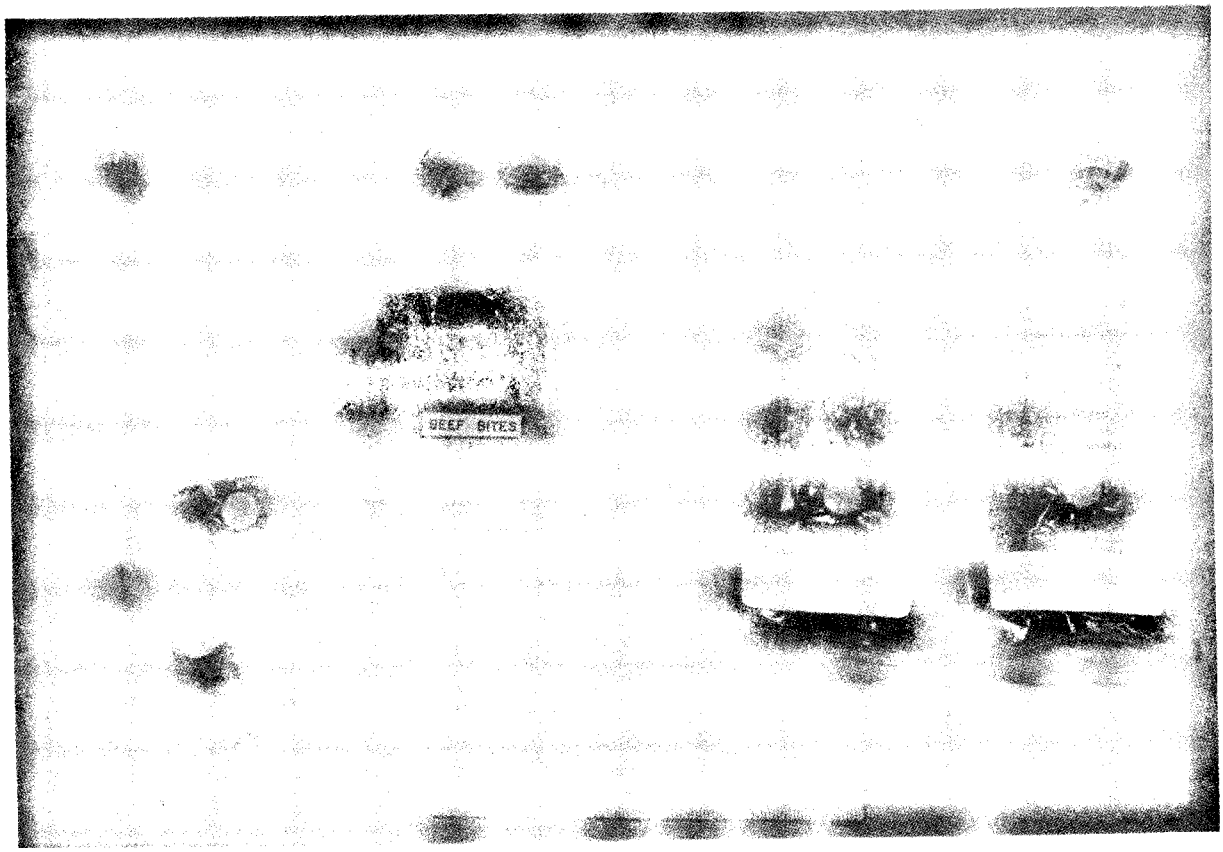

Figure 13-10. Typical Space Meal in Zero-G Feeders.

