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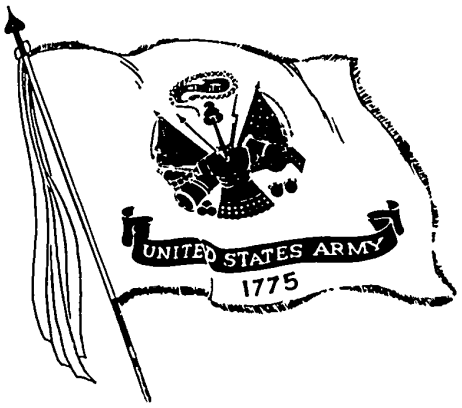

The Department of the Army sponsored the Third Joint Military-Industry Packaging and Materials Handling Symposium 1–3 October 1957 at Fort Lee, Virginia.

The outstanding cooperation, assistance, and participation of the Departments of Navy, Air Force, and Commerce, and the National Security Industrial Association not only assured the success of the symposium, but demonstrated again the effectiveness of our Nation's dynamic MILITARY-INDUSTRY TEAM.

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SECRETARY OF THE ARMY
WASHINGTON

In no other era in history have we been faced with such rapid and profound changes in our methods and implements for conducting warfare. Continuing joint military-industry cooperation and effort are vital to successfully meet the challenges that face us today.

I look upon this symposium as a positive indication of the manner in which the military-industry packaging and handling team is keeping pace with ever-changing requirements.

Wilber M. Brucker
Secretary of the Army

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PART I

General Conference

The Third Joint Military-Industry Packaging and Materials Handling Symposium opened at 10 a. m., Tuesday, 1 October 1957, in the Post Theater, Fort Lee, Va. Approximately 800 representatives from Government and Industry were present.

Lt. Col. PETER W. MIRRAS. Good morning, ladies and gentlemen. Welcome to our Third Joint Military-Industry Packaging and Materials Handling Symposium. At this time, I wish to present the Commanding General of the Quartermaster Training Command, and your host, Maj. Gen. Ira K. Evans. General Evans.

MAJ. GEN. IRA K. EVANS

Maj. Gen. IRA K. EVANS. General Magruder, Mr. Higgins, Mr. Morris, Mr. Morrow, distinguished guests, and ladies and gentlemen: As Commanding General of the Quartermaster Training Command at Fort Lee, it is a privilege and a pleasure for me to welcome you here to Fort Lee. We not only hope you have a very enjoyable and informative time while you are at Lee, but also hope that you can see some of the post while you are here. I know that this symposium will be of great benefit to you, and both myself and my staff are at your service in any way in which we can help you and make your stay more pleasant.

Our next speaker this morning is an officer of long, broad, and distinguished logistical service, starting out in 1918 when he was commissioned a second lieutenant of infantry. He graduated from the Military Academy in 1923, has been through practically all of our Army Schools, and also has a Master's Degree from Purdue. Although he is basically an artilleryman, he started out his logistical career in 1941 in the G–4 Division of the War Department. Later on, he became the Plans Officer for the Army Service Forces and, as such, planned all of the logistical support for all of our theaters. In 1944, he went to the Mediterranean Theater and as G–4 of the Allied Headquarters there, he served through the invasion of Southern France. At the conclusion of World War II, he came to the European Theater first as the Chief of Staff of the Theater Service Forces and later as the Commanding General of the Theater Service Forces. Subsequent to that he was G–4 of the European Theater and was finally Chief of Staff of the Army in Europe. Returning therefrom, he came back to Washington and served in many logistical spots. In 1953, he went to Korea and commanded the 24th Infantry Division and later the 9th Corps.

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Early in 1954, he became Chief of Staff of the Far East Command in Tokyo, and in 1955 assumed his present position as the Deputy Chief of Staff for Logistics. It has been my distinct pleasure and privilege to have been associated with him in many of these jobs. At one time, I was his deputy, and to all of us who know him, or to anyone who knows him, there is no doubt in our mind that he is the foremost military logistician in our Army today. It is a distinct pleasure and a privilege to introduce to you now the Chairman of this Symposium and the Deputy Chief of Staff for Logistics of the United States Army, Gen. Carter B. Magruder. General Magruder.

LT. GEN. CARTER B. MAGRUDER

Lt. Gen. CARTER B. MAGRUDER. Thank you, General Evans. On behalf of the members of this gathering, let me express my appreciation of the hospitality you are providing us here at Fort Lee.

Honored guests and gentlemen: As representative of the Host Service, Army, it is my privilege to serve as chairman of this Third Joint Military-Industry Packaging and Materials Handling Symposium.

Having seen the spoilage that took place among our supplies stored in the open in North Africa early in World War II, having seen the damage that took place in shipment during World War II and Korea and having learned in conjunction with limited budgets the heavy cost of packaging that would give full protection in spite of rough handling and exposure, I have a keen interest in the subject of your discussions here today.

During recent years, three great developments have profoundly affected our military logistics and, with it, our packaging and materials handling problems. The first has been the continuous increase in the complexity and sensitivity of our military equipment, resulting in a requirement for more protective packaging. This is a new and continuing problem. Building real ruggedness into our equipment and the elimination of weak points is a continuing and time-consuming process. As we make product improvements, we improve our equipment so that it is more rugged and handles better in the field. But obsolescence takes place over a shorter period these days. Although we make the effort to improve our equipment, and will in the future, we will always have some equipment which is more sensitive than we would like to have. This requires more protective packaging.

The second great development has been the tremendous increase of our military commitments overseas. There is hardly a country outside the Russian sphere of influence in which our supplies and equipment are not present. In many of these countries, storage is under less than desirable conditions. This makes it necessary for us to package our supplies and equipment so that they will stand up in any country and in any climate.

Finally, the third great influence has been the change in tactics and techniques under the threat of atomic attack, which requires much greater dispersion and mobility. These, in turn, mean that we can afford less weight for our packaging and must use more containerization and materials-handling equipment for greater speed in handling.

Continued progress toward meeting these requirements is the product for which we in the Army look to the Industry-Military team represented here today.

The first item on your program today is an address of welcome.

For the past 2½ years it has been my privilege to work closely with and for your opening speaker. Starting his career in industry with the Willys-Overland Co., he became manager of the Willys-Morrow Co. During World War II he served his country in the office of the Chief of Ordnance. During the last 6 months of that military service, he was special assistant to the Under Secretary of War, Robert Patterson. During 1949 and 1950 he served as assistant director of the Marshall Plan Program in Paris. Coming to us as Assistant Secretary of the Army for Logistics in 1954, he brought us his wealth of background in industry, in the military service, and in Government, together with patience, wisdom, and a selfless devotion to the service of his country that we soldiers strive to emulate. It is a pleasure to introduce to you the Assistant Secretary of the Army for Logistics, The Honorable Frank H. Higgins. Secretary Higgins.

The Honorable FRANK H. HIGGINS. Thank you very kindly, General Magruder, for that very generous introduction.

Honored guests and my fellow members of the symposium: It becomes my very pleasant and honored privilege to welcome you here today to this most important gathering. I know you will hear inspiring messages from the two gentlemen to follow me, my colleague in the Defense Department, Tom Morris, and one of the newer and up-and-coming vice presidents of the Chrysler Corporation, Tom Morrow.

Gentlemen, I will do my very best to stay out of your field, but while here, I have a thought or two I would like to leave with the conference on this vital subject and to tell you in just a moment or two some of our objectives in the logistical area of the Army. We are striving to get to you fast and objective action in this area. I like to illustrate this by an actual happening with a plumber in Brooklyn and his experience with one of the bureaus in Washington. This poor little fellow thought he hit upon a very good idea, and he wrote a bureau in Washington that he had found that hydrochloric acid was fine for cleaning drains and asked if it was harmless. The bureau in Washington replied, "The efficacy of hydrochloric acid is indisputable, but the chlorine residue is incompatible with metallic permanence." So the poor little plumber in Brooklyn pondered that reply awhile and finally sent a post card back that he was glad they agreed with him, to which the bureau replied, "We cannot assume the responsibility for the production of toxious and noxious residues with hydrochloric acid and suggest that you use an alternate procedure." Well, the plumber struggled with that one awhile and finally sent back another post card and said he was delighted that he had their approval, to which the bureau then blasted forth with, "Don't use hydrochloric acid. It eats the heck out of your pipes!"

Now, gentlemen, we are trying to be just that objective and give you the last answer first in the whole logistical area in our dealing with industry, because those of us who have been associated so long with industry and have had the great honor and privilege of serving our Armed Forces always daily remind ourselves that the greatest asset that our beloved United States Army has is its Army-Industry team. We cannot have military might in this World of ours today without industrial might. I saw that so graphically displayed on my fairly recent trip through the Far East. Most of those

THE HONORABLE FRANK H. HIGGINS

countries over there are very impotent as far as any industry whatsoever is concerned, so they are very impotent in their military resources and effectiveness except to the degree that this country has furnished them with weapons. But the moment a person puts foot on soil in Japan, he feels the resurgence there of the might and power of the Japanese industry and the effect that it has on arming a great mass of people. So we are conscious of this great asset of ours possessed by you in industry here today and how we need to call upon it to protect our very precious way of life, and the kind of an Industry-

Army team we have today is far and away our greatest asset. I would like to say just a word about logistics. I may be a little biased, of course, on this subject, but I feel that it is far and away the very important and most important part of the Army function today, and I would like to quote you some pretty good authority of coming along with me in this belief, because at the end of World War II, the then great military leader, Gen. George Marshall, had this to say about logistics, and I quote him: "The requirements of logistics are seldom understood. The burdens they impose upon responsible military authorities are never appreciated."

And the then great military leader, General Eisenhower, now our beloved President, had this to say: "It is logistics which controls all campaigns and limits many."

And Admiral King, the great Naval leader at that time, said, "Whatever else the war is, so far as the United States is concerned, it is a war of logistics."

In my own homely homespun backyard definition of logistics as I have found it in the Army is this—it's the bridge from the industrial plant, from the farm, from raw materials, from skilled man power, from science, yes, from those who are packaging our products to the military forces in the field. Logistics means equipping and maintaining a modern Army that will be successful in war. That is our constant daily objective. It means to secure the maximum defense for the minimum tax-payer dollar. So, you see, this logistical operation with which you are associated is so very important to the welfare of our troops and the security of our Nation.

My colleague, Gen. Carter Magruder, who just spoke to you and who gives me so much comfort in this job—our offices are right together—we contact each other many times during the day, and I find great comfort in this soldier who knows so much about this whole subject that we address ourselves to in the area of logistics. The feeling I have about General Magruder is pretty much like the Tommy Harmon days out at the University of Michigan. You know, Tommy Harmon used to make all the headlines, and he was the fellow that made the touchdowns and one thing or another, but there was a fellow by the name of Evashevski who opened up the hole in the line for Harmon to go through. My Evashevski is sitting right back here. He opens the holes for any glory I get out of this job, and I find it a great privilege and a great soul-satisfying moment with me to be able to acknowledge this to this gentleman before the proper people.

As I started to say, General Magruder touched upon the great problem we had generated for us in World War II by improper packaging. Early in '43, I was called to Washington, as were many other men from industry, to come down and put on the uniform and help lighten the administrative load so these professional soldiers could go and do their fighting job on foreign lands. In fact, I was with the Ordnance group that moved into the Pentagon when it was ready for occupancy—and the struggle we had in those days is well known, I am sure, to all of you loyal supporters of the Army that are in this room today. We worried through the days of too little, too late—the greatest indictment upon this industrial empire of ours that it will probably ever have—too little, too late. You will remember those dark days with me, I am sure. And then through the great genius of American industry, we plugged up the gap. We got our boys supplied in a pretty fair shape with what they needed wherever they were, and "wherever they were" was a big order in those days. They were all over the World. You can well imagine what a heart sickening thing it was to us, after having this great struggle of overtime and Sundays and holidays and everything of three plant operations throughout the country to plug up this gap and then to find that when our material hit the beaches in the South Pacific and the jungle, it was worthless. It simply fell out of the packages, corroded, rusted, loaded with sand, and what have you, and you can well imagine the problem we had and the very dear lesson we learned.

Then we had the integrating committees from industry come and study this, go overseas and study it, and then, of course, you folks did—as you have always done once you found out what the requirement really turned out to be—why, you filled the bill! And, thank Heavens, our productive capacity was great enough to rebound and get those fuses and those shells, and all the other intricate types of munitions that we had scattered all over the World, back into production and into their proper packages and back in the hands of our fighting people. So you can well understand my deep feeling for the work you are doing, for the challenge you have before you. In my travels throughout our logistical installations, and I am glad to report to you that I have seen them all over the Free World, all through the Far East, a couple of years ago in Europe, and I am kicking off next week to visit them all again throughout the European theater, that I have had a chance to observe first hand how well or how poorly the job is being done today.

I have been through most of our large general depots and a number of the technical service depots here in the zone of the interior, and I think the packaging job is being done today so it would stand the rigors of whatever the climatic requirements; but I see a need beyond that day of greater standardization, gentlemen. Here is a very broad field. I mean from a package of cotter pins to the kimona we put around a three-quarter-of-a-million-dollar missile and everything in between. We need better standardization. One of the things I have seen that was not original with me—I saw it out at Columbus General Depot—that if we could get a package for a given set of spares, let us say, that would be standardized, and that is the minimum package we would issue, and then that package would set into a carton that would hold a half a gross, or a gross, or five gross, or whatever that particular turnover would demand, and that would be a standard package, and then so many of those packages would set into a packing case, and we would have three packages for the whole job. That is, we would have three standard containers for the whole job instead of the multiplicity of the things we are getting into today.

I sincerely hope this conference embraces that idea and comes forward with more specific recommendations than we have today. We need to pay greater attention to weight because our plans in the future will require more and more things to be airborne. We must get it there by air. We now need to get out of the mud and the snow and the slush and get it there—and get it there in a few hours. Packaging will have its roots pretty much in weight. And then we will need to watch the cost. As I say continually to our procurement people, our 1958 and 1959 procurement buck is going to look something like this. (Holds up piece of paper simulating the shrunken size of the procurement dollar.)

So we are going to need to watch the cost. And, finally, I encourage you to challenge us from the standpoint of military requirements wherever you feel they are unrealistic from the standpoint of producability. Now, you remember that these gentlemen in the uniform, and rightly so, have their eyes pretty generally glued on the utility of what you are producing and what they expect it to perform in the field. That's their job. Heaven knows none of us would want to divert their attention from that, but you and I are people who must solve the industry side of the job. We must produce these things. We must produce them in great quantities. We must produce them to meet the trying task they have to fulfill wherever they are, and we have to do it at low cost. Now when we get a little bit on the ridiculous side or a little bit on the extravagant side in our specifications of what the packaging requirements may be according to good old American horse sense, challenge us! Please do that, because this is the only way we will have to find out when we are getting a little bit on the extravagant side with these things, and then if the military requirements are able to yield, why we can make a decision in favor of the producability. If they are not able to yield, we will say so. But I leave that foremost thought with you. Please don't feel because it is a Government Specification, it is "holy script." It's only as good as it will serve our soldier in the field with the back up and the means that we have to put behind him.

Welcome to this conference, and I know we are all going to leave it with a better understanding of the problems ahead of us. Thank you very kindly, gentlemen.

General MAGRUDER. Thank you, Secretary Higgins.

The next speaker on the program is the military keynoter. We have been fortunate in securing for this address another key civilian member of the military side of the team. He, too, has a broad background in the military service, in industry, and in government.

After graduation from the University of Tennessee, he was affiliated with the Tennessee Valley Authority and the United States Steel Corporation.

During World War II, he served on the staff of the Secretary of the Navy, James Forrestal.

In 1948 he became a partner in the management consultant firm of Cresap, McCormick, and Paget. In that capacity, he has worked with the Hoover Commissions in their studies of the organization of the Executive Branch of the Government.

He returned to Government service in 1956 to serve as a special consultant to the Deputy Secretary of Defense. In May of this year, he was appointed to his present position.

It is my pleasure to introduce to you the Deputy for Planning and Director of Requirements Policy in the Office of the Assistant Secretary of Defense for Supply and Logistics, Mr. Thomas D. Morris. Mr. Morris.

Mr. THOMAS D. MORRIS. Secretary Higgins, General Magruder, General Evans, Mr. Morrow, Gentlemen of the symposium:

It is a pleasure for us in the Office of the Secretary of Defense to participate in this the Third Joint Military-Industry Packaging and Materials-Handling Symposium. Secretary McGuire, who deeply regrets his inability to be with you today has asked that I emphasize to you in the strongest terms our interest in the Office of the Secretary of Defense in supporting and encouraging joint meetings of this kind, meetings which provide each of us with a greater appreciation of our mutual problems and

MR. THOMAS D. MORRIS

with the improvements which we should mutually seek in protecting the national security. We are proud of the fine relations which exist between you and the military services and the whole-hearted support and understanding which you have given to our programs. As you know, the Secretary of Defense is required by law to develop programs leading to a reduction in nonessential varieties of materials, components, equipments, processes, practices, and procedures in use by the military departments. The Department of Defense has a coordinated program for the standardization of preservation, packaging, packing, and marking for shipment together with provision for the standardization of materials handling techniques and equipment. Under this program, real progress is being made in reducing divergent practices and in restricting the variety of items carried in our military supply systems. In many areas, uniform procedures for the preservation, packaging, and handling of items have been adopted by all three departments, and it is planned to expand these uniform practices just as rapidly as the manpower to accomplish this objective can be made available.

As you know, in arriving at these decisions, the applicable segments of industry are consulted in order to assure that the desired practices can be accomplished by industry. We find that when our specific objectives and problems are outlined industry is most cooperative and helpful.

I note from the program that many specialists in the fields of packaging, preservation, and materials handling will appear before you. We hope that these specialists, representing both the military departments and industry, will discuss not only their progress to date, but also their problems of today and of the future. We believe that by getting these problems out in the open you will apply the same ingenuity and cooperation in solving them as you have applied to past problems with such outstanding results. We in OSD would like to pose for your consideration some of the areas in which further progress is highly desirable by way of underscoring the comments already made by General Magruder and Secretary Higgins.

One, for example, is the need to develop a standardized pack or packs which can remain intact from producer to consumer.

Another is the need for new techniques and materials which will result in savings both in weight and space, and yet will give adequate protection.

The third is the importance of maximum exchange of packaging and materials handling intelligence between industry and the military.

First, let us consider the need for a standardized pack. There are many reasons why the package which left the producer's plant must be changed prior to issue to the consumer.