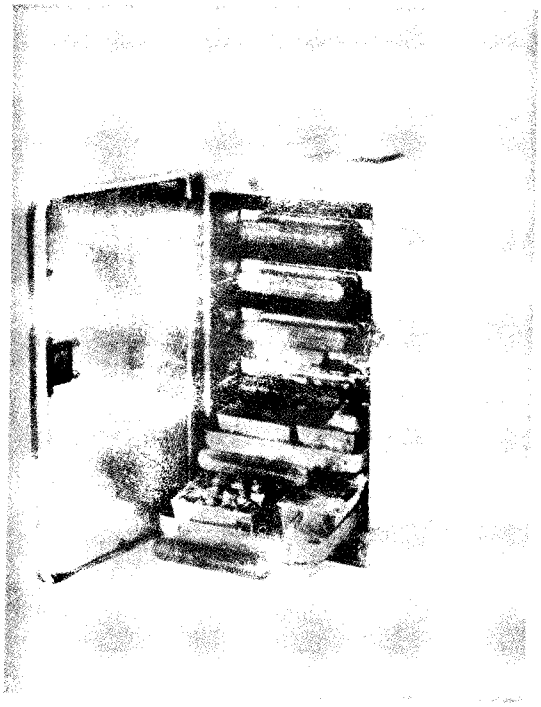

Figure 13–11. B–4 Oven With Foil-Pack Meals on Lower Shelves.

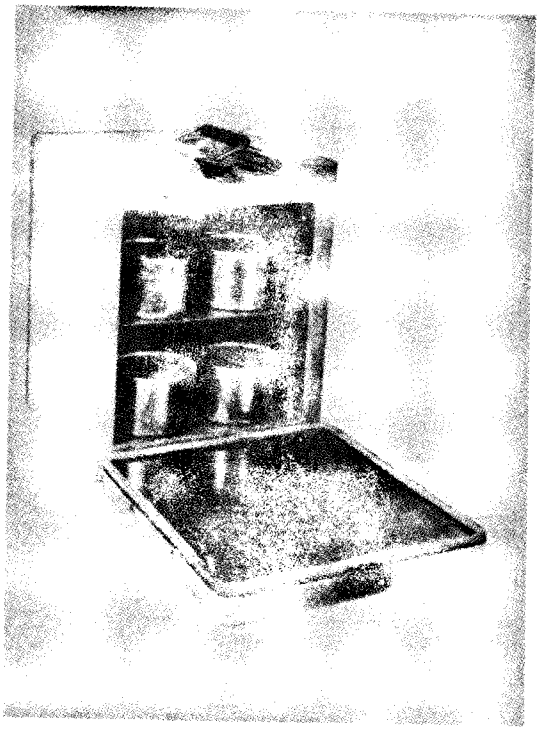

Figure 13–12. B–3 Oven With IF-Food Packet Cans in Place for Heating.

by gravity to the point of consumption. The bottles are designed to keep liquids above an acceptably warm temperature for a period of at least 6 hours at an ambient temperature of 77° F.

A device has been developed for piercing commercial juice and beverage cans and provides for drinking the liquid directly from the can. Refer to the accompanying illustration. This device is contained in the "Dispensing Kit-Liquid Can Piercing-Drinking" which is described by USAF Dwg. No. 54B3827.

New Foods for Special Aerospace Operations

Low-moisture foods have been developed for feeding systems in space vehicles where the environment and weight and volume limitations have required highly stable, lightweight rations which require minimum preparation. These feeding systems are composed of bite-size dehydrated foods, rehydratable precooked freeze-dried foods and rehydratable beverages. These foods packaged in flight-qualified packaging material are stable for 2 years or longer at room temperature (see figure 13–10).

Foods developed for in-flight feeding in fighter aircraft are currently being tested in operational aircraft. Bite-size foods similar to those used in space feeding have been produced in large quantities for test in aircraft which require the wearing of an oxygen mask. Tube foods, liquid-formula foods, and rod-shaped foods are being developed for operational aircraft which require the continuous wearing of a full pressure suit. Details of completed studies on evaluations of foods for space feeding and other special aerospace operations are contained in Technical Reports distributed from the USAF School of Aerospace Medicine, Brooks Air Force Base, Texas.