For example, there is the factor of quantity. The commercial pack may not correspond with the unit of issue which must be provided for the military consumer package. Then there is the factor of climatic protection. The current world situation makes usability under any climatic conditions mandatory. Current preservation and packaging specifications are aimed at accomplishing this purpose. Commercial requirements may not call for such all-weather protection, and then there is the factor of transportation. The ultimate mode of transportation is usually not known at the time of production. Material must be protected against all transportation hazards at the lowest possible cost, and still attempt to keep the weight and cube of packaging material at a level where it is not prohibitive to transport by air. The operation of repackaging is a very expensive one. Every effort should be made to reduce the necessity of repackaging. This leads to the second area.

In developing standardized packs, we also need to develop new techniques and materials which will give adequate protection and result in savings both in weight and space as well as in the time and costs of processing and handling. The Utopian solution to this problem is probably the development of a package which would—

(1) Be economical and capable of accomplishment at the producer's plant.
(2) Be of sufficient strength to withstand the rigors of land or water shipment.
(3) Be sufficiently light in weight and cube to facilitate premium shipment by air.
(4) Provide adequate protection under all climatic conditions.

With respect to the exchange of packaging and materials handling intelligence between the industry and the military, we are well aware of the many improvements that have been accomplished through the painstaking research and outstanding instances of industry-military cooperation. Industry and Government must continue to share the initiative and responsibility for such progress. We must assure a free exchange and flow of information and ideas. The Department of Defense is eager to keep an open line of communications with your industry. We are striving to do this by coordinating proposed new or revised military specifications with interested segments of industry, and we will seek opportunities such as the one provided by this symposium to pass on our knowledge of new materials, new methods, and new techniques developed in our own facilities. Two notes of caution should be noted in looking at our needs for future improvements. One is that we must be constantly alert to the fact that our planning and decisions as logisticians must suport military requirements. For example, if the tacticians decide that support of troops is required by air drop, we must be prepared to support that decision. If they decide that storage of certain materials will be required under adverse climatic conditions, we must be prepared to support that requirement. It must be our continuing endeavor to avoid the possibility that a military requirement cannot be met because of our inability to package and protect materials so as to insure safe arrival at destination regardless of climatic condition or method of delivery. The second caution has to do with the importance of getting a larger return for each defense dollar as Secretary Higgins so well emphasized. We are spending a significant number of defense dollars for the packaging, shipping, and storage of goods and equipment. I am sure that all of you are well aware of the present efforts to stabilize and reduce defense expenditures. Undoubtedly, it will be necessary that the packaging and materials-handling program absorb its share of this reduction. This means that even greater effort will be required in the development of techniques and materials which will result in greater economies. We are confident that your industry will assist in meeting this challenge. Our confidence is bolstered by the significant progress of your industry during the last 15 years, including such notable developments as deterioration-prevention techniques, shock-reducing practices, and the use of lighter weight and less critical materials.

In conclusion, we in the Office of the Secretary of Defense would like to express our appreciation to the Department of the Army for sponsoring this program and to the Departments of Navy, Air Force, and Commerce, and to the National Security Industrial Association for the splendid assistance and team work shown. We are confident that the results accruing from this symposium will be a positive contribution to our national security. Thank you.

General MAGRUDER. Thank you, Mr. Morris.

The next address on the program is that of the industry keynoter. General Somervell felt, I believe, that we won World War II primarily by snowing the Axis under with our superiority in military materiel of all types. It was through the efforts of men like your next speaker that the United States was able to make it snow. Closely associated with Chrysler tank production during World War II; general manager of defense products for Chrysler until 1955; and now vice president of Chrysler heading the company's guided missile operations and in this capacity in charge of research, development and production of the Army's Redstone missile; he is a man who to me personifies what industry can do for the armed services. It is a privilege

to present to you the vice president of Chrysler Corporation, Mr. Thomas F. Morrow. Mr. Morrow.

Mr. THOMAS F. MORROW. Thank you, General Magruder. Secretary Higgins, Mr. Morris, General Evans, and ladies and gentlemen, good morning.

It is, indeed, a very great honor to be invited to this, the Third Joint Military-Industry Packaging and Materials-Handling Symposium. This is a subject that affects everyday life and is particularly important under conditions of warfare. I have been asked to discuss the impact of efficient packaging and material handling in industry.

MR. THOMAS F. MORROW

As a form of reference, I am responsible for both defense and special products of Chrysler Corporation, and the special products include such diverse items as Cycleweld chemical materials, Amplex powdered metals, Airtemp heating and air conditioning, and Marine and Industrial engines. In other words, all of the nonautomotive commercial products of Chrysler Corporation. And, therefore, it is not within my province to talk about Plymouth, Dodge, DeSoto, Chrysler, or the exclusive Imperial. So much for the commercial. I promise I will not do it again.

This meeting is of real importance to our country, not only because it will bring immediate results, but equally as important, it will provide a rough outline of the shape of things to come.

In our time, we are conscious above all of accelerating change. We are subject to mechanical and scientific progress which so often appears to outrun mankind's capacity for moral and ethical growth. Unlike our fathers, who smiled tolerantly at the impossible fancies of Jules Verne, we are not quite sure whether Buck Rogers is not closer to reality today.

Our technological progress, as it affects us in our everyday lives as producers and consumers, presents itself in a form of never-ending obsolescence. Through research and development we obsolete ideas, techniques and processes, and by means of this continuous revolution we keep replacing our known world by building a new one.

Obsolescence can appear like a bolt out of the blue. During World War II, our Evansville, Ind., plant produced more than three billion cartridges for the Armed Forces. Initially, these cartridges were packed in containers of double dipped, heavy waxed paper enclosed in heavy wooden boxes. This had proved to be ample protection for the needs of our Armed Forces in the European Theater of Operations. By midsummer of 1943, General MacArthur relayed an urgent call for a better package to meet a different kind of need in the South Pacific. Almost overnight, Chrysler Corporation designed, developed, and had in production a heavy gage, hermetically sealed can which opened with a turn key, like a tin of corned beef. In brief, our engineers had devised overnight a vacuum pack method of storing and shipping bullets.

The rate of technological advances sometimes varies a great deal in industry and military. In transportation, for example, up to World War II, civilian modes of travel kept pace with the speed of military means of travel. More recently, however, military airplanes, atomic-powered ships, and guided missiles have out-distanced their civilian counterparts.

In my own company, we have been making a few contributions of our own to obsolescence. It may be, for example, that our gas turbine engine will eventually make the V–8 engine as obsolete as the radial air-cooled engine is on fighting planes today. And those of you who follow automotive affairs know that pushbutton automatic transmissions, power steering, and power brakes are rapidly making manual controls a thing of the past.

In the overall automotive picture, obsolescence plays a very important role. In a single month in this country we scrap—throw away—as many cars and trucks as the total in use in all of India. In 6 months we scrap as many motor vehicles as are in use in all of the vastness of Soviet Russia. These examples could be multiplied many times in many fields—in electronics, in packaging, in communications.

In planning and building, the military and industry often bring about change of such an abrupt kind and on such a scale that it can hardly be called obsolescence. And this frequently occurs in the field of packaging. The Redstone ballistic missile, developed by the Army and built by Chrysler Corporation, is a good example of this. Our engineers have had to design and to develop a method of transporting this huge weapon so as to take up a minimum amount of space and yet offer a maximum amount of protection for the delicate instruments which are located inside the missile itself. They developed a trailer design similar to the container trailer concept presently used in industry. The trailer itself has as its running gear a standard Ordnance dolly. To protect the missile to a very low "G–level," they designed and developed a suspension system within the trailer itself, comprised of eight spring snubber units in each trailer. This trailer is large enough to carry the entire thrust unit of the missile, which is approximately 35 feet long. It has withstood drops of one foot in various attitudes on its end, corners, and also a completely flat drop. They have also run the container loaded with the missile into a 200,000-pound abutment at 8 miles an hour, and have proven that this package can effectively isolate the missile from external physical environment.

Packaging and materials handlings have played, and are continuing to play a significant role in the functioning of industry and our Defense Services. In time of peace, they help to reduce the cost of operation, and in time of emergency the outcome of an entire conflict may depend on the quality, quantity, and condition of equipment and material received at the front. This was amply illustrated during the early part of World War II, and when we had become more proficient as the war progressed, the damage was cut to approximately 15 percent.

Our present efforts in packaging bear little resemblance to those of World War II. Prior to that time, few people felt a need or importance of expert packaging and material handling. Everything was handled on a crash basis, however today industry and the Armed Forces working together seek to anticipate the problems of tomorrow, a year from tomorrow, and 10 years from tomorrow. This, I feel, is best illustrated by the fact that this symposium is meeting here today.

A package means many things to many people. In radio and TV advertising, for example, a 39-week TV series is considered as a "package buy." A housewife might define a package as being the 5-pound bag of sugar which she brings home from the supermarket. At Chrysler, we put the "Forward Look" "Swept Fin" of our 1957 models into a single "package" with other features like Torsion-Air suspension, 3-stage transmission, compound-wrap windshields, and so on.

By the way, there is an interesting story in connection with automotive packaging which I would like to pass on to you. A few years ago, we were asked to put together an automotive package to give the buying public basic transportation at basic prices—a car that might sell for about a thousand dollars. So, our engineers took a standard Dodge sedan and stripped it of everything that didn't have to do with basic transportation and yet retain all of the quality and safety in the car. They removed body insulation, chrome-plated trim, radio, automatic heater controls, delux steering wheel, and carpeting. They reduced the rubber insulation and eliminated the fancy dash panel. They installed less expensive, single-acting shock absorbers. They substituted painted truck bumpers. The cushions were thinned down and very utilitarian upholstery was fitted. Interior hardware was painted. A basic type of conventional transmission was installed. And so it went.

The engine, brakes, axles, suspension system parts, body structure, and so on, were at full quality. We did not cheapen materials nor design where safety or satisfactory performance was involved. What did we have? We had the noisiest, most uncomfortable, ugliest automobile you ever saw. One ride in it and we couldn't get anyone but test engineers to ride in it or drive it again. But it was basic transportation. And how much money did we save? A mere $150 from the original selling price. This was hardly what you would call an improved package.

Regardless of the interpretation of packaging, we all know that it represents a very substantial item in both industry and Government. The cost of the package itself, improved methods of packaging, and utilization of material handling methods all directly concern the profit picture. In industry we report to the shareholders. The military has an even tougher taskmaster—the voting taxpayer. So, for the same basic reasons we both aim for the same goal in packaging and material handling—the realization of greater economy. In peace and in war, the close working relationship of industry and Government has meant mutual progress in all of these areas.

As mentioned before, our ultimate boss in business is the shareholder. One of the most important aspects of our business to the shareholder is the profit picture. I can think of no area more closely allied with profits than the techniques of material handling used in our automotive plants. If I may, I would like to limit my material handling remarks exclusively to the realm of automotive assembly operations.

A short time ago, Chrysler Corporation completed a $20-million body assembly and painting plant adjacent to the existing assembly plant of the Chrysler Division. The construction work always seemed to be encroaching on space the material-handling department had occupied and wanted to keep on using, but there was nothing to do but move and find room wherever possible. That really took some doing. At times, certain types of material had to be stored temporarily out in the open, protected from the weather only by tarpaulins while the materials-handling men stood in the weather checking them.

In addition to working under the handicap of shortened space and constant demands to "keep moving," material handling had to keep traffic moving in and out of the gates nearest the construction, getting trucks between buildings, through aisles that never were too wide under any conditions, and that had become further restricted by the construction work. Fire routes also had to be kept clear, and on top of everything else, the building contractor was moving tons of materials by truck and boxcar while all this was going on. Yet, miraculously, all this was done without losing production of a single car during an output that was the second largest in the Chrysler Division's history.

To bring all of this into better perspective, I would like to outline some facts about the automotive assembly line itself. There are 8,500 parts in an automobile, give or take a few according to the model. Inasmuch as there are very few components of the car manufactured at the assembly plant, everyone of these parts must be handled by somebody between the time it arrives at the plant gate and finds its place in a complete car. So, when you multiply 8,500 parts by some 1,213,000, which is our domestic 1957 model output, you will realize that the somebody mentioned has a considerable job.

There are, in fact, many hundreds of persons in the material-handling department who are responsible for just one thing—the movement of goods. It is entirely separate from the actual production operations, yet its efficient functioning is absolutely necessary to keep up production scheduling.

Just to give you a general idea of the magnitude of the job performed by material-handling departments, let's take a quick look at some figures. In an average working day at the Chrysler Division plant, material handling will pick up and put down something like 2,000 tons—4 million pounds—of various kinds of things that go into the making of cars. It is impossible even to estimate the number of operations represented in handling this huge bulk for the reason that in many cases the piece will be a subassembly which in itself is made up of a number of parts. It takes from 300 to 400 trucks every day to handle the incoming and outgoing materials and an average of 45 boxcars. All of this, bear in mind, is entirely separate from shipments of complete cars, for as soon as the vehicle gets its okay, it belongs to the shipping department, which is a big body in its own right.

Within the confines of the Chrysler Division plant, materials-handling operates its own fleet of some 160 pieces of rolling stock. These are used just to get pieces from one place to another.

The great miracle of progressive assembly and materials handling in the automotive manufacture is, of course, getting the right thing at the right place at the right time—the right engine or body, or wheels, will meet the chassis at a designated place on the assembly line in split-second timing. This perfection obviously is necessary to meet production schedules that combine quality and quantity.

The wizards of the material handling department are the people who keep this operation going, for inventories cannot be allowed to pile up beyond a reasonable point, and, at the same time, there must be no waiting.

Broadly defined, material-handling at Chrysler Division is a service organization, at the call of any department engaged in actual manufacturing. It has no limitations in scope insofar as making itself useful is concerned. It does around-the-clock jobs, too. Most of its operation coincides with the regular manufacturing shifts, but it always has a crew on hand to back up any department that may be working at any hour. The money value of the materials handled in the course of a year at this one Chrysler plant runs to astronomical figures, doubtlessly well over a half-billion dollars. An inventory of around 15 million at the end of a month is nothing unusual, and that is after there has been a constant flow each working day.

The value of incoming materials may run as high as $60 million a month, and this represents only so-called productive material.

So, you can see that trying to build a new Chrysler body plant and keep production going at the same time is something of a job in itself. Without a capable and efficient material-handling department, this task would have been a complete impossibility.

Packaging and material-handling in a sense are sciences in themselves, since they deal with discovery, study and the application of physics, mechanics, and chemistry. We have already pointed out that they directly affect the picture.

To realize the utmost of benefits from these areas requires the interest and help of management, both in industry and in the Armed Forces. When constructive information on these subjects is properly presented to management, concern over a problem is translated into understanding which then leads to recognition and action.

Arrangements and relationships between Government and industry should remain flexible at all times, and lines of communication kept open for a constant interchange of ideas. In the case of industrial automation, the design concept has contributed to the military. New design concepts envision not only the end use salability from a customer viewpoint but also the shipment and the manufacturing processes and the cost which accompany these factors. On this basis, if commercial industry is successful in its approach, then that part of its operations devoted to defense must have the same approach to the design of military equipment.

I feel certain that I speak for industry when I say we are ready and willing to be of assistance at any hour of the day and night.

I appreciate this opportunity to be with you at the start of the Third Joint Military-Industry Packaging and Materials-Handling Symposium. I know it will be a success, and we are looking forward to the results of this conference with much anticipation and interest. Thank you.

(At the conclusion of Mr. Morrow's speech, the Fort Lee United States Army Band played the National Anthem. Immediately afterwards, a short recess in place was taken.)

Maj. DALE E. HENDERSON. Ladies and gentlemen, if you will please be seated, I have a few announcements.

. . . . Announcements . . . .

Major HENDERSON. We will adjourn now and reconvene here at 1:30, this afternoon.

(Whereupon the symposium adjourned to reconvene at 1:30 p. m.)

PART II

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Panels

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SECTION 1, ARMY PANEL

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Packaging and Handling for Your FUTURARMY

SECTION 1, ARMY PANEL

AFTERNOON SESSION, 1 OCTOBER 1957

Lieutenant Colonel MIRRAS. Good afternoon, ladies and gentlemen:

This afternoon we commence the panel phase of our program. By tomorrow noon, we will have heard from five panels. Each panel will take approximately 90 minutes. We have what we believe to be a well balanced agenda of panel presentations

LT. COL. ROBERT H. EDGER

covering a comprehensive cross section of the packaging and materials handling field. You will find that the panels will amplify in detail many of the points made in this morning's speeches.

A complete transcript of the panel talks—for that matter of the entire symposium—will be published in a report of proceedings in the near future. If you have not registered yet, please do so. A copy of the report of proceedings will be sent to all of those who have registered.

The first panel this afternoon is the Army Panel which will present "Packaging and Handling for Your FUTURARMY."

Lt. Col. Robert H. Edger, the panel chairman, is intimately involved with practically all aspects of packaging. As the Chief of the Rossford Ordnance Office, he exercises staff supervision for the Chief of Ordnance over the far-flung packaging activities of the Ordnance Corps, and he also runs the Joint Military Packaging School. Colonel Edger was born in San Francisco. He graduated from the United States Military Academy in 1941, and from the Command and General Staff College in 1956. Colonel Edger served in various Ordnance command and staff assignments in the South West Pacific Area during World War II. Some of his other assignments include instructor at the Military Academy, Ordnance officer of the Military Assistance Advisory Group in Thailand, and commander of the Pantex Ordnance Plant in Amarillo, Tex.

It is a pleasure for me to introduce Lt. Col. Robert H. Edger. Colonel Edger.

Packaging and Handling for Your FUTURARMY

Lt. Col. ROBERT H. EDGER. Thank you, Colonel Mirras.

The Army Panel will present to you members of industry today the story of Army Packaging and Materials Handling Equipment, as we see it at this time. The story is not easy to relate as all of you must know. I'm sure that we in the packaging and materials handling field have had experience in giving our side of this business to our superiors in a short time, and realize how much there is to tell and usually how little time there is to discuss it.

Today is no different for us on the panel in presenting the picture to you. We have selected those aspects of Army packaging and materials handling which we feel will be of greatest interest and value to you and your organization. It must be realized,

however, that there is much that is going on in the Department of the Army that may not be quite as spectacular as that which we approach today.