Equipment

Food Servicing Equipment has been briefly referenced in preceding sections, but a number of additional items also exist, either recently developed or previously standardized for aircraft supply. When such apparatus can be made readily available to aircrews,

TABLE 13–1. *FOOD SERVICING EQUIPMENT FOR AIRCRAFT

Bracket and Receptacle, Hot Cup, Four Unit, 28 volts, Type A-1 Spec MIL-B-7528 (Standard)
Bracket and Receptacle, Hot Cup, Single Unit, 28 volts, Type A-2 Spec MIL-B-7526 (Standard)
Bracket and Receptacle, Hot Cup, Four Unit, 115 volts, Type B-1 Spec MIL-B-7527 (Standard)
Bracket and Receptacle, Hot Cup, Single Unit, 115 volts, Type B-2 Spec MIL-B-7527 (Standard)
Bracket and Receptacle, Hot Cup, 115 volts, Single Unit, Type B-2 Spec MIL-B-7525 (Standard)
Cup, Food Warming, Electrically Heated, Aircraft, Type A-1 28 volts, Spec MIL-C-7615 (Standard)
Cup, Food Warming, Electrically Heated, Aircraft, Type B-1 115 volts, Spec MIL-C-7561 (Standard)
Cups and Lids, Paper, Hot Food or Drink, Style A, 603 Spec UU-C-8344 (Commercial Standard)
Dispenser, Paper Drinking Cup, Wall Mounted, Aircraft, 24 Cup Capacity (USAF Dwg No. 49D3786)
Dispensing Kit, Liquid Can Piercing, Drinking (USAF Dwg No. 54B3827) (Standard)
Jug, Insulated, Type CNU-2/c (2 Gal.) Spec MIL-J-25718 (Standard)
Jug, Insulated, Type III, Grade A, Class 2, 1 Gal. and 2 Gal. Spec MIL-C-3164A (Commercial Standard)
Oven, Food Warming, Electrically Heated, Type B-4 Spec MIL-O-6438B (Standard)
Refrigerator, Dry Ice, Precooked Frozen Food Storage, Type B-1, Weber Aircraft Corp., Burbank, Cal., Dwg. No. R72202 (Com. Stand.)
Refrigerator, Mechanical, Non Frozen Storage, 4 cu ft, Model SR-4, Dale Sales, Inc., Los Angeles, Cal. (Com. Stand.)
Refrigerator, Mechanical, Non Frozen Storage, 6 cu ft, Model SR-6, Dale Sales Inc., Los Angeles (Commercial Stand.)
Refrigerator, Mechanical, Non Frozen Storage, 12 cu ft, Model SR-6A, Dale Sales Inc., Los Angeles (Commercial Stand.)
Refrigerator, Mechanical, Frozen and Non Frozen Storage, 10 cu ft, Model SR-10, Dale Sales Inc., Los Angeles (Commercial Stand.)
Tray, Inflight, Food Servicing, Disposable Spec MIL-T-8166 (Commercial Standard)
Water Bottle Assemblies, Crew Position, 2 qt Horizontal, 2 qt Vertical, 1 qt Horizontal, 1 qt Vertical Spec MIL-B-25337 (Standard)

*Subject to change.

the occurrence of in-flight feeding problems and deficiencies should proportionately diminish. Principal types of equipment items are listed in table 13–1, and are discussed in the following paragraphs.

The B–4 in-flight feeding oven, as illustrated, is intended to be used to heat precooked frozen meals, foil-pack meals and IF canned components in aircraft using 28 volt DC, 120 volt single phase AC and 208 volt three phase AC. The oven has six removable shelves, each with a 375-watt heating element, which can be respaced or heated separately. There is a 175-watt heating element in the side wall to hold foods warm at 150-160° F.

The maximum power drain of the oven is 2425 watts. Its weight is 21 lbs. The oven will warm six precooked frozen meals, six foil-pack meals or 18 IF canned meat components in a period of approximately 30 minutes. Further information regarding the oven can be obtained from specification MIL–O–6438B (USAF) and technical orders 13B1–2–1 and 13B1–2–4. The B–4 oven is being replaced by a new, forced-air oven of superior design and versatility.

The type B–3 oven, here shown, was designed for warming canned IF food-packet components, and cans of "ready to serve" type soups in aircraft using either 28 volt DC or 115 volt single phase AC power. The

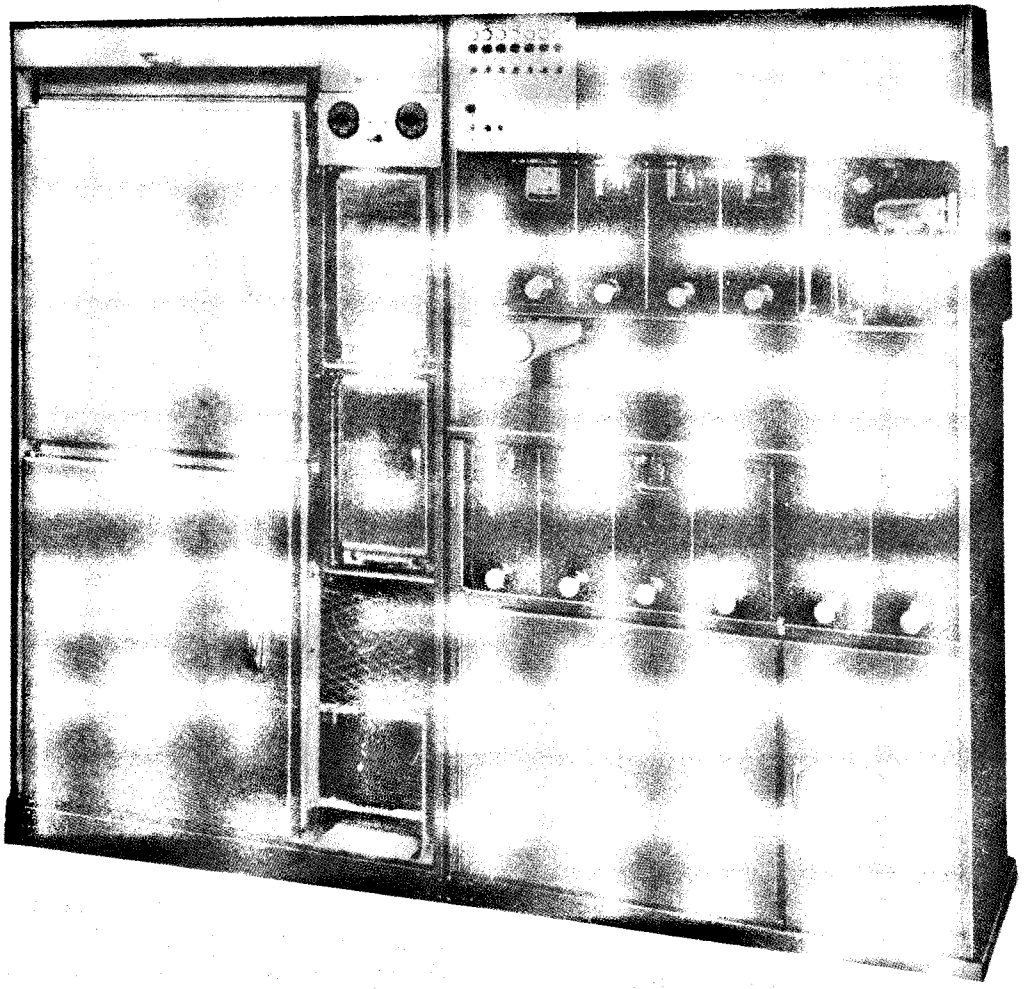

Figure 13–13. Completely Equipped Galley.

capacity of the oven is eight cans which can be heated to palatable temperatures in 10 to 20 minutes, depending upon the initial can temperature. The type B–3 oven has a total wattage of 920, with one 400-watt element embedded in each of two shelves and a 120-watt "holding" element located in a side wall. Maximum weight of the unit is 8¾ pounds. This oven is no longer available from supply. The B–4 oven previously described is used as a replacement.

Galleys

Aircraft food galleys consist essentially of a framework incorporating a storage space, a work surface and various items of insert equipment, as the illustration shows. Specifications MIL–G–25608A and MIL–G–25607 cover respectively the design and testing of galleys. The current practice is to design a different galley in accordance with the physical space available, and the feeding requirements on each type aircraft.

It is recommmended in specification MIL–G–25608A, that insert equipment be selected from the following list:

a. Rectangular liquid containers per MIL–J–25718.

b. Type B–4 ovens per MIL–O–6438.

c. Hot-cup brackets per MIL–B–7525, MIL–B–7526, MIL–B–7527, or MIL–B–7528. (Hot-cup brackets may be designed into the galley with the approval of the procuring activity.)

d. Hot-cups per MIL–C–7561 and/or MIL–C–7615.

e. Drinking-cup dispensers.

f. Refuse container and disposal facilities.

g. Swing-a-way type, or equal, can opener.

h. Refrigerator (mechanical, dry ice, or other approved type).

i. Other insert equipment approved by the procuring activity.