We have tried to interweave throughout this discussion several different approaches. First and foremost is what are we doing in the service today in the realm of packaging and materials handling activities. This is in contradistinction to what you are doing in industry that effects packaging. Your industrial exhibits and shows, I think, serve the purpose to give us in the service ideas of what you are doing. Second, we have selected those phases of both operational and administrative military concept as they exist and are planned for, and their related implications to packaging and materials handling techniques. It is what we think that you people in industry should be familiar with in order to better serve the needs of the Army. Third, there is the approach of where we have been, what we are doing, and where we are going. Fourth, we will discuss those fields of packaging and materials handling which you will subsequently see demonstrated at Fort Lee, either in an operating status or on display.

At this point it may be desirable to state that we are not planning to take up anything of an extremely technical nature, for example, we feel that an engineering topic on any particular phase of packaging might be of interest to a few, but would not necessarily be of overall interest to the group. We feel that during the 3 days here any of you who wish to take the "stump" on any strictly technical matters may gather your own audience, and do so at your leisure. There will be much of that done after hours anyway, if I know packaging people.

It must be pointed out that some of the subjects we plan to present to you do not directly concern themselves with packaging and materials handling, however, the new systems which we are employing in the Army, and our new methods of doing things will have such tremendous influence on our subject that we feel that you should be aware of what is going on.

If you can walk away from this panel with one new idea, you will have paid for your trip out here. Believe me, we have, we think, plenty of ideas to go into at this time.

All of you are aware of the fact that in the past few years there have been many improvements, especially in the field of materials and their application. Much of this has been adopted by the Army. We thank you for leading the way in research and in the field of application. We hope that some of the things that you hear today will be useful to you since many of them represent developments undertaken by the Army.

(At this point a soldier appears on the stage laden with normal combat equipment to include helmet, unopened parachute, submachine gun, and full pack. He appeared to be staggering under the load.)

DIALOGUE COMMENCES

Colonel EDGER. Hello—what are you doing here at this gathering?

Private MARKS. Sir, I am Private Marks from Company A, 503d Parachute Infantry Battalion, United States Army. We are currently on maneuvers and are on a practice forced march. I guess I became lost from my unit.

Colonel EDGER. Well, you chose a very interesting place in which to become lost. This is the 3d Joint Military-Industry Packaging and Materials-Handling Symposium you just ran into.

Private MARKS. The 3d what?

Colonel EDGER. Well, it doesn't make any difference, but as long as you are here I think you can take this time to learn something, and I will see to it that you are squared away with your Company Commander. By the way, do you parachute infantrymen have to march with your unopened parachutes like that?

Private MARKS. Not normally, but our CO was trying something new for today.

Colonel EDGER. It's an amazing array of equipment you have on hand. I guess no one realizes the amount of it more than you who have to carry it all.

Private MARKS. That's right. Sometimes I wonder whether or not it's all necessary.

Colonel EDGER. Well believe me there is usually a pretty well planned need for everything you have. Sometimes I wonder whether you combat infantrymen realize the degree to which the planning must go in order to provide you with this fine equipment. You have probably heard over and over that we are interested in providing the finest equipment for the finest soldiers in the world.

Private MARKS. Well I know it's very good quality all right, but I also know that it sure is heavy, and when you are on a march like I have been you don't see the reason for it.

Colonel EDGER. Well there is nothing like having the equipment that you need at the time you need it. It reminds me of a few things that happened during Korea that you probably aren't aware of since you have just recently come into the Army. There was many a soldier in Korea who was very thankful he had the equipment that he needed at the proper time, and not the least of the reasons that he had it was because of the care and forethought put into the proper preservation, packaging, and handling of that equipment. Let me show you how some of this equipment which you infantrymen need was supplied in a very serious emergency during the Korean action. I think you will find some of the background very enlightening. After we see this mass airdrop of equipment, Mr. Barton Roffee of the Quartermaster Food and Container Laboratories is going to tell us a little of what goes into the development of aerial drop techniques with respect to packaging and handling, and what we are doing today to improve these operations.

(Near the completion of the talk Private Marks begins to eat some item of the combat rations.)

Aerial Delivery Techniques and Progress

Mr. BARTON ROFFEE. Under the new concept of modern warfare with our mobile Army we cannot expect to have railroads, highways, or even landing fields available when needed. It therefore became

MR. BARTON ROFFEE

Figure 1.

imperative to provide the final link in our supply system by dropping the supplies to combat troops from aircraft in flight. This is Aerial Delivery—which we call "Supply from the Sky."

In May 1955 the Quartermaster Food and Container Institute was given a mission to "develop optimum packing materials and procedures necessary for the preparation of supplies and equipment for aerial delivery."

This was divided into a short and long range program. The short range program which I will discuss, was to provide as an interim or immediate measure, packing materials and procedures which would produce an improved system for aerial delivery and employ standard equipment wherever possible. In other words, produce a better aerial delivery system employing standard components, reduce the cost if possible, and do it now!

Our initial research efforts at the Institute included laboratory testing on available packing materials and their applicability to aerial delivery. The static tests in the laboratory were followed by tests at drop-tower facilities to provide dynamic data on energy absorbing capabilities.

In October 1955 the Quartermaster Food and Container Institute embarked on a Field Research Program at Camp Pickett, Va. This employed C119 aircraft, the familiar flying boxcars, from the Air Force, and rigging crews from the Airborne Department at Fort Lee.

We first observed the existing system for aerial delivery of 1-ton loads of combat rations such as shown in figure 1. This employs a 64-foot diameter solid-canopy cargo parachute to lower a 48-case load of C rations which are enclosed in a webbed sling known as the A–22 aerial delivery container. This system descends at an average of 25 feet per

Figure 2. One-Ton Ration Load

second which is about the same rate as a paratrooper jumping from a plane. The velocity at impact is about 30 feet per second, which is low enough to prevent excessive damage to the rations.

Figure 2 shows the configuration of the 1-ton ration load with the 48 cases in the container, stacked in 6 layers of 8 cases each and in the background the men can be seen gathering up the 64-foot parachute.

We also observed that when larger loads were airdropped, they were extracted or pulled from the plane by a vented extraction parachute which then floated freely to the ground while the load was lowered on a large solid-canopy chute.

Previous research had indicated the desirability for higher velocity airdrops to improve performance, so we decided to try and drop the 1-ton load using the 24-foot diameter ribbon extraction chute in place of the 64-foot diameter solid-canopy cargo chute. As you can imagine, it came down much faster, in fact, it came screaming down and the impact velocity was 88 to 90 feet per second, and frequently the loads landed on concrete runways. Our problem was how to absorb the tremendous amount of energy of impact of this ton load, which at the old 30 feet per second velocity was about 28,000 foot-pounds, but at the new 90 feet per second was over one-fourth of a million foot-pounds. Eighty-eight feet per second is 60 miles per hour, so the problem was as if we were to place the 1-ton load of rations on a truck and drive it into a solid concrete wall at 60 miles per hour and then attempt to design a cushion or energy absorber to protect the rations from damage at impact.

As previously stated, tests were made to determine the energy-absorbing capability of a number of cushioning materials and figure 3 shows a few of these. Number 1 is a sample of foamed plastic before a compression test and number 2 is a similar sample after the compression test. Number 3 is an empty beer can before testing and number 4 is a similar can after compression testing to determine its energy absorbing capability. The empty beer cans were surprisingly effective in that they absorbed the energy of impact and did not return enough energy to the load to cause an objectionable amount of rebound, however, there was always the problem of getting assistance in emptying the beer cans. Number 5 is a sample of paper honeycomb before compression test and number 6 is a similar sample after testing. The paper honeycomb was finally selected as the most suitable material for immediate use as an energy-absorber in an aerial delivery system. This paper honeycomb is available in various cells sizes as can be seen in figure 4, the smallest or $\frac{7}{16}$-inch cell size being the one recommended for use under the C ration load in the new high-velocity system with the larger cell sizes available for more fragile items of supply.

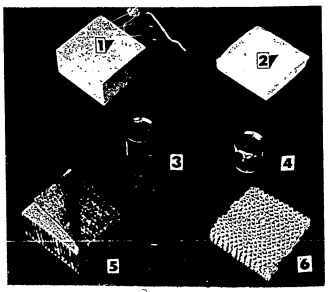

Figure 3 Cushioning Materials

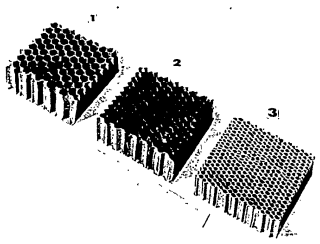

Figure 4. Paper Honeycomb

Paper honeycomb is better than the more conventional cushioning from the standpoint of both cost and efficiency as can be seen in figure 5, where we note that a standard Quartermaster felt shock pad, 1 foot square and 6 inches thick, costs $2 and is 15 percent efficient compared to an ideal energy-absorber, while an equal volume of paper honeycomb, costs 25 cents and is five times as efficient. An additional advantage of paper honeycomb is that it can be purchased in an unexpanded form as shown in number 1 of figure 6 and expanded prior to use as it is in number 2.

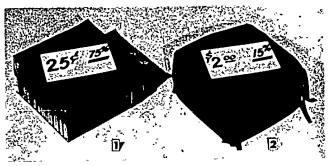

Figure 5 Cost and Efficiency (in %) of Honeycomb vs. Felt Shock Pad

The ratio of expanded to unexpanded honeycomb is 20-to-1 which means that one carload of unexpanded material, shipped to forward areas will make 20 carloads of cushioning material for aerial delivery.

We have discussed the existing system, and a small number of the energy-absorbing problems in considering a new system, so here in figure 7 we have a diagram of the new high velocity system for aerial delivery proposed by the Quartermaster Food and Container Institute in January 1956. Note

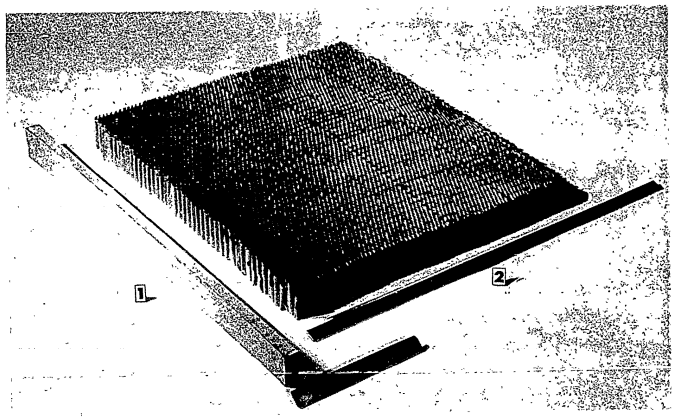

Figure 6 Paper Honeycomb Before and After Expansion

Figure 7.

that the 24-foot chute is composed of 2-inch wide ribbons instead of a solid canopy. This diagram also shows the use of a 40-foot riser and double length "spider" between the chute and the load which was incorporated upon recommendation of the Airborne Division, to reduce pendulum motion and oscillation of the load during descent. The new shape of the 48-case load of C rations can be observed and details of this are shown better in figure 8 which shows the wider and lower configuration of the load to provide more stability especially after impact on the side of a steep hill. This

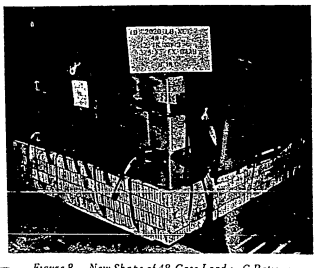

Figure 8. New Shape of 48-Case Load of C Rations

is a photograph of one of the test loads at Camp Pickett just prior to airdrop and figure 9 shows this same load after an airdrop from 1,500 feet using the 24-foot extraction parachute. Notice particularly the excellent condition of the cases of C rations—after an airdrop which in all respects was similar to one we are about to see now in this brief movie which provides a dramatic comparison between the existing and the proposed new system for aerial delivery of 1-ton loads of food, fuel and ammunition.

Successive drop tests indicated that the proposed high velocity system will provide protection to the loads that is equal to, or better than, that with the existing system.

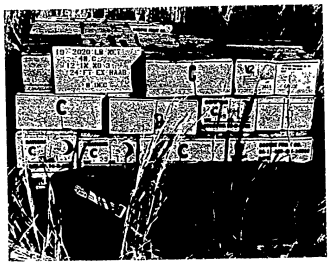

Figure 9. 48-Case Load of C Rations After Airdrop from 1,500 Feet

In addition to the protection against damage, the high velocity system has many advantages over the other and one of these is illustrated in figure 10 which shows that the system with the 64-foot chute will require 60 seconds to descend from a 1,500-foot height which means that in a 20-knot wind it will drift 2,025 feet—while the system with the 24-foot chute will require only 20 seconds to descend from the same height, and therefore in the same 20-knot wind would drift only 675 feet. This may make the difference between supplying our own or enemy troops or dropping into a contaminated area.

Additional "handling" advantages are illustrated in figure 11 which shows that it requires three men to recover the 64-foot chute which weighs 125 pounds whereas one man can pick up and run with the 24-chute which weighs only 35 pounds. When they are returned to the pack shed it requires three

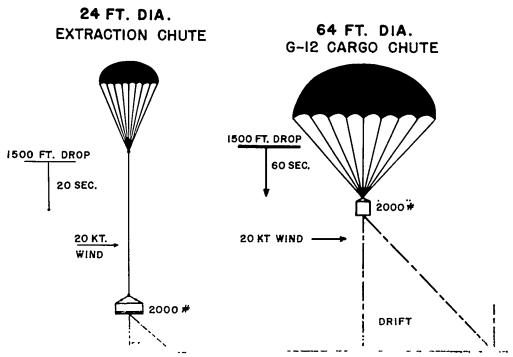

Figure 10.

Figure 11. Weights of 64-Foot & 24-Foot Parachutes & Number of Men Needed to Recover Them After Airdrop

Figure 12. The Old Method and Its Cost

men 1 hour to repack the 64-foot chute, while the 24-foot chute can be repacked by one man in 20 minutes. We also anticipate a higher rate of recovery on the ribbon extraction chutes, because to date, no one has figured a way to make scarves or petticoats from the ribbons.

Until now we have not mentioned what may be one of the most important advantages of the high-velocity system and that is the dollar savings.

This cost difference is illustrated by figure 12, which shows that the cost of the 64-foot diameter cargo chute for the present system is $555 and figure 13, which shows that the high velocity system employs a 24 extraction chute at an estimated cost of $150 plus $15 worth of paper honeycomb.

The savings of $390 to $400 per ton may not seem impressive until we realize that one division of 15,000 men, requires 500 tons per day, of food, fuel, and ammunition.

On this basis, the savings by the adoption of the proposed high-velocity aerial delivery system would be over a million dollars per week for every division supplied by airdrop.

That's the story of our accomplishments in Aerial Delivery Research at the Quartermaster Food and Container Institute—and we are proud of it.

Colonel EDGER. Well what do you think at that?

Private MARKS. It certainly is impressive in the amount of planning that it has to have to get us our supplies. I didn't realize that there was so much work involved.

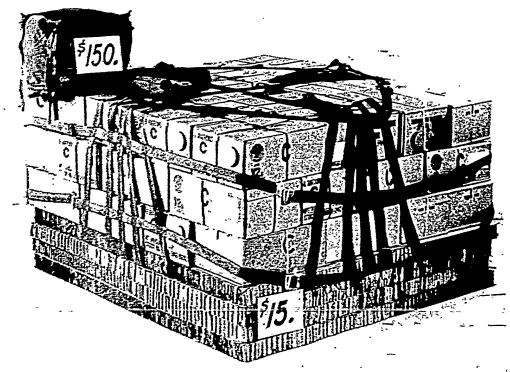

Figure 13. The New Method and Its Cost

Colonel EDGER. I see you have been issued some of the Army's new type rations. What do you think of them?

Private MARKS. Very palatable, very tasty.

Colonel EDGER. Again, I wonder if you ever stopped to think about how these rations can be gotten to the front line soldiers so that they are sure to arrive in a condition where they will be wholesome palatable food?

MR. FRANK J. RUBINATE

Private MARKS. No, I hadn't, but I would like to hear something about it.

Colonel EDGER. Well we just happen to have a man at our symposium this afternoon who has had a lot of experience in the Army in the field of the packaging of food products. I think he would be the one to tell us the Quartermaster story of recent progress and developments made in the field of food packaging. At this time I would like to introduce Mr. Frank Rubinate of the Quartermaster Corps Food and Container Laboratories. Mr. Rubinate, will you please enlighten Private Marks and myself on the subject of progress made in the packaging of food products?

Food Packaging Developments

Mr. FRANK J. RUBINATE. Before discussing the packaging of the 25-in-1 quick-serve meal (which has been served to you, Private Marks) and its smaller brother the 5-in-1 quick-serve meal, it would be well to cover a little of the background and reasoning behind the development of these meals. Since the advent of atomic warfare, guided missiles and other new weapons of war, the military planners have been busy developing an Army with a new look. The result of their efforts is a new tactical concept that envisages relatively small, highly mobile combat units that are "armed to the teeth." Such attack teams would move in fast, strike hard, and move on before atomic retaliation. Everything would be geared to quick assembly, swift mobility, smashing striking power, rapid withdrawal, and effective dispersion of combat troops—their weapons, their vehicles, their food.

World War II type operational rations could not fill this bill. Some required special kitchen equipment, special transport and storage facilities, and the presence in the theater of operations of a large number of highly trained food service personnel and skilled cooks and bakers. Some which required less extensive handling and preparation, also tended to be less than highly acceptable. All were somewhat too bulky, heavy, and perhaps too highly specialized and too inflexible in use to fit into the new logistical concept that has developed along with the new concept in tactical operations.

Yet, the picture was by no means dismal. With the new food processing techniques rapidly becoming available—notably radiation preservation, freeze drying, and the combination of precooking with either irradiation or dehydration—the ration planner has found, almost at hand, the means for meeting the uncompromising requirements outlined above. Now flexible packaging materials plus new methods of packaging are serving as valuable adjuncts in the new approach.

The 25-in-1 quick serve meal shown in figure 14 is intended for use in reserve areas where large messes are neither practical nor desired. Each shipping container contains sufficient food for 25 meals, or, put another way, one meal for 25 men and requires no additional utensils or items for preparation other than hot water. Trays and eating utensils are a part of the packed meals. The following items typify components of one dinner menu.