A water tank, sink or drainage part, and accessory plumbing may also be included in the galley.

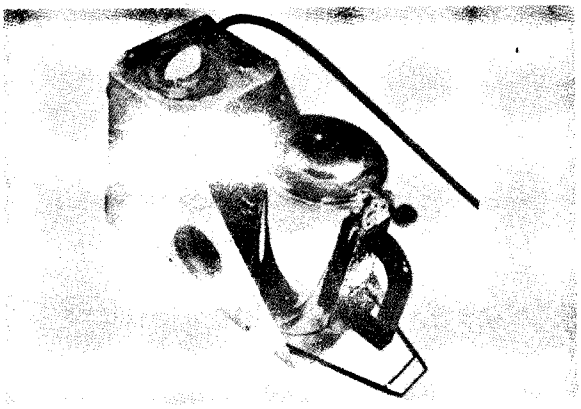

Figure 13–14. The Hot Cup, Mounting Bracket, and Timer.

Hot-Cups and Brackets

The type A–1 hot-cup is designed to operate on 28-volt DC, and the type B–1 hot-cup is designed to operate on 115-volt AC. The cups have a capacity of 37 fluid ounces and are designed to provide hot water for reconstituting beverage concentrates; for heating two un-opened 211 x 304 single-strength soup cans or three 300 x 200 IF ration cans in boiling water; and to warm liquid and semisolid foods directly.

Since aircraft facilities seldom permit adequate cleaning of food solids from the cup, its use for substances other than water is not recommended. When filled to the brim with water at 70° F (ambient temperature 77° F), the cups are designed to heat the water to 212° F within 10 minutes. One unit and four brackets with receptacles, timers, and warning lights are available for each of the 28-volt and 115-volt cups.

Mechanical Refrigerators

The type C–1 mechanical sectional refrigerator has been succeeded by mechanical models with better operating characteristics. The following models, manufactured by Dale Sales, Inc., Los Angeles, California, are now in use in the Air Force.

Model SR–4 is a 4-cubic foot refrigerator designed to keep food in the temperature range of 32-45° F. It has a small ice-cube compartment. Outside dimensions of the refrigerator are 34½" high x 24" wide x 24" deep.

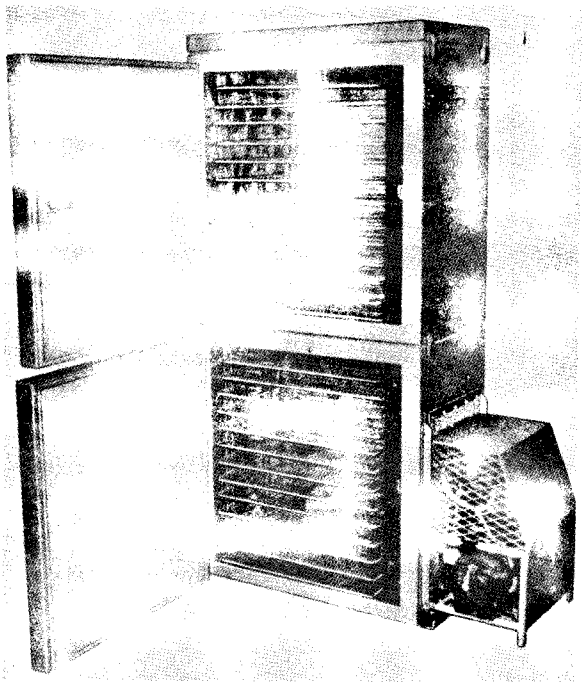

Figure 13–15. Mechanical Refrigerator SR–6A.

Model SR–6 has a volume of 6 cubic feet. It will maintain food in the temperature range of 32-45° F, and will accommodate 52 foil-pack or precooked frozen meals (provided conditions permit thawing of the frozen meals). A forced air system circulation provides rapid pull down and even distribution of temperature. The box has no ice cube compartment. Outside dimensions of the refrigerator are 33″ high x 27″ wide x 18⅝″ deep. A refrigeration unit 12-9/16″ wide x 20½″ high x 18⅝″ deep extends from either the left or right side or from the rear panel.