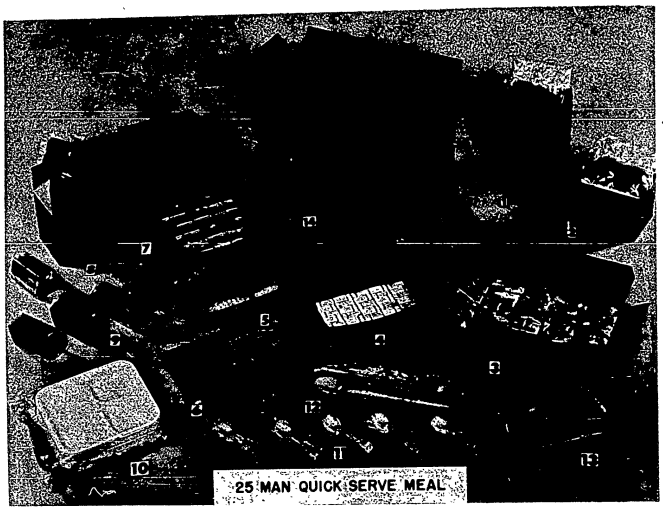

Figure 14.

Dehydrated pea soup
Precooked dehydrated chicken and rice
Bread rolls
Jam or jelly
Dehydrated apricots
Chocolate fudge bar
Coffee
Cream
Sugar.

Accessory items include:

Paper cups
Fiberboard trays
Plastic spoons
Serving ladles
Paper towels.

A wide variety of dehydrated meats, fruits, vegetables, and packaged baked items are in various stages of development. The roast beef, potatoes, and cabbage which you have before you are examples of items which have been developed.

The 5-in-1 quick-serve meal shown in figure 15 follows the same pattern as the 25-in-1, but is designed for use immediately behind the combat area, where feeding of smaller groups is more practical.

There are actually two packaging features of these quick serve meals which are new to the military. First, is the extensive use of the flexible type containers (present operational type rations are in the main, packed in metal cans). Second, is the multipurpose use of these containers, serving as vessels for reconstituting the foods as well as providing the normal protection against deterioration and damage during storage and transportation.

The extensive use of dehydrated and dry items naturally results in a tremendous reduction in weight. To take full advantage of the reduction in weight makes it mandatory for the packaging technologist to reduce as well the weight of the packaging materials used. As an example, a metal can 3 inches in diameter and 2 inches high weighs 44 grams. A flexible container to hold an equal

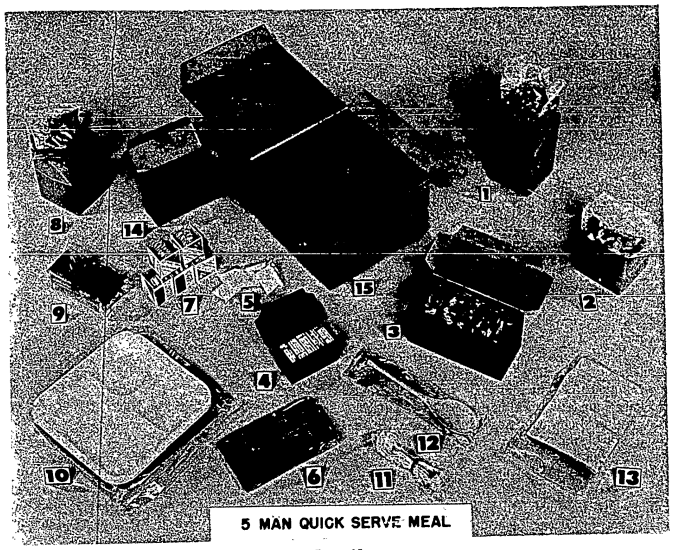

Figure 15.

amount of food would weigh 4 or 5 grams or only about one-tenth as much as the can. Our goal therefore is to package all items in flexible containers in order to achieve the maximum reduction in tare weight and cube.

As you view the exhibits you will see that maximum use has been made of aluminum foil and plastics. I do not mean to imply that the meals on display are packaged as they will be when our research and development effort has been completed. The materials used for many items leaves much to be desired. For instance, we do not have a satisfactory flexible material for many of the pre-cooked dehydrated meats. In addition to the problem of maintaining a moisture level as low as 2 percent in components, we must, in some instances, provide a desiccant within the package. The dessicant is needed, not to maintain the moisture content of the product at time of packing, but rather to reduce the initial moisture content of the product to a lower level during storage.

We are, in effect, continuing the dehydration process because of the inability of the food processor to economically and practically dry the item to the optimum moisture level. For example, meats are dehydrated to approximately 5 percent moisture, but the maximum moisture content allowable for long term stability is about 2 percent. The desiccant is added to the package in order to remove the 3 percent excess moisture.

The types of flexible containers needed should have a zero water-vapor transmission rate and zero gas transmission rate because of the low moisture content of the items and the need for either vacuum or gas packing under CO_2 or nitrogen. In addition, the material must be tough enough to resist

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puncturing by the hard sharp edges of many of the dehydrated food, and rugged enough to stand transportation including delivery by air.

At what stage of packaging research and development are we today? As a general statement, we can say the packaging progress is about on a par with progress in the development of the food. In some instances, we are in good shape, while in others, we have a long way to go. For items such as crackers and cookies we can provide overwraps or bags of aluminum foil and plastic construction. For dehydrated fruits which have been developed to date, a similar material could be used. Where dehydrated steaks are concerned, much remains to be done. In addition to previously mentioned problems of moisture and gas transfer, there exists one of fragility of the steak. The dehydrated steak is porous and extremely brittle and will not stand the hazards of wartime shipment without the addition of some type of cushioning.

Baked items, such as rolls, pose a severe packaging problem since the container must withstand pasteurization temperatures of 325° for 25 minutes. We have found two flexible materials which will withstand the high temperatures, but the materials cannot provide the necessary protection to the product during shipment and storage. At least one type of folding carton is available which is so designed that when opened it provides the extra volume required when the item is reconstituted. This you will see when you view the exhibit.

From the standpoint of overall reduction in weight and cube, we have made progress, as shown in figure 16. Let me take the prototype 25-in-1 quick-serve meal which you will see as the example and compare it with the present ration individual, combat, C and ration, small detachment, five persons, having extended the present rations to a 25-meal basis.

The rather small reduction in cube is due primarily to the large volume occupied by the bread rolls. It should also be pointed out that the 25-in-1 quick-serve meal as packed in the shipping container includes serving trays, cups, spoons, and cartons and bags designed to allow for the increase in volume of the contents when reconstituted in the package, all of which contribute to the gross weight and cube. However, the cube picked up by the packed ration more than compensates for the reduction in cube of food preparation equipment now required for conventional type rations. The 50-percent reduction in weight is a large step forward and it is expected that further work on packaging will result in even further reductions in tare weight.

COMPARISON OF GROSS WEIGHT AND CUBE*

	GR. WT.	INCREASE	CU.	INCREASE
25-IN-1 QUICK SERVE MEAL	26 LBS.	—	1.2 CU.FT.	—
RATION INDIVIDUAL, COMBAT, C	56 LBS.	30 LBS.	1.8 CU. FT.	0.6 CU. FT.
RATION, SMALL DETACHMENT, 5 PERSONS	49.3 LBS.	23.3 LBS.	1.8 CU. FT.	0.6 CU. FT.

* BASED ON 25 MEALS

Figure 16.

Colonel EDGER. Now, Marks, I would like to change the direction a little bit and give you an insight into what it takes to handle this equipment that the Army finds itself having to move to soldiers like yourself and other troop units stationed throughout the world. You must realize that there is an ever growing list of items and an ever growing quantity of materiel that requires getting to specified places at specified times in specified amounts. Any field that we touched upon would constitute a long story in itself, as an example, we could spend an hour or two talking about the movement and supply of the large quantities of fuel that we must undertake today, but we don't have time to consider every aspect of this, so I think that at least your education should include some of the high spots of the transportation problems, and progress made to overcome them in moving this ever increasing amount of materiel. Would you like to hear this?

Private MARKS. I certainly would.

Colonel EDGER. Well then, I have here on the stage with us a well qualified representative of the Transportation Corps, Col. William P. Tuggle, Jr., Transportation Supply and Maintenance Command, St. Louis, whom I would like to call upon at this time to give us an insight into the highlights of what we are doing about movement of our equipment for the Army.

Transportation Developments

Col. WILLIAM P. TUGGLE, JR. Transportation alone cannot win a war, but inadequate transportation alone can lose a war.

Col. William P. Tuggle, Jr.

No matter how good a job our industry does in making what our combat troops need, it is of no value, if the materiel is not in our troops' hands when and where needed—and in the quantities required.

History of wars is replete with examples of logistic failures losing battles.

That the job of getting what the soldier needs to him when he needs it is vital, is evidenced by the fact that transportation capability was a limiting factor in every allied decision on strategy in World War II. Analysis of German and Japanese records has clearly established that breakdowns in transportation were the initial steps in disintegration of their fighting capabilities.

The army of the future must have a transportation system which will support highly mobile, dispersed forces. The threat of atomic warfare dictates this mobility and dispersion—we can no longer accumulate large stockpiles of supplies within range of enemy aircraft or guided missiles.

We must, therefore, integrate all modes of transportation into a transportation system which will move supplies rapidly from the source to the ultimate user.

It must be recognized that an integrated transportation system implies centralized control of the transportation capability. Through this centralized control, optimum utilization of air transportation, both land and water based, express surface transportation, and rapid handling of cargo can be accomplished.

How can we move supplies from the source—the factory—to the consumer? This would be a fairly simple problem if we were assured of a 100 percent air line of communications. While this is a desirable objective, it is not realistic at this time. It also requires air superiority which cannot be assumed. To compensate for the expected shortage of air transportation, an express surface transportation system is being developed to make full use of scheduled supply, automatic data processing, electronic submission of requisitions, and unitization of cargo so that required shipments of assorted supplies may move on schedule to meet the daily and special requirements of combat units. Unitization will eliminate time-consuming, multiple handling of bulk shipments.

Scheduled resupply will be used to the maximum extent and, we can assume, will move primarily by ocean vessels—existing airlift capability will be available for critical cargo and troops. As more air transport becomes available it will be possible to deliver the shipment closer to the consumer—and reduce intermediate transportation problems.

Much of our transportation problem is the problem of keeping wheels under our cargo, that is, transferring it from one set of wheels to another. Commercial railroads have solved part of this problem by the use of "Piggy-back" whereby loaded trailers are transported on flatcars—as have maritime shipping companies by the use of roll-on roll-off vessels. However, these trailers and trucks are not the complete answer to the problem of getting the unit of supply direct to the consumer, since the trailer is too large for a load for one unit. Transferring cargo from one mode of transportation to another requires about as much time as the actual travel time. There is yet much handling of the cargo by forklifts, cranes, yes, even by hand, moving it from one set of wheels to another. Perhaps a further refinement would be wheeled pallets or containers.

For peacetime operation, it is conceivable that in major arteries of transportation, completely mechanized handling of unitized cargo from source to destination can be achieved. In time of war, with the destructive potential of modern armies, there

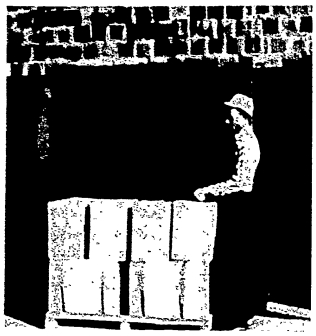

Figure 17. Unitized Load

would undoubtedly be many instances where handling facilities would be reduced to the expedients of the moment. For that reason, if no other, the continued ingenuity of the packaging trade is vital to our security. Perhaps the greatest single challenge is the marrying of the concept of the unit load with the need for self-sufficiency of the individual containers. It is not sufficient to tie together a group of heavy, oversize boxes, nor to pack together a group of individually inadequate containers with protection of their contents dependent on the medium of unitization. We dare not tailor our packaging to the requirements of favorable transportation conditions. We must seek the ultimate in versatility, strength, water-proofness, light weight, minimum cube, and minimum package cost. We must standardize our packages to fit mechanized transportation, but we must also fit our standards to the lowest common denominator in warfare: The foot soldier.

Let us first consider how supplies will move to consumers overseas if water transportation is used. Should our major ports be destroyed we will outload from many smaller ports and beaches in the United States. How will we speed up cargo handling through these ports?

It is planned that unitization will be used in so far as possible and practical from manufacturer to consumer. If it is not practical to have the manufacturer unitize the supplies then it will be accomplished at the depot. As you know, the usual means of unitization are secured pallet loads and relatively large containers, normally reusable. These techniques will be continued but new and improved devices and techniques must also be found. Figure 17 shows the stowing of Quartermaster supplies into our present shipping containers.

Of course shipments must be documented; however, unitization of supplies will simplify documentation. It is intended that the initial transportation documentation will be valid from the source to the consumer, regardless of the number of times a shipment is transferred from one mode of transportation to another.

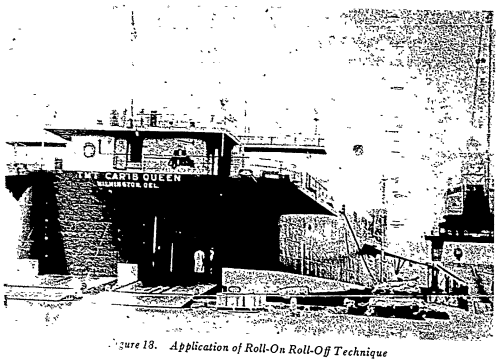

Figure 18. Application of Roll-On Roll-Off Technique

Figure 19. World War II DUKW

At dispersed ports, both here and overseas, the roll-on, roll-off method of cargo handling as shown in figure 18 will greatly expedite loading and discharging. Vessels designed for this concept will permit fast handling of tanks, trucks, and other self-propelled vehicles which account for about one-fourth of all military cargo. It is anticipated that these vessels will have a cargo tonnage capacity one-fourth greater than a Liberty ship and can be loaded or discharged in 10 hours or less. Supplies may be unitized and loaded on vehicles which would be placed on the roll-on/roll-off vessel. In this way greater utilization of cargo space will be obtained and the movement of supplies on and off vessels will be accelerated.

Methods of discharging roll-on/roll-off ships will be standardized and ocean transports and cargo vessels will be modified to accommodate helicopters for priority discharging operations.

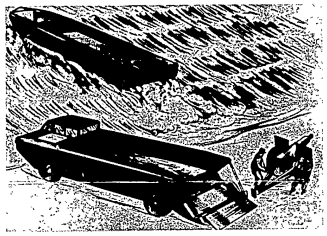

Figure 20. Proposed 5-Ton Amphibian

In addition to the use of roll-on/roll-off type vessels, conveyor type discharging apparatus, amphibious equipment, and spud barges will be employed. Let's look at some of the equipment that will be operating in and out of our terminals.

I'm sure you have seen the World War II DUKW in figure 19, which was an amphibian 2½-ton truck.

We have prepared military characteristics of a larger 5-ton amphibian shown in figure 20 as a replacement for the 2½-ton.

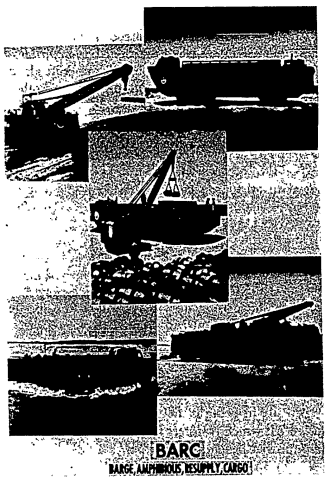

Figure 21.

Still in the test stage, the barge amphibian resupply cargo in figure 21 is proving one of the most effective developments. It has been tested in the Northeast Air Command operations and in support of the Dewline. Designed to transport army vehicles and heavy cargo up to 60 tons from ship to shore, over the beach and to points inland, the barc has a rated speed of 7 miles per hour in water and 14 miles per hour on land. It can negotiate grades up to 60 percent and can turn in a radius of 75 feet.

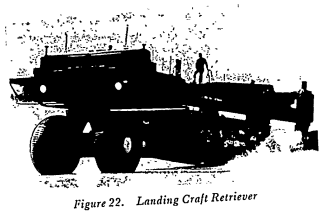

Figure 22. Landing Craft Retriever

The landing craft retriever shown in figure 22 was designed to recover broached, beached, damaged, and otherwise inoperable landing craft along the beach. It can recover landing craft and other equipment having lengths to 70 feet, beams to 22 feet, and weights of 70 tons from water up to 6-feet deep. Thus it can be used to provide a "safe harbor" by clearing the beach and water of all landing craft. Two diesel-driven generators furnish electric power to all four wheels and the hoisting motors. It is sectionalized for transport by vessel, truck, or train.

The spud barge serves as a sea island for our aerial tramway or as a ready-made pier for a port (fig. 23). Rapidly telescoping caissons permit establishing a port in a matter of hours. Shore connections 300 feet long have been designed to allow the speedy flow of cargo from pier to shore.

For use where ports have been destroyed or across beaches is the package port shown in figure 24. You will notice that these are made of spud barges with the caissons removed flush with the deck.

Already in being is the aerial tramway shown in figure 25, which transfers cargo over rough terrain, unimproved beaches, and at port sites destroyed by

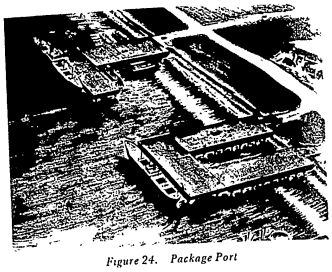

Figure 24. Package Port

action of the combatants. In over-the-beach operations, two spud barges are positioned to constitute a sea terminal and cargo is unloaded by ships boom onto platforms which are moved inland by the skycars. Under development is a continuous circuit aerial tramway which will have a greatly increased capacity. You will learn more about this and the overland conveyor system which was designed to carry unitized cargo inland from a beach or port in other presentations and displays. The conveyor will help avoid short truck hauls and alleviate beach and port congestion.

Forklifts also play an important part in the transportation picture. The Quartermaster Corps has developed two forklifts to move cargo over the beach or other rough terrain. The capacity of the forklifts is 6,000 and 10,000 pounds. These are finished items and are being standardized for issue.

Development and construction of the prototype of the beach discharge lighter is under way (fig. 26). The lighter will receive vehicular and other cargo directly from roll-on/roll-off vessels and move such

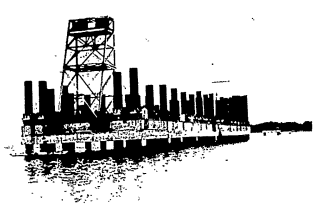

Figure 23. Spud Ba

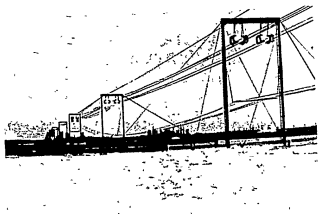

Figure 25 Aerial Tramway

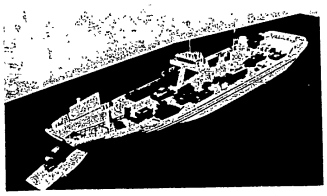

Figure 26. Prototype of Beach Discharge Lighter

cargo to the beach. Vehicles will move under their own power onto the lighter, and from the lighter across the beach. Capacity of the beach discharge lighter will be 600 long tons of vehicular cargo or 1,000 long tons for transfer to another vessel or pier. It has a cruising speed of 12 knots and range of 4,800 miles, permitting self-delivery to a theater of operations. Two 1,200-horsepower diesel engines furnish the power. Some of its features are an hydraulically operated ramp, an hydraulically operated ram to push the lighter off the beach, and a ballast system for trimming fore and aft.

Thus far I have discussed equipment to move cargo expeditiously from continental United States to overseas and across the beach. We now are faced with the problem of getting the supplies from the terminal area to the combat troops. This demands development of faster, more efficient vehicles to handle heavy loads over poor terrain. Trucks with better capability for off-road operation for operation over any type surface are needed. Also required are vehicles or truck-trailer combinations which are air-transportable, which have large capacities and low ground pressure. They must be simple in design, and possess a high degree of buoyance to permit water crossing. They must have maximum ratio of payload to curb weight and

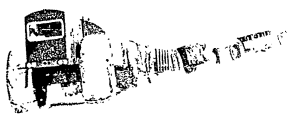

Figure 27. Logistical Land Train

must be capable of being easily and rapidly loaded and unloaded in order to decrease turn-around time and reduce manpower requirements.

The problem of maintenance must be solved in some manner that will obviate deadlining a vehicle for minor repairs. The problem of rapid exchange of engines and other components must be solved in order to reduce the required reserve of vehicles in the theater for exchange purposes. Component parts must be standardized.

Among items with cross-country capability for the motor transport service are the logistical land train and the rolling fluid transporter.

The logistical land train is one answer to the problem of a combination high-cargo carrying capacity and maximum mobility in the arctic and

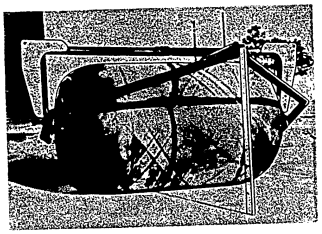

Figure 28. Rolling Fluid Transporter

desert over flat and rolling terrain (fig. 27). Consisting of a lead vehicle and powered cargo trailers, it was designed to carry a payload of 45 tons across Arctic regions at speeds in excess of 10 miles per hour. The lead vehicle houses the driver control station, communication station, crew quarters and the powerplant which is a 600-horsepower diesel engine driving a generator. Each wheel (10 ft. in diameter and 4 ft. in width) is powered by a separate electric motor. Overall length with three trailers is 174 feet and the cruising range is 200 miles.

The rolling fluid transporter was developed to transport liquid cargo in large low-pressure bags which also serve as wheels, as shown in figure 28. These containers may be harnessed together with a towing rig so that several may be towed behind a prime mover. It operates both on and off the road. Each has a capacity of 500 gallons.

Figure 29.

Numerous other items are under study or test but time does not permit me to discuss those here. Nor does it permit discussion of the many new developments, either perfected or under test, in railway equipment—such as multigage locomotives and cars.

Thus far I have spoken about surface transportation. However, within the combat zone of the Army of the Future the combat units—the squads, platoons, companies, will be so widely dispersed that it can be reasonably doubted if any type of surface vehicles can adequately supply them. Air transportation seems to offer the best solution to the problem of getting supplies to these units.

There can be no long landing strips or air fields in these forward areas. Therefore most supplies must be delivered in the combat zone by types of aircraft requiring either no prepared landing strip or very short ones.

Most battle supplies could be delivered within the combat zone in assault-cargo and convertiplane aircraft while short take off and landing (STOL) and vertical take off and landing (VTOL) planes and improved helicopters could move units and their equipment—or could resupply units—across rivers and other obstacles. These aircraft must be organic to the Army—an integral part of the field army.

Figure 29 shows some views on a study of helicopter ship-to-shore operations showing loading a helicopter on a freight supply vessel and cargo discharge behind the beach. This may be one means of minimizing congestion on the beach.

These are some of the helicopters we have now that could operate in this manner.

H–19 which has a capacity of ½ ton and cruising range of 240 nautical miles (fig. 30).

For these next two, the H–21 and the H–34 we have let contracts for turbine powering.

The H–21 has a capacity of 1½ tons and a range of 300 nautical miles (fig. 31).

The H–34 has a capacity of 1½ tons and a range of 385 nautical miles (fig. 32).

H–37 which has a capacity of 3 tons and a cruising range of 200 nautical miles (fig. 33).

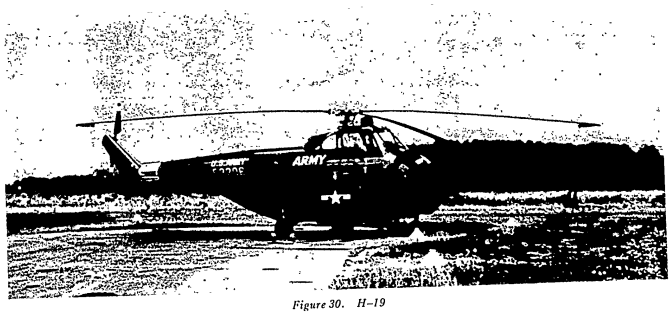

Figure 30. H–19

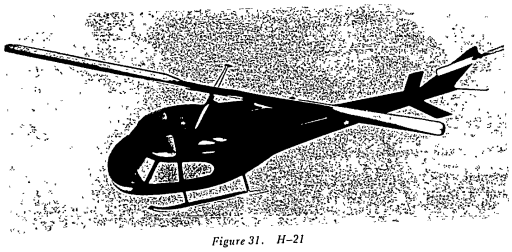

Figure 31. H–21

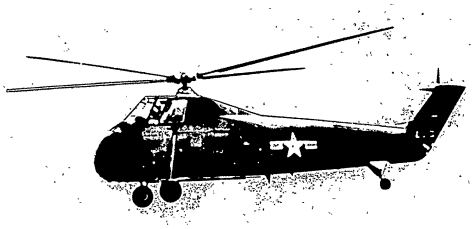

Figure 32. H–34

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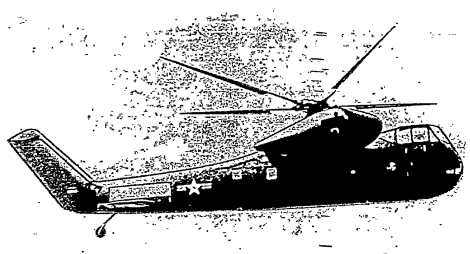


Figure 33. H–37

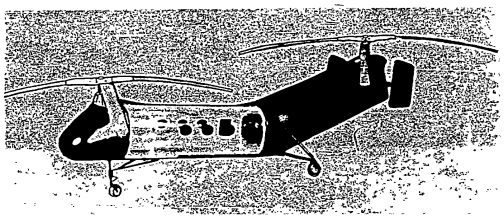


Figure 34. Experimental XH–40

The experimental XH–40 which has a capacity of six persons and a range of 200 nautical miles (fig. 34).

The Army, in cooperation with the Navy and the Air Force is sponsoring many projects in this field of STOL and VTOL aircraft.

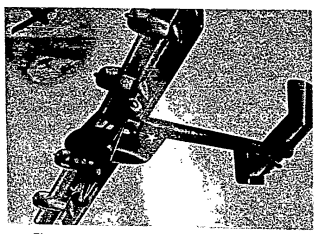


Figure 35. Four-Engine Deflected Stream Aircraft

A contract has been let for the design, fabrication, and test of a 4-engine deflected stream flying test bed. Figures 35 and 36 show two types of deflected stream aircraft.

Another contract has been let for the design, fabrication and test of a ducted fan flying test bed as

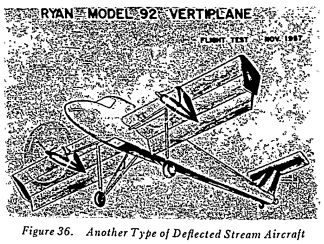


Figure 36. Another Type of Deflected Stream Aircraft

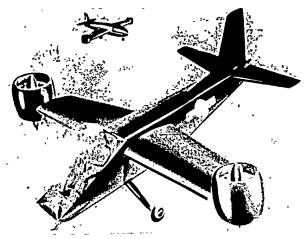


Figure 37. Ducted Fan Flying Test Bed

shown in figure 37. The ducted fans mounted on each wing tip will rotate through 90° to provide vertical and level flight.

Still another contract has been let for a feasibility study of a tilted wing flying test bed. Figures 38 and 39 show 2 types. In these, the wing structure, along with the motors and propellers, will tilt upward from their normal position to provide both level and vertical flight.

Design studies are being made to determine the characteristics of a flying crane—to be used for heavy lift—8 to 16 tons—over short distances where conventional means of transportation cannot be used (fig. 40).

You probably read recently in the papers that design contracts have been let for the aerial jeep (fig. 41). As its name implies it is a small vehicle capable of performing all the tasks we associate with the land jeep including the transport of an antitank weapon.

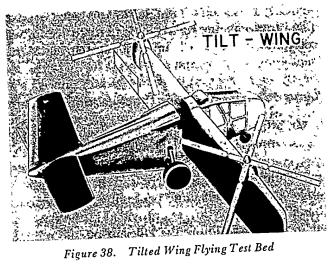


Figure 38. Tilted Wing Flying Test Bed

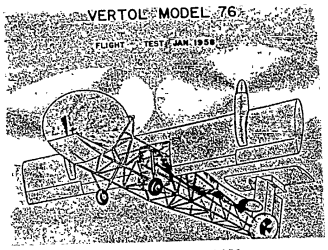


Figure 39. Vertol Model 76

Based on current evaluations of one-man flying platforms, we are endeavoring to develop a remotely controlled flying pallet—the sky hook (fig. 42).

We are evaluating proposals on high performance observation aircraft (HPOA) giving us range, speed, and other performances exceeding those available with the L–19 (fig. 43).

The feasibility of a nuclear-powered, remote-controlled, cargo- carrying device with VTOL capabilities is being investigated.

We have developed and are presently testing in Europe a complete mobile aircraft maintenance system. We are also working on an aircraft recovery and evacuation system, utilizing helicopters as recovery vehicles.

A few years ago some of these projects would have been found only in the pages of science fiction. Today we believe them to be not only feasible but also practical and necessary.

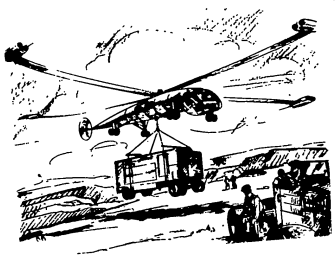


Figure 40. Flying Crane

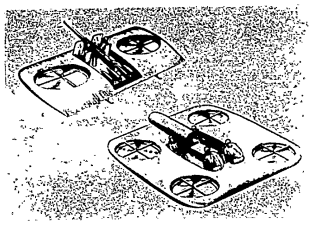


Figure 41. Aerial Jeeps

Briefly summarizing, in order to assure that our combat units in the Army of the Future have what they need, where needed, and at the right time, we require:

1. Methods and equipment for more expeditious handling of cargo.
2. A simpler system of documentation—one document per shipment, valid from factory or CONUS depot to ultimate user.
3. Better and more economical methods of unitization—perhaps disposable containers, ones kept in the theater of operations for other uses, two sizes of containers.
4. More efficient vehicles capable of cross-country operation, of being rapidly loaded and unloaded and of being air transported.
5. Simplified maintenance for both surface vehicles and aircraft; standardization of component parts. We must be able to quickly replace engines and other components. Perhaps a unit package of

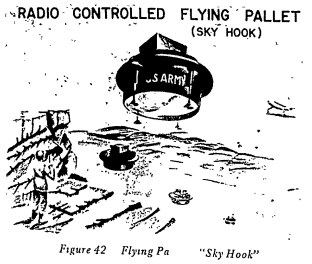


Figure 42 Flying Pa "Sky Hook"

engines and other components which require frequent or periodic replacement.

6. STOL and VTOL aircraft and helicopters having greatly increased capabilities.

Colonel EDGER. Now, Marks, we have covered some very spectacular things in our talks so far. I don't want to give you the impression that we don't have to get down to earth here in our Army packaging and materials-handling problems. I don't want to leave you with the impression that everything is in the nature of a romance and that we are all knights in shining armor in this business. There is much hard administrative effort that goes into the normal everyday field of packaging. I would like you to hear a little bit about what it takes at this time. We have here with us today a man who has been associated with the field of packaging admin-

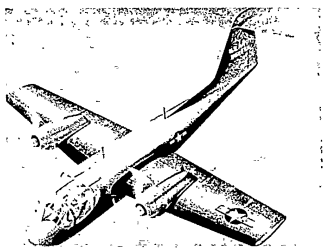


Figure 43. High Performance Observation Aircraft

istration for the Chemical Corps in their Research and Development Command. He is their representative on the Army Packaging Board, and is well qualified to speak on the subject of what we are doing in packaging today. Mr. Milton Raun, will you please tell us a little bit about our current Army packaging practices and concepts?

Current Army Packaging Practices and Concepts

Mr. MILTON RAUN. The preceding presentations have emphasized very graphically that packaging and materials handling are a most important factor in military logistics. There can be no doubt in anyone's mind that static packaging and materials-handling concepts are as outmoded as the bow and arrow for maintaining the efficient mobile military striking forces required for nuclear age warfare. The task of packaging and materials handling becomes more difficult and complex with every new technological advance in the defensive and offensive weapons of our military establishment. The contributions to our national defense of our scientists, skilled workers, and engineers are readily apparent in the flow of items from our industrial manufacturing sources. However, the efforts of the personnel engaged in the accomplishment of the myriad of details necessary before the material is placed in the hands of a user, personnel such as the packaging and materials-handling specialists and technologists often are not recognized. Behind the glamour and public awe when a new weapon is released is a group of logisticians who helped to make the weapon a thing of reality.

Frequently in the past, packaging consisted of a selection of a method of preservation from a rather static group of methods and a selection of a shipping container, which in more instances than not was a nailed wood box which could be readily manufactured at the contractor's facility. It is true that this type of packaging has performed yeoman service in the past. However, today we cannot permit ourselves the luxury of indeterminate methods of packaging if we are to efficiently utilize the tremendous capability of our national industrial facilities. To quote from the Army Policy Regulation on Packaging, "Preservation, packaging, packing requirements shall be specified in invitations for bid, procurement documents and specifications as applicable. Over-protection shall be avoided. Packaging procedures shall be set forth in sufficient detail to preclude misinterpretation which may result in the inclusion of costly or unnecessary materials and procedures in the completion of the package."

What is the intent of this policy? The intent is that packaging for army supplies must be engineered. Not just packaging engineering for complex, fragile, or sensitive items of equipment—but packaging engineering for all items of military supply. Packaging engineering that is commensurate with the contemplated usage of an item. Why should an item scheduled for delivery to a user in one of our 48 States be packaged in an identical manner as an item scheduled for delivery to Alaska, Japan, Tahiti, or some other global destination? A single standard of packaging is inefficient, needlessly costly, and unnecessary for our military operations. It is true that our standards of packaging for mobilization requirements, long term storage and indeterminate use material requires the best packaging that can be developed. But our supplies for domestic consumption need not indiscriminately be packed in the same manner. Engineered packaging for three basic levels is required in all new army specifications if the item is eventually to be used by both domestic and overseas military units. The highest level of packaging is level "A" which is required to protect the product from damage during shipment to any global point and assure as long a storage life as possible for the item. The next level is level "B" which is utilized for material entering the military depot system for reissue and shipment both stateside and

MR. MILTON RAUN

overseas when the time of use is known. The lowest level is "C" which is generally for material obtained from a vendor and shipped directly to the user or requisitioner and which does not enter the depot type of distribution. Level "C" today is being utilized to a greater and greater degree. Dependency is being placed on industry to furnish engineered packaging to fulfill most requirements for this area. It is our concept to utilize commercial containers and packaging procedures to the maximum degree for all military operations where this type of packaging will satisfy the requirements. To broaden our packaging base, emphasis is being placed on specify-

ing of alternate methods. Methods that are not only as economical and efficient but methods that offer a greater choice for industry to meet military packaging requirements.

Another concept that is of prime importance today is the Army's packaging data sheet for repair parts. We are all aware of the criticism of the packaging of repair parts in the past. Criticism that was justifiable as the packaging was inefficient and unreasonable. Many times this was due to improper stating of requirements, requirements that forced industry to use a crystal ball in an effort to furnish packaging that would meet military requirements. The purpose of the packaging data sheet is to obtain engineered packaging for the repair parts that are *active*. It is significant to note that packaging requirements for each of the three levels are stated on this card.

In the selection of the packaging data sheet, the various data sheets of the Army services and industry that were in existance were reviewed and the best features of each selected and integrated into the Army standard sheet. When this data sheet is properly filled out the advantages to be derived are:

1. The same package is applied to a particular part no matter who performs the work or where it is accomplished, thus speeding the packaging standardization objectives established by Public Law 436.
2. Permit accurate planning of requirements for transportation capacity.
3. Simplify inventory taking.
4. Promote storage efficiency.
5. Encourage currency of packaging requirements.
6. Simplify procurement packaging functions.

These factors contribute to a compatible marriage of technical and logistical areas. A significant benefit is that packaging requirements can be readily established and can be revised with a minimum amount of interference with the formal specification program.

Some of the Army services will complete this program next year and some of the others with a vast amount of repair will require several more years to complete their progams. These packaging data sheets for repair parts will tell the industry exactly what is desired to meet the military requirements. They will also assist in establishing definitive inspection requirements. A further benefit is that a common basis for bidding and evaluation given to each potential supplier. Needless to say there is room for improvement in any program. The advice and constructive criticism of industry is earnestly solicited. It is our desire to obtain improvements that will be beneficial to both the Army and industry.