Model SR–6A, here illustrated, has a volume of 12 cubic feet and consists of a basic SF–6 unit with a stack-on section of equal volume. The refrigerator is designed to maintain an internal temperature range of 32-45° F and to hold 104 foil-pack or precooked frozen meals (provided conditions permit thawing of the frozen meals). The SR–6A has the same rapid temperature pull down characteristics as the model SR–6. Outside dimensions are 63″ high x 27″ wide x 18⅝″ deep. It also has an additional refrigeration side unit similar to model SR–6.

Model SR–10 is a dual-temperature refrigerator. The six-cubic-foot upper chamber can be regulated for +40° F or −10° F and will hold 126 precooked frozen or 98 foil-pack meals. A lower 4-cubic-foot section is adjusted for 40° F only, and is designed for the storage of milk, butter, fruits, bread, etc. Outside dimensions are 58″ high x 24″ wide x 24″ deep. A refrigeration unit 25″ high x 24″ wide x 11″ deep joins the box on either the right or left side or the rear panel.

Dry Ice Refrigerator

The type B–1 refrigerator is an insulated aluminum box that holds 60 pounds of dry ice in a center well, and 32 frozen meals on the sides. When packed in this way, it will maintain the meals between 0° and 20° F for 48 hours at an outside ambient temperature of 90° F.

Minor Items

A disposable pasteboard tray has been designed to accommodate IF cans, foil-pack, and precooked frozen meals.

Packet, Accessory, In-Flight Feeding, Type I, is an accessory cellophane packet for use with precooked frozen and foil-pack meals, containing plastic knife, fork and spoon, salt envelope, pepper envelope and paper napkins. The Type II Packet is intended for use with sandwich-snack meals, consisting of plastic spoon, salt envelope, pepper envelope, and paper napkin.

Some work has been done in the past to develop a disposable refuse container. Most galleys are now provided with a metal refuse container. It has been found that satisfactory watertight, disposable inner liners for the refuse containers can be made from polyethylene tubing, cut into lengths, and heat-sealed on one end.

Microbiology of Flight Meals. Food-borne infections are always distressing and become particularly serious when the symptoms develop during flight. These may occur when the perishable components of preflight and

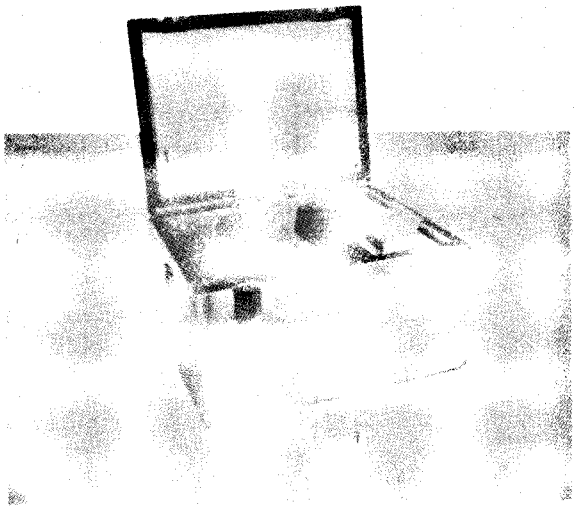

Figure 13–16. Refrigerator, With Center Well for Dry Ice.

in-flight meals are improperly handled. Continuous preventive control is necessary, including ground-kitchen sanitation and refrigerated storage of packaged in-flight meals on the flight line or aboard aircraft. This involves the time-temperature factors of bacterial growth in foods prior to consumption and also the design, use, and cleaning of all servicing equipment. (See AFM 161–6 for recommended refrigeration and consumption procedures.)