Another concept that is closely related to our repair parts packaging data sheet and our specification requirements for three levels is our packaging standardization program. Standardization of packaging is the establishment of the minimum number of sizes, kinds, and types of packaging materials and methods essential for protection of supplies.

In a study of the repair parts packaging practices of one Army service depot, method 1A–1 conforming wrap, dipcoat sealed and method 1A–2, container, overwrap dipcoat sealed, two of the 26 packaging methods available in Military Specification MIL–P–116, were specified for 40 percent of their repair parts. Since it was believed that labor and materials utilized in applying these methods might be more expensive than other MIL–P–116 methods of providing equivalent packaging protection, a cost study on all methods of packaging of MIL–P–116 was prepared based upon cost information obtained from industrial and military packaging operations.

I am not going to discuss figure 44 at this time, however, I will be pleased to forward specific information to those that express their requests in writing.

COMPARATIVE COSTS OF MIL–P–116 PACKAGING METHODS [1]

Method	Labor	Materials	Total
III	0.004	0.015	0.019
IC–3	.006	.020	.026
I	.022	.019	.041
IA–13	.012	.059	.071
IA–8	.022	.054	.076
IC–4	.024	.064	.088
IA–5 (Can)	.027	.063	.090
IA–1	.060	.053	.113
IA–2	.076	.048	.124
IC–2	.080	.052	.132
IA–6	.013	.123	.136
IB–1	.037	.111	.148
IId	.019	.137	.156
IB–2	.048	.141	.189
IIc	.018	.214	.232
IIe	.100	1.969	2.069
IIb	.150	2.240	2.390
IIa	.344	3 274	3.618

[1] Data developed on mean item size of 85 cubic inches, wage rate, $1.50 per hour, and average material cost as of June 1955. Indirect costs, administration, overhead, and profit ratio are not included.

Figure 44.

Another factor developed by this study and other studies was that approximately 15 percent of the Army's repair parts represent approximately 85 percent of total issue. Also, that this 15 percent of Army repair parts represents approximately 93 percent of total dollar value of all repair parts issued.

From these studies that determined the most active items of issue it was very easy to progress a step further and evaluate the packaging for the repair parts. Rather than go through all the details of the study, I will present a summary of what was accomplished in the packaging operations of one Army depot and what can be accomplished in all packaging operations by applied engineering.

a. From 26 methods of unit packaging and 18 kinds of preservatives specified in MIL–P–116, nine methods of unit packaging and seven kinds of preservatives were adopted.

b. From numerous sizes and 78 styles, types, and grades of fiberboard boxes in specifications MIL–P–108 and LLL–B–631, 18 sizes were standardized for depot stocking.

c. From 18 types, grades, and classes of fiber cans MIL–C–3955, three were selected and 17 diameters have been determined adequate for all depot requirements.

d. From 11 types and classes of interior bags in Specification MIL–B–117, three have been standardized for use, and of numerous sizes formerly employed, only six sizes have been standardized for use; while only two sizes of MIL–B–131 bags have been standardized.

e. Out of 25 types, grades and classes of wrapping materials available in five specification materials used, only five kinds of material have been standardized for use.

f. From numerous kinds of available cushioning material, five kinds have been adopted; and out of the 33 types, grades, and classes in which these five kinds of material are available, seven have been standardized for the repair parts packaging.

g. From 13 types and classes of three different kinds of tape, three varieties have been adopted.

h. From six types, grades, and classes of adhesive covered by specification MIL–A–140, one has been specified for use.

Standardization of packaging methods, materials and containers is inextricably related to re-engineering of packages and the preparation of repair parts data sheets. To obtain maximum value for each defense dollar spent continued vigilance to new concepts is required. The old adage "We've been doing it this way for a long time and never had any complaints" is an echo from the past. We need not have complaints before we initiate sound, progressive, cost-cutting administrative and operating concepts of modern management.

Colonel EDGER. Now I would like to give you an insight into a field which does not directly involve packaging or materials-handling equipment; however, it is an area of supply procedure and administration which has such a far-reaching impact on our packaging and handling procedures and techniques that you should be aware of what is going on. You may have heard of what I am referring to in the term

Mr William Phillips

Project MASS. The word MASS stands for Modern Army Supply System. Briefly, it is a means to try to supply high mortality rate repair parts for using units more rapidly than ever before by the fastest means of communication and transportation, while eliminating the needs for large stocks of items in our depot systems. But really I am getting ahead of myself here, and I would like to call on one who is much more qualified than I to tell you the story of Project MASS. I would like to introduce Mr. William Phillips of DCSLOG, Department of the Army, who will give you the story of MASS at this time.

Project MASS

Mr. PHILLIPS. Thank you, Colonel Edger. Gentlemen, it is a pleasure to be here this morning to talk very briefly to the members of the Packaging and Materials Handling Symposium about the new concept in military logistical support being tested in Project MASS.

Project MASS is the first step of a modern supply system to gear our supply system to hte demands of the commander of the highly mobile field Army of the atomic age. Specifically Project MASS is a 2-year test of the feasibility of reducing the repair parts stockage at an oversea field Army to fast-moving items only and supplying slow-moving items direct from zone of interior distribution depots.

Project MASS became operational in the Seventh Army in Europe in July 1956. Although the test will continue until July 1, 1958, its basic concepts have already proved so successful that the concepts are being integrated into the European theater supply system.

In developing a logistical system for supporting a modern Army we need a system which:

a. Provides a maximum of service with a minimum of stock.

b. Stocks only the essential fast-moving items overseas.

c. Maintains oversea stocks using normal transportation.

d. Insures that fast-moving items are available to the customer as needed.

e. Reduces order and shipping time to the minimum.

f. Supplies combat forces with items not stocked overseas by expedited means when the lack of such items is causing the deadline of equipment.

If we can develop a supply system to meet these objectives then our modern mechanized Army will have the logistical support required ot operate and maintain our increasingly complex military machine.

The MASS concept embodies a supply pipeline of small diameter, capable of great and variable velocity, controlled by demand. If items are taken out rapidly, replacements are put in rapidly and the overall velocity is increased. If there is little or no consumption of an item, there is no movement of that item in the pipeline. If a large number of customers are using an item, we put it in the pipeline in selected quantities and send these quantities to a depot overseas for issue to the customer. If there are only a few customers for an item we introduce the item into the pipeline tagged to bypass the depot and go directly to the customer. Further, instead of one big pipeline going to one central point, we are using a direct pipeline to each area of operation. It is obvious that this concept supplies an overseas army with what it needs without so much material buried in the pipeline. It is not only more economical but it provides more responsive supply support.

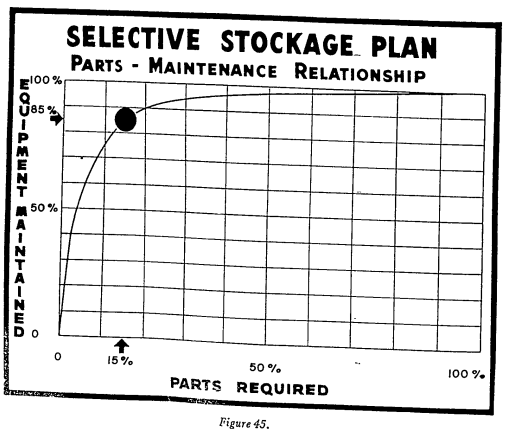


Figure 45.

Selective stockage (fig. 45) is but one of the four major elements of Project MASS. The other three being electrical communications, high speed data processing and rapid transfortation service.

The Selective Stockage Plan provides for the selection and stockage of fast-moving items forward and the slower-moving items to the rear. A relatively small number of repair parts (approx. 15 pct.) accomplish a very high maintenance return (approx. 85 pct.). To obtain a higher maintenance return requires a considerably wider range of repair parts at forward echelons. We cannot afford this, however, from the standpoint of economy and mobility. Therefore under the selective stockage plan selection is made of those small number of items which account for the largest volume of business and such items are stocked at each echelon of supply support. Except for items held on a "standby" basis, forward supply points will not stock slow-moving items.

The criteria being used to determine items stocked at each echelon is three demands in 180 days. Items may be added to or deleted from stockage based on changes in demand. Experience to date reveals that the number of items normally stocked at forward echelons will be reduced by over 50 percent by the application of selective stockage. Thus service will be substituted for stockage of slow-moving items.

Figure 46 illustrates the theory of the selective stockage plan. Each *using* organization will have available to it a list of every item it is authorized to retain in stock. The Direct Support Unit (most forward supply point) will also have an *Authorized Stockage List*. Stockage list items will be those which meet the criteria of three demands in 180 days in addition to a few items classified as "standby" items. Thus the *Direct Support Unit* will stock a full range of parts stocked by its supported using organization. The *Army Depot Authorized* Stockage List will contain all items stocked by its supported *Direct Support Units* plus items required for stockage to support other satellite units. The *Base (Distribution) Depot* will stock all items stocked at the *Army Depots* plus other items meeting the demand criteria and certain standby items. Stockage lists, therefore, are the basis for stockage at all supply echelons.

Under the MASS concept the distribution or base depot is located in the zone of interior, thus eliminating intermediate storage and handling in overseas communications zone depots. Consequently

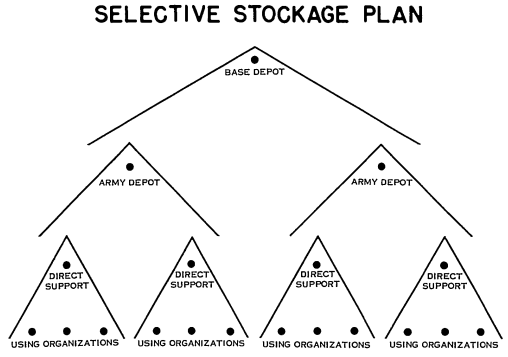


Figure 46.

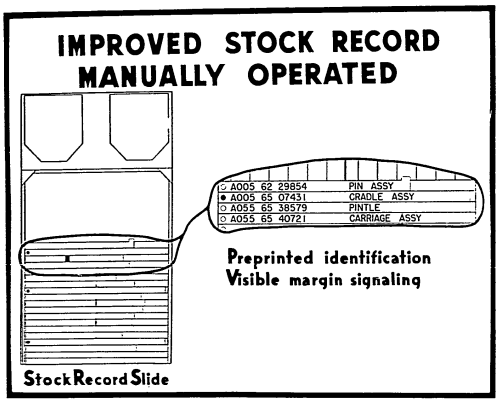


Figure 47. Improved Stock Recording

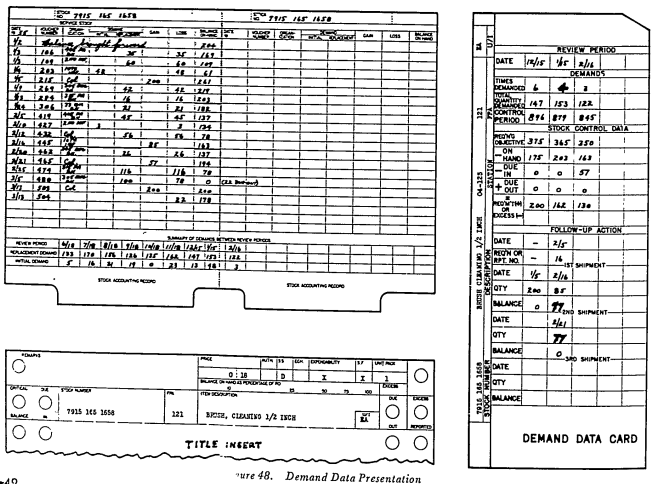


Figure 48. Demand Data Presentation

in the MASS concept resupply support is still provided by the next higher echelon but many intermediate supply echelons have been eliminated.

Improved stock records (fig. 47) for direct support units using visible files furnish supply personnel with an efficient, uniform, effective record easily operated and managed for controlling stocks to insure an efficient inventory of parts based on replacement demands for those items.

The use of actual demand data (fig. 48) (rather than past issue experience) is the basis for computing supply requirements. This is another departure from old supply concepts which based requirements on issue experience. The accumulation of "demand experience" will result in stockage of the item demanded.

Single line requisitioning (fig. 49) permits the requisioning of a single line item on a single requisition and avoids time lost at the various supply echelons for the consolidation of requirements.

The second major element of MASS is the utilization of electrical and electronic communications achieved through the use of data transceivers (fig. 50). This equipment will transmit and receive data in the form of punch cards from one point to any other point which is connected by either radio channels or land lines or any combination thereof. In MASS this equipment is utilized to transmit requisitions and other related supply data in punch-card form between all points in the supply chain starting at *Direct Support Units* as shown in figure 51 which are the forward supply points. The forward supply points in the Army are connected to the Army Inventory Control Center which is connected to the Army depot complex and to Overseas Supply Agency in New York. The Overseas Supply Agency is in turn connected to all Zone of Interior depots and transportation channels which are participating in Project MASS. A uniform format is utilized in MASS for the transmission of requirements and supply status between all technical services.

The third major element of MASS is the application of electrical and electronic data processing

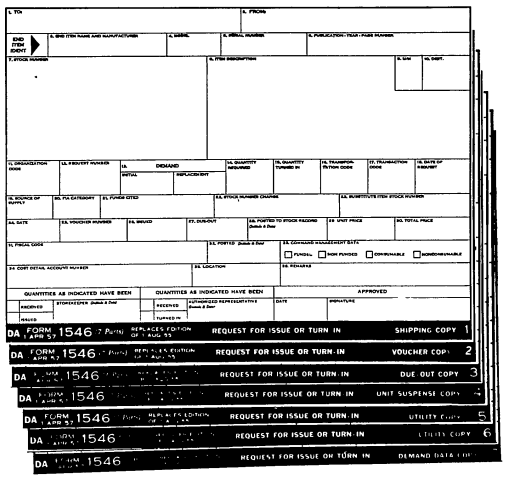


Figure 49. Single Line Requisitioning

DATA TRANSCEIVERS

MASS REQUISITION AND ADVICE CARD

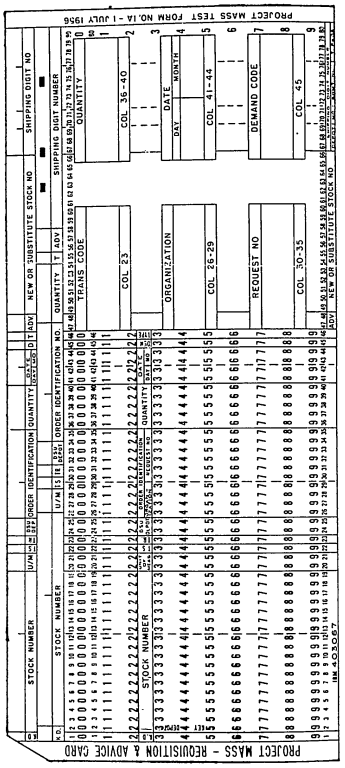


Figure 50.

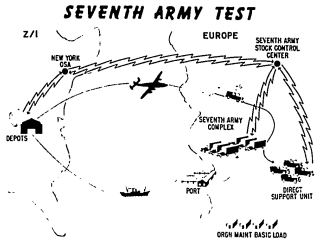


Figure 51.

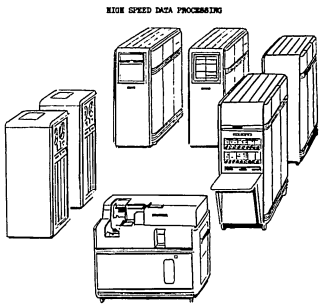


Figure 52.

(fig. 52). Conversion from electrical to electronic equipment is planned. Transceivers, the first step toward electronic conversion, provide the input in punched-card form. Conventional electrical accounting machines are presently used in the Seventh Army Stock Control Center, at the Oversea Supply Agency, New York, and at Zone of Interior depots. The electronic data processing machines will perform calculations in milliseconds and have memory units to retain repetitive data such as stock numbers, units of issue, substitutions and the like. This type of equipment will also record data on magnetic tapes to maintain current stock status records at an emergency alternate supply control point.

The fourth major element of MASS is the utilization of all modes of transportation (fig. 53) to

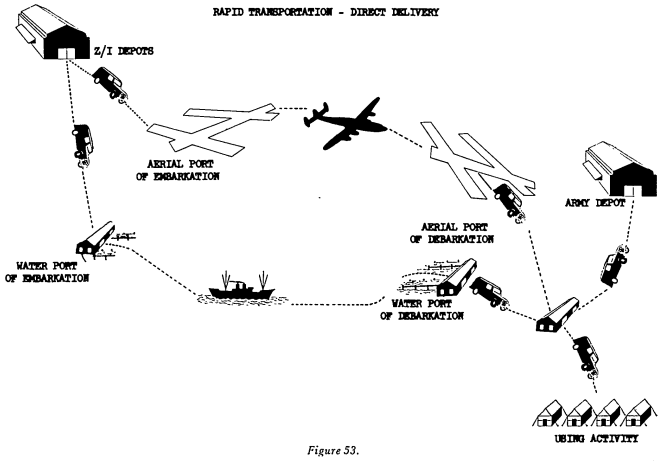
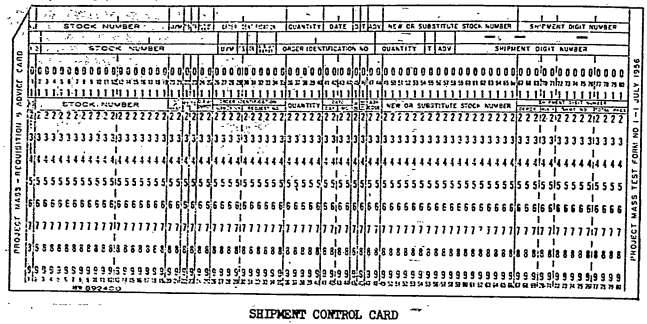


Figure 53.

ITEM CARD



SHIPMENT CONTROL CARD

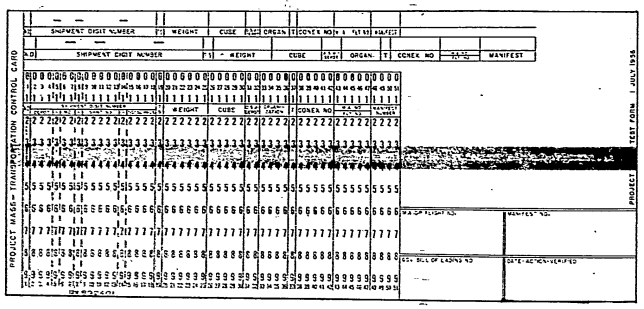


Figure 54. Streamlined Punched Card Cargo Documentation

achieve delivery of supplies within a period of time consistent with the urgency of the requirement. Normal surface transportation is utilized for replenishment of stocks and for the delivery of nonstocked item requirements which are not causing the deadline of equipment. Requirements which are causing the deadline of equipment are transported by air from the Zone of Interior to the oversea command.

Express truck movement of supplies is made from the oversea water or air terminal to a central transportation terminal. Supplies are delivered from this terminal to the destination on a daily basis. Replenishment stocks are delivered to the appropriate storage point. *Nonstocked items are delivered directly to the consuming activity without being channeled through any intermediate supply point.*

Another improvement in Project MASS is the use of a streamlined punched card cargo documentation (fig. 54). With this system a punch card replaces a raft of conventional shipping documents.

Simplified marking instructions (fig. 55) using only minimum essential data with a final destination code greatly simplifies marking and facilitates cargo handling.

The final element of Project MASS is greatly reduced order and shipping time. Normal shipments from the Zone of Interior to USAREUR requires 120 days order and shipping time with an additional 60 days from the USAREUR to Seventh Army. Under Project MASS replenishment of stocked items requires 30 days using normal surface transportation and 20 days for stockage items causing equipment deadline—using priority handling and transportation. The total order and shipping time for nonstockage items causing equipment deadline is 30 days, and 60 days if there is no deadline of equipment.

With the extension of the principles of Project MASS to other overseas commands, the Army will be able to provide the necessary supplies to our troops in the right quantity, at the right time and at the right place. This is the long-sought goal of logisticians and combat troops alike.

Colonel EDGER. Well, now we have seen about all of the aspects of packaging and materials-handling equipment that affect the combat soldier of the Army of today. To completely round out your knowledge on this subject I would like to give you an insight into the future. I know you have heard through your troop information and education program, and by reading periodicals and newspapers, about the fantastic claims that are made for special weapons, guided missiles, etc. It challenges the imagination and makes you feel as though you are living in an age with Buck Rogers, but the important point is that we *are* in this age and there is the ever present possibility that war may be fought utilizing the devastating effects of atomic weapons. So at this time let us take a look into perhaps a less romantic field than the subject of the guided missile in itself, but again let us see what it takes to get that missile into action. This is an extremely complex field in itself, but I would like to show you a few of the highlights of packaging and materials-handling equipment as applied to the guided-missiles field. I think it will open your eyes as to what can be done

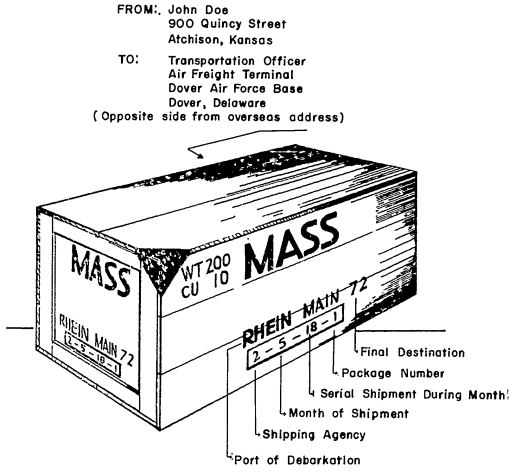


Figure 55. Simplified Marking Instructions

in the engineering field to adapt much of the conventional to a specialized area such as that of guided missiles. Lt. William H. Lentz, from our Ordnance Corps Guided Missile School, Redstone Arsenal, who has been closely associated with the handling systems used in guided missiles is present here today to give us the story on what we are doing in the field of missiles packaging and handling equipment. Again, please understand that we are in a big field and that therefore we have chosen a representative missile, the Corporal, about which to present the story, but before we start I would like to give you a visualization here on the screen of what we are talking about.

(At this point excerpts from the film on guided missiles were shown.)

1st Lt. William H. Lentz

Packaging and Materials Handling Equipment for Guided Missiles

1st Lt. WILLIAM H. LENTZ. The film you have just seen will serve, I hope, to give you a visual picture of the equipment we will be talking about for the next few minutes.

To give you an insight to some of the packaging and handling problems associated with guided missiles, I would first like to give you some information on the basic characteristics of the CORPORAL Missile System. Before doing so, however, I would like to say that each different type of missile system presents its own peculiar packaging and handling problems. The CORPORAL System is representative, only in that the missile is medium in size as compared to other missile systems. The CORPORAL is a Surface-to-Surface Ballistic Missile capable of delivering an atomic payload deep into enemy territory with a very high degree of accuracy. Unlike rockets, it is guided during flight. The guidance system accounts for its accuracy, but adds to the packaging and handling problem. There are over 5,000 soldered joints, and 140 vacuum tubes in the missile alone. Failure of any of these could cause the missile to fail to hit the target. The Missile propulsion system is a liquid, by-propellant, air pressure fed system. That is, the fuel and oxidizer are liquids and they are forced into the rocket engine by high pressure air rather than a pumping system. This adds new headaches to our handling problems, especially since the propellants used are hypergolic, (they ignite spontaneously when mixed together). The missile itself is 45 feet 4 inches long and has a body diameter of 30 inches. This, and the fact that the missile weighs over 11,000 pounds when it is fueled, has the warhead attached, and is pressurized, also adds to the handling problem. To further emphasize proper handling, I would like to say that unlike piloted aircraft, once a missile is fired, deficiencies in its guidance or propulsion system cannot be corrected in flight. The system, to be 100 percent reliable, must function 100 percent correctly. To help insure this, it is necessary to thoroughly check out each missile prior to firing. By this time I imagine that many of you are beginning to feel that we are faced with an impossible packaging and handling problem and an extremely complex missile system. As for the missile's complexity, I feel that I need only to remind you that television is also an extremely complex system, yet it is used every day and is now considered commonplace. The packaging and handling problems presented by the CORPORAL system have been met and successfully overcome. The missile system has been in the hands of troops for about 5 years.

The missile itself is packaged and shipped in three main sections. The nose section in one package, the stabilizers (which when attached to the missile body give the missile a tail fin arc diameter of 72 in.) in another, and the missile body in the largest of the containers. What are some of the considerations necessary for successfully packaging a missile body of this type? Well, first, it must be protected from shock. Shocks encountered in normal handling of packaged materiel could cause damage to the electronic systems, the missile structure, and its fuel, oxidizer, and air systems. Second, it must be protected from moisture. Moisture in the guidance systems could lead to fungus growth and corrosion, and moisture in the air system would freeze as high pressure air passed through the system thus causing regulators and valves to malfunction. Finally, the packaging should be such that the missile is protected from the time it is packaged, through unlimited storage, until the time it is ready to be checked out, fueled, pressurized, and fired. Early efforts to attain all of this, took the shape of a 4×4×40 foot reinforced plywood crate. The missile was suspended in the crate by rubber shock mounts at the forward end and near the aft end of the missile. It was wrapped in barrier material with a dessicant to absorb moisture. Shock recording devices were mounted on the missile. These served to tell us how much shock the missile had been subjected to, but did not offer protection. This packaging system was not satisfactory for several good reasons. The missile was extremely difficult to uncreate and to prepare for checkout. The container top (40×4 feet) was first removed. This alone took 6 to 10 man-hours to accomplish. A special sling arrangement had to be used to reach down into the crate, fasten to the missile and lift it out. After this had been done, it was necessary to remove the barrier material and place the missile in special rings and dollies so that it could be rotated, the fins attached, and the missile checked out. After checkout the missile had to be transported to the launching site with relatively no shock protection. To meet all of the requirements we have briefly discussed, a new missile body container was developed. This new container, as you saw in the movie, is metal and is reuseable (fig. 56). It can be easily handled in the field by standard Army 5-ton wreckers. Missiles packaged in this container can be stacked, as shown in figure 57, for storage and shipment. The missile is protected from shock by the container's unique system of supporting and suspending the missile. Cables, shown in figure 58, attached to torsion bars suspend the missile in the center of the container. So you see that not only new cars are using torsion bar suspension systems. Dessicant, placed in both the ends of the container, keeps the missile dry, and to further insure dryness and freedom from foreign matter, the container is pressurized to a low pressure with clean dry air. A gang receptacle on each end of the container as shown in figure 59 provides a quick and easy means of checking the condition of the missile during periods of storage, and for pressurizing and depressurizing the container. Built into the container is a set of rails. These rails aid in uncrating and crating. To uncrate the missile, the container is depressurized and the cap removed. A portable

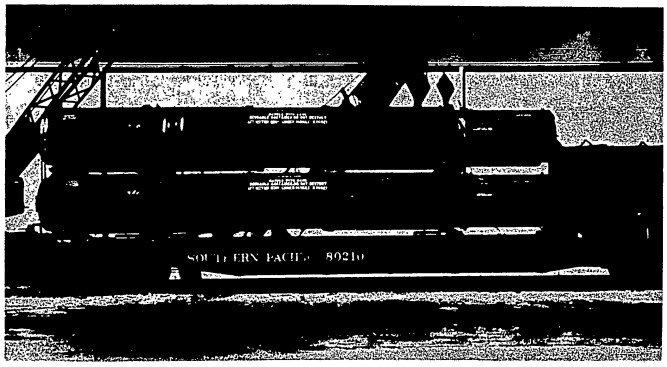


Figure 56. Container for U S. Army's CORPORAL Missile

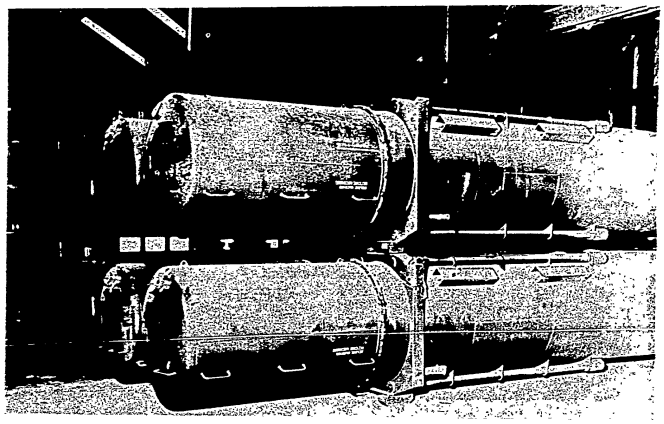


Figure 57. Stacking of CORPORAL Missiles

track is then alined with the container rails and bolted into place. Two access panels are removed from the forward end of the container and a screw jack with wheels is lowered so that the wheels make contact with the container rails (fig. 60). The forward suspension cables are then removed from the missile. A hydraulically operated carriage assembly as shown in figure 61 is placed under the aft end of the missile and the aft suspension cables are removed. The missile is then simply rolled out of the container on the track. Handling rings are placed around the missile and when the forward jack and carriage assembly are removed, the missile is ready (fig. 62) for the installation of the stabilizers and for checkout. After checkout the missile can be returned to the container with the stabilizers still attached. This is possible due to the size of the container cap which was removed. The missile body is again attached to the torsion bar cables and the front jack and the carriage assembly are re-

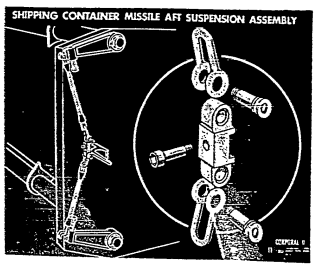


Figure 58.

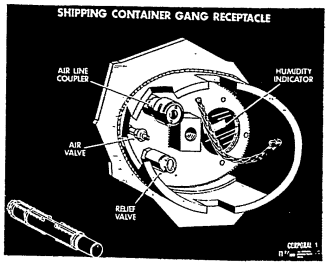


Figure 59.

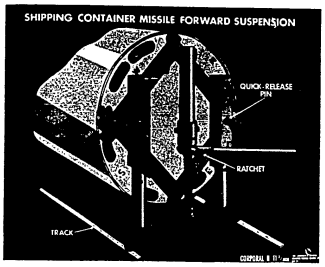


Figure 60.

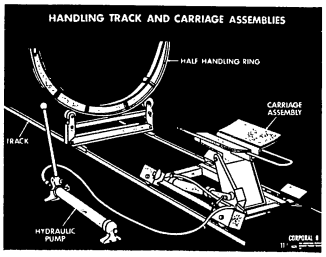


Figure 61.

moved. A fabric cover is placed over the aft end of the missile and stabilizers, and provides dust protection for that portion of the missile. The missile, thus protected from dirt and shock, can be loaded onto a flat bed truck and easily transported to the launching site. Here the process of uncrating the missile is repeated. With the missile on the track, it is in position to be picked up by the erector. The other two large containers used to ship the CORPORAL missile, the stabilizer container and the nose section container, have recently been redesigned with the realization of about a one-third saving in size of the containers. Both containers are reuseable and are made of plywood. A dessicant and barrier material (fig. 63) protect the stabilizers and nose section from moisture and dust. Figure 64 shows how moisture indicators provide a quick means of checking the condition of these items.

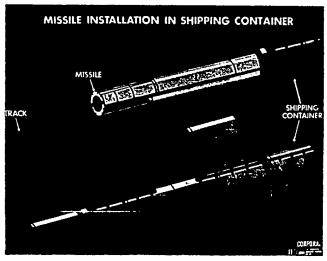


Figure 62.

Now I would like to briefly discuss some of the special purpose equipment needed to handle the missile. As was mentioned before, after the missile is checked out and transported to the launching site, it is again removed from the container and supported on the portable track. The next problem is to pick up the missile from this track, transport it to the fueling and warhead mating area, attach the warhead, fuel it, and finally transport the fully loaded missile to the launcher and erect it onto the launcher. To perform this job a special purpose vehicle, the erector, was designed. As the movie

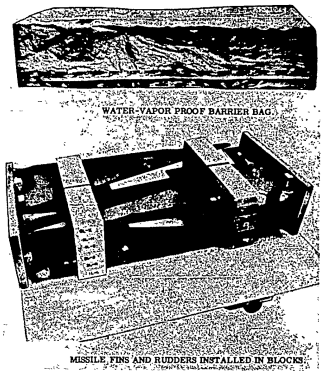


Figure 63.

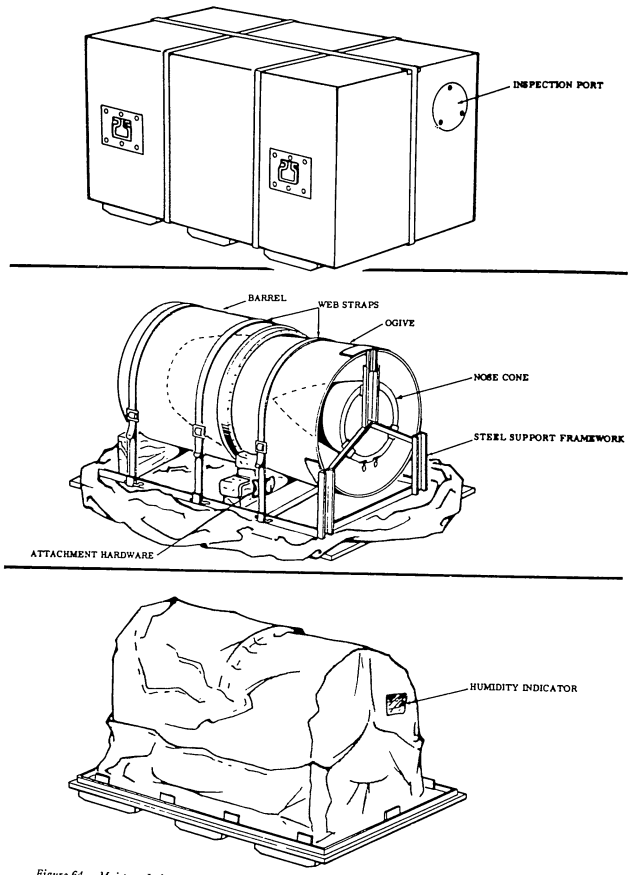


Figure 64. Moisture Indicators Assist Army in Checking Condition of Packaged Stabilizers & Nose Section

showed, the erector's rotary boom is capable of being moved through an arc of 180° to the rear. Two clamps are then lowered by cable and placed around the missile. The missile, held by the clamps, is then raised and hooked to the rotary boom. The boom is rotated 180° forward and the erector, with the missile in the carry position, is ready to move to the fueling area.

The erector weighs about 30 tons. It is electrically operated and controlled. Electrical power is provided by a gasoline engine which drives two generators, an AC and a DC generator. The DC generator supplies electrical power to each of 4 DC drive motors, one for each wheel. The AC generator provides electrical power to the accessory motors; the rotory boom motor, the hoist motor, blower motor, and two steering motors. One steering motor turns the front wheels, the second turns the rear wheels. Due to front and rear wheel steering the erector has a turning radius which is less than the length of the vehicle. Another unique feature of the vehicle, is the ability to operate it remotely. Through a remote control panel, consisting of various toggle switches, the operator can guide and position the erector so that he can aline the vehicle with the missile to pick it up from the track. He can operate the rotary boom and hoist assembly and can position the erector so that it is exactly alined with the launcher so that the missile can be erected for firing. The erector is an extremely powerful and versatile piece of handling equipment. It can travel at speeds from 35 miles per hour to only inches per minute. It can traverse terrain over which a standard Army 5-ton truck can be operated.

The other item of equipment which is basically new in design is the launcher. The film showed the launcher emplaced for firing. Figure 65 shows the launcher in a road travel condition. As you see,

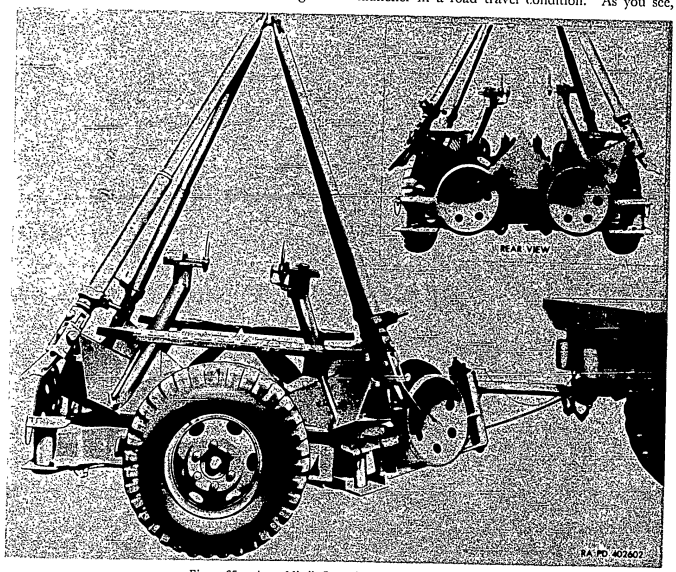


Figure 65. Army Missile Launcher for the CORPORAL

the launcher becomes a trailer when the outriggers are folded and the wheels attached. It takes only about 10 minutes to emplace the launcher.