Microbiological studies delineate the approximate temperature range of 50-130° F as the zone in which food infection organisms multiply and exterotoxin can be produced by microorganisms. The minimum incubation period for bacterial growth of hazardous proportions is generally five hours. The safe supply of perishable flight foods therefore demands: sanitary practices to preclude inoculation of pathogens during ground stages of food preparation and to reduce all bacterial contaminants in number; holding at incubation temperatures (above 50° F) no longer than 5 hours before consumption; and maximum use of refrigeration (below 50° F), or alternatively heating to above 130° F for continuous periods before serving.

These principles apply to any type of in-flight perishable meal items (for example, sandwiches, snack lunches, and hot meals), whether originating from flight kitchen, commercial courses, or household supplies. Individual packaging in disposable, sanitized containers is a desirable supplementary protection in view of the limited hygienic facilities of military aircraft.

Repeated bacteriological analyses have been made on the perishable in-flight foods, especially the more complex precooked frozen meals and foil-pack meals. The bacterial counts are sufficiently low to indicate minimal hazard in such feeding, provided that carefully organized supply procedures are followed. Aircraft food heating equipment also provides temperatures above 165° F which inhibit and often destroy food bacteria of pathogenic significance. However, such high temperatures will not inactivate the more stable enterotoxins if already formed in food prior to heating. Complete cooling or freezing is the essential for all protracted periods of transport and storage.

The establishment of consistent bacterial safeguards greatly determines the types of food perishables that can be utilized in aircraft. This is dependent upon the efforts and training of personnel directly responsible for the conduct of flight feeding in the operational commands.

Postflight Feeding

The postflight phase depends considerably upon the physical and mental condition of the returning airmen, as affected by the operating and nutritional demands of the completed flight period. Postflight feeding stimulates both physiological processes and morale, helping to shorten time lost between missions and to prevent chronic fatigue. For these reasons, it should not be long delayed, and convenient flight-line kitchen facilities are a requisite.

One purpose of eating at this time is to relax tensions induced by long hours of alert concentration or other fatiguing flight pressures. Extreme cases may justify the special provision of some light refreshments (*for example,* beverages, ice cream, or juices) before or during such postflight duties as interrogations. This would be preliminary to

a later more complete dinner meal in which protein is predominant in the menu. Some degree of feeding is routinely indicated as the first measure of rest and recuperation.

Survival Feeding

Survival situations are emergencies of bailout, ditching, or other forced landings into primitive isolated regions or behind enemy lines. In the "struggle for existence" toward escape and ultimate rescue, the availability of water and food may be critical. The emergency parachute kits, or life rafts and clothing stowed in military aircraft, are accordingly designed to carry the equipment and the foods necessary for survival.

It is anticipated that survivors will undergo some water imbalance and caloric deficit, ranging downward to possible starvation levels. This will be alleviated over protracted survival periods only to the extent that nutrients can be foraged from the surrounding terrain. For this reason, such items as desalting kits, fishhooks, and hunting gear are included in emergency packs to assist the more fortunate and resourceful airmen in "living off the land."

Where the environment is completely nonproductive, the survival-energy potential is limited to the water and food substances that can be carried individually. Special survival-type food packets have been produced specifically to maintain physical condition and morale over the longest possible periods. These are all concentrated foods designed to occupy minimal space in survival packets. The food items are tested for their ability to sustain life in different climatic conditions and for general storage stability which must exceed 2 years.

The Feeding of Patients

Flight-feeding facilities in the Air Force are responsible for the preparation and handling of regular flight meals for hospital patients aboard aeromedical evacuation aircraft in the continental United States and overseas. The aeromedical evacuation control officer, or the aeromedical evacuation coordinating officer, as defined in AFR 164–1, is responsible for procuring required modified diet items and/or meals from the hospital food service. Guidance for the ordering and preparation of modified diet in-flight meals is in chapter 21, AFM 160–8, 1 June 1968.

REFERENCES

The reader should insure the currency of listed references.

AFM 146–1, *Food Service Management.*

AFM 146–2, *Flight Feeding.*

AFM 146–7, *Instructor's Guide—Sanitary Techniques and Personal Hygiene.*

AFM 160–8, *Applied Clinical Nutrition.*

AFM 161–6, *Medical Aspects of Food Service.*

AFR 160–95, *Nutrition.*

MIL–F–3764C, 17 December 65, *"Military Specifications, Food Packet, Individual, In-Flight."*