As you saw in the film, most of the other vehicles used in the missile-handling operations are basically standard Army 5-ton trucks with the specialized equipment mounted on the chassis.

Missile Propellant handling is a study of its own. We will not attempt to go into it at this time other than to show equipment worn by the CORPORAL Propellant handlers in figures 66 and 67.

In closing I would like to re-emphasize that the handling and packaging requirements of any missile system will differ as to the size of the system, the propellants used, and the protection and mobility required. There is no problem in the packaging and handling of guided missiles which cannot be solved with resourcefulness and ingenuity so that we can provide the combat arms with safe, reliable, easy-to-handle, weapons systems.

Colonel EDGER. Well, Marks, I hope that you have profited by this presentation this afternoon, and I hope that you do not feel that you have been cheated out of your training that you would have received in a practiced forced march. I sincerely feel that you combat soldiers must know more of the Services' side of things than you do. It is the only way in which you can intelligently realize what we are up against when you ask us to do things for you.

Private MARKS. I certainly have had my eyes opened today, and even if I draw a week's extra duty for becoming lost from my outfit I think it will be worth it in terms of what I have learned and what you service personnel are doing.

Colonel EDGER. Well, I will intercede for you with your Commander, so don't worry about your being here, and I wish to thank you for being an attentive listener. Thanks to you members of the panel for giving us your side of this picture. This concludes the presentation of the Army panel for the symposium.

Lieutenant Colonel MIRRAS. Thank you, Colonel Edger, and members of the Army panel for a most informative and interesting presentation.

Ladies and gentlemen, please check the call board in the lobby. There are some personal messages on it. It is now 3:20. Let's take a 15-minute recess. Coffee is being served in the lobby. Please be back in your seats at 25 minutes of 4. Thank you.

(Whereupon a 15-minute recess was taken.)

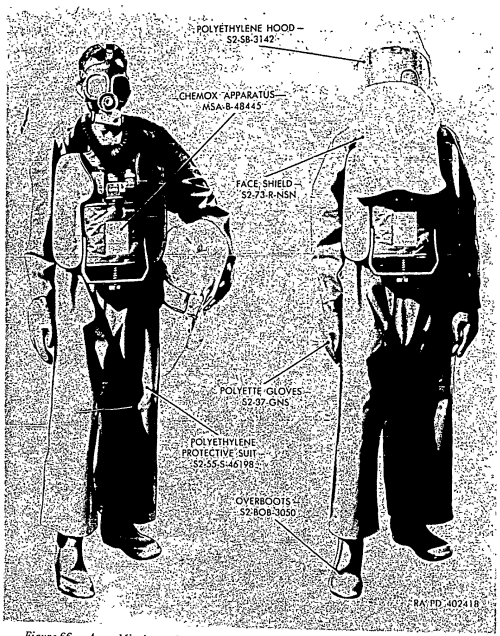


Figure 66. Army Missilemen Wear Protective Clothing When Handling Missile Propellant

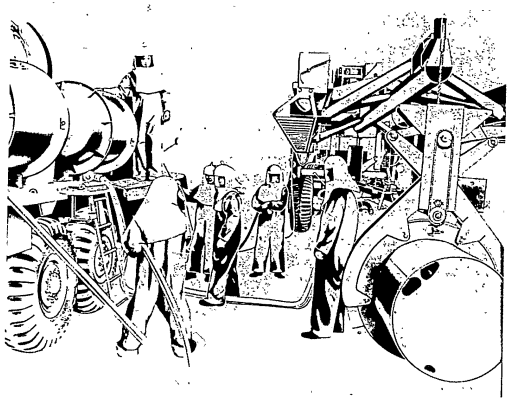


Figure 67. Army's CORPORAL Being Readied

SECTION 2, INDUSTRY PACKAGING PANEL

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SECTION 2, INDUSTRY PACKAGING PANEL

Lieutenant Colonel MIRRAS. Gentleman, it is now my pleasure to introduce the Industrial Packaging Panel under the chairmanship of Mr. John D. Farrington, Jr. Mr. Farrington was born in 1920. He is a graduate of Princeton University. He was

MR. JOHN D. FARRINGTON, JR.

Packaging Engineer for Marshall Field Corporation for 5 years. During the Korean War, he served at the Rossford Ordnance Depot as Assistant Officer in Charge of the Joint Military Packaging School. At the present time, Mr. Farrington is Packaging Engineer and Advertising Manager for the Jiffy Manufacturing Co. He is also chairman of the Packaging and Advisory Committee of the NSIA, Director of the Eastern Division of the Society of Industrial Packaging Materiels-Handling Engineers, and is on the Forum Committee of the Packaging Institute. Mr. Farrington.

Packaging

Mr. JOHN D. FARRINGTON, JR. Thank you, Colonel Mirras. Good afternoon, ladies and gentlemen. We were to have two additional members on our panel here who unfortunately were grounded by bad weather. One was Mr. Walter O'Malley, who was going to speak on packaging for trans-continental shipment of baseball teams. He couldn't show up today. Then we also had a man who was going to talk on consolidating containers and integrating unit loads. That was Governor Faubus He could not come either. Needless to say, we in industry most enthusiastically welcome the opportunity of exchanging information with our Government counterparts. It is really unnecessary to say that such a procedure cannot be beneficial to both sides and serve as greater identity of thinking and action. "A good field message is clear, concise, and complete." Thus we were taught in the Tank Destroyer School in 1942. "There is nothing new under the sun." Thus spoke the cynic from time immemorial. We in packaging gratefully accept this challenge. We shall now prove in five talks of no more than 8 minutes each that in packaging there is always something new. Our first speaker is Mr. Al Hoffman who is Quality Control Manager of the Fibre Drum Corrugated Box Division, Robert Gair Paper Products Group, Continental Can Co. A graduate of Columbia University, he was with Container Laboratories, Inc., for more than 18 years in various technical and managerial capacities before he joined Robert Gair in 1954. He is a member of the Packaging Institute, Society of Industrial Packaging Materials Engineers, TAFFI, NSIA, and several other associations. He has lectured on packaging at New York University for the past 10 years. It is a pleasure to present Mr. Al Hoffman who will speak on new developments in paper, paperboard, and containers. Mr. Hoffman:

Mr. Alfred W. Hoffman

Paper and Paperboard Containers

Mr. ALFRED W. HOFFMAN. Three types of shipping containers will be discussed within the framework of the subject multiwall paper shipping sacks, corrugated fibreboard boxes, and fibre drums. A feature common to all three in today's and tomorrow's developments is the increasing amalgamation of the basic paper or paperboard with other media to provide, economically, performance properties which greatly expand the field of use.

With respect to multiwall bags, the current period is one of intensive research and experimentation devoted to the achievement or improvement of special properties such as insect and rodent repellency, greaseproofness, strippability, fungusproofness, water vapor resistance, acid resistance, water repellency, wet strength, and flexible coatings through wax additives. Let us consider two of the items.

Grease resistance—associated with items represented by wax, shredded coconut, fish meal, launching grease and sweeping compound—is currently obtained through the inclusion of individual sheets of glassine and parchment. Lamination of parchment and greaseproof papers to the natural kraft for greater structural strength is being tested the greatest promise is shown by glassine wax—laminated to the kraft. Other treatments under experimentation include Minnesota Mining and Manufacturing's Scotch-Gard for kraft and Du Pon't Quilon for parchment and glassine; these have the additional virtue of preventing grease crawl or wicking.

Asphalt, rubber, joint sealing compounds, and toxaphene are examples of materials which require easy strippability from the walls of bags. Special coated papers are being tried as liners to prevent the adherence of these materials; the new sheets include a clay-coated base with an overcoat of polyethylene, silicone-treated glassine and parchment.

Multi-wall bags constructed with polyethylene-coated, special clay-coated release sheets, and others of this type are now being produced with heat-sealed seams replacing the latex type adhesives generally used. Efficiency is greatly increased since a much tighter bond is provided with greater resistance to damage from the product packaged.

Proceeding now to corrugated fibreboard, it will be recalled that the trade publications a year ago gave prominence to a packaging development involving the substitution of polyethylene bags in corrugated fibreboard boxes for returnable containers such as metal cans. At that time the new packaging combination was utilized primarily for milk, ice cream mix and similar dairy products.

In the interim, this new development has mushroomed and it is difficult to predict accurately the vast range of products for which it will ultimately be employed. Shipments in poly bags in corrugated boxes have been made of such diverse items as flavoring syrups, cherries, strawberries, blueberries, shortening, ice cubes, putty, and mastics. Experimental work is proceeding with items such as hard candy, ravioli, pulverized seaweed, salad dressing and mayonnaise, frozen eggs, peas, lima beans and carrots.

The basic advantages includes reduction of costly storage space, greater ease of handling because of lighter weight, and the elimination of the expense and trouble necessitated by deposits, bookkeeping, return transportation, cleaning, and repairing of the expensive returnable containers.

Although the specific packaging requirements must be carefully analyzed for each new product, the industry has been able to frame fundamental specifications. These are not inflexible but serve as a point of departure for such modifications as may be necessary. Broad recommendations as to type of plastic bag, film thickness, dimensions, and closing have been set up. Similarly, recommendations as to the grade of corrugated box, style, shape, interior packing, flute direction, and manufacturer's joint have been established.

Occasionally, special features are incorporated into the corrugated container to facilitate one or more of the operations involved in the use of this packaging combination. To make filling easier, a patented construction has been used which leaves two diagonally opposite slots incomplete; i. e., not running to the edge of the flaps. The flaps can either be folded back when the box is set up and held in a downward position or maintained in a rigid upright position. Furthermore, an easy-opening device is occasionally utilized.

Another extension in the field of use of corrugated containers is evidenced by a proposed Specification 12A in the Interstate Commerce Commission's Regulations for the Transportation of Explosives and Other Dangerous Articles. If adopted, this would permit the shipment of such items as corrosive battery fluid, hydrobromic acid, hydrochloric acid, sulfuric acid, and formic acid in glass bottles in corrugated fiberboard boxes.

Construction specifications are provided for the corrugated fiberboard containers but not for the glass bottles or inside cussioning. However, the completed package must satisfactorily withstand a prescribed series of tests involving drops from a height of 4 feet.

Two of the newer advances in fibre drums are on exhibit in the Fibre Drum Manufacturer's Association Booth Number 23. One of these utilizes an eduction probe consisting of one tube inside another which is introduced through the bung in a modified metal cover. This permits extraction of the contents without removing the locking band or cover. This development is most advantages for the dyes utilized for gasoline and other petroleum products. Dusting is eliminated, clean-up time is saved, damage to workers' clothing is reduced and a rapid transfer of dye from the drum to the production system is established. Also in connection with dyes, a new dust control procedure has been adopted to eliminate cleaning the exterior of the dye drums with solvents causing discoloration. An outer kraft jacket secured with tape at the drum factory remains on the drum during successive handling and filling operations at the dye plant. It is removed from the filled drums at time of loading into cars or trucks.

Vacuum filling has greatly enhanced space saving in the packaging of powders. Materials such as nitroguanadine—a very explosive, light and fluffy commodity—can now be packaged in 18-gallon drums whereas otherwise 38-gallon containers would be necessary.

Three other recent improvements relate to increased water vapor resistance, exterior water resistance and the successful packaging of liquid and semiliquid products.

Organic films such as polyethylene do not possess a low enough water vapor permeability rate and, therefore, aluminum foil is used as the vapor barrier. Although silica gel and similar hygroscopic products have been successfully packaged in an aluminum foil barrier drum for a number of years, a recent improvement in assembly and construction of the bottom chime has resulted in an improvement of 40 percent in the MVT of the drum. Further work along these lines has produced specially constructed drums having a water vapor transmission rate of less than one-quarter of the maximum figure of 0.075-gram per 100 square inches per 24 hours at a temperature of 100° F. and a relative humidity of 75 percent stipulated in a new military specification covering packaging of desiccants in fibre drums.

For exterior water protection, in addition to utilizing water resistant adhesive, it is now possible to construct the outer ply of the drum from a special barrier in which wet strength kraft is laminated to regular kraft with polyethylene. Obviously the polyethylene serves as the outer water barrier, protected from damage by a heavy ply of wet strength kraft.

At the present time, fibre drums for shipping liquids have created the greatest interest, particularly for shipping products that are corrosive to steel—such as emulsions, brined fruits, vegetables and meats, vat dyes, wetting agents, liquid detergents, phosphoric acid, etc. Two basic types are generally in use, one in which a plastic film bag or liner (normally polyethylene) is inserted within a strengthened fibre drum and the other with a liquid-tight lining integrally constructed into the drum. This latter type is now being used by the military for shipping Aluminum Brightener, which consists essentially of phosphoric acid.

Mr. FARRINGTON. Thank you, Mr. Hoffman. Our second speaker is Mr. Lawrence F. McKay. He is executive vice president of the Ohio Corrugating Co. in charge of operations and sales. He was educated and trained as an industrial engineer. He has worked for several steel fabricating companies including the Container Division of Jones & Hoffman Steel Corp. where he was operating vice president. He is currently vice president of the Steel Shipping Container Institute, Inc., and co-chairman of its Technical Advisory Committee. He has also

Mr. Lawrence F. McKay

served on the Petroleum Packaging Committee of the Packaging Institute and on the Chemical Packaging Committee of the Manufacturing Chemists Association. It is my sincere pleasure to introduce to you Mr. McKay who will speak on what is new in metal drums and containers.

The Steel Shipping Container

Mr. LAWRENCE F. McKAY. Gentlemen. It is a pleasure to be here and I appreciate the opportunity to talk with you about steel shipping containers.

Much has been accomplished in the last few years which should prove of great value to the military. Of prime consequence has been the development of standards by the Steel Shipping Container Institute, Inc. as to types, sizes, and gages in cooperation with the military through the Standards Division of the Office of the Assistant Secretary of Defense for Logistics and Supply coordinated with the General Services Administration, the Containers and Packaging Division of the Department of Commerce, and the principal consuming industries such as the Manufacturing Chemists Association and the Petroleum Packaging Committee of the Packaging Institute, Inc., National Paint, Varnish and Lacquer Association, and the Institute of Shortening and Edible Oils.

This has also been related to work with several branches of the Armed Forces such as the Navy, Air Force, Ordnance, Chemical Warfare, etc. The Coast Guard has also shown interest.

The standards mentioned are soon to be published by the American Standards Association as American Standards. It is of interest that these same standards have been converted to the metric system and adopted by more than a dozen foreign countries to the point that the great bulk of commonly used sizes of steel drums and pails may now soon be universally available on a world-wide basis—and further work is being done by the petroleum packaging people to enhance this. To the petroleum people goes the full credit for this accomplishment.

These new standards are soon to be reflected in the reissue of several Federal Specifications such as PPP–D–729, PPP–D–704 and 705, and PPP–D–711. Container specifications especially used by Ordnance and the Air Force covered by Mil–C–6054A are under review in the hope that they can be brought in line with these widely used standards.

A program as to exterior finishes to prolong field life is also under way with the Navy facility at Bayonne, N. J., in relation to Military Standard–290.

Of further significant interest to the military should be the extensive program the Steel Shipping Container Institute, Inc., has under consideration toward the evaluation of the design of drums and pails as it relates to the service life of such and by this is meant—what we can do as an industry to improve the design of steel containers to provide for a greater useful life in the field. This program involves not only extensive basic research but a considerable amount of field work and evaluation. This, too, would be coordinated with the military through the Quartermaster Research and Development Command at Natick, Mass.

Cooperating in such a program would be the Chemical Packaging Committee of the Manufacturing Chemists Association and the Petroleum Packaging Committee of Packaging Institute, Inc., through their subcommittee on Metal Drums and Pails and their Government-Industry Subcommittee on Petroleum Packaging in their work with the Military Petroleum Supply Agency. The Bureau of Explosives would also cooperate on behalf of the Interstate Commerce Commission and American Association of Railroads.

A group of specialized engineers representative of the major manufacturers of steel containers is also studying the design of containers looking toward greater safety in shipping and this is independent of the research program mentioned earlier which will probably be carried out by a private research organization such as Battelle Memorial Institute at Columbus, Ohio.

At this point it would be well to mention that the Steel Shipping Container Institute, Inc., would welcome any suggestion or ideas the military might care to put forth. Contact should be made through Livingston Keplinger, president, at 600 Fifth Avenue, New York 20, N. Y.

I would be negligent if I didn't also remind you that research and development work is continuing in the matter of organic linings for steel containers permitting the shipment of many corrosive materials and other chemicals not previously possible to ship in steel. Many new linings are now available.

In this same field much has been done to improve the life of the finish of exterior coatings employed commercially and for the military. This program, too, envolves basic research.

Because of the time limitation I have restricted myself to generalities and avoided details. If I have overlooked any subject that would interest you or mentioning any of the many cooperating groups, I hope I will be forgiven.

Overall then, what does this program mean to the military? They could be enumerated thus:

1. A uniform and standard size package for all purposes in the field.
2. Simplication of storage, handling, palletizing, and shipping problems.
3. Greater availability in the event of an emergency—and on what we hope to be a world-wide basis.
4. Greater service life hence minimizing field requirements of storage, dumping, refilling, replacing containers, rehandling and all that goes with it.
5. Better retention of markings and other identification.
6. In the aggregate a more economical means of storage and transportation.

It has been a privilege to be here and may I wish you all God-speed. Thank you.

Mr. JOHN D. FARRINGTON, JR. Thank you, Mr. McKay. The third speaker had me a little worried this afternoon. As a matter of fact he didn't show up until about an hour ago. The third speaker is Mr. Mike Williams who will deliver a paper written by Mr. John M. Cowan, managing director of the National Flexible Packaging Association. Mike is a past president of the NFPA and president of Cadillac Products, Inc. He is an active member of the Packaging Advisory Committee, National Security Industrial Association. It is with great pride that I introduce to you my good friend, Mr. Mike Williams, who will speak on new developments in the flexible packaging field.

Mr. Mike Williams

Flexible Packaging Barriers

Mr. MIKE WILLIAMS. Flexible barrier materials cover such an array of products and possible combinations that only a few basic principles can be discussed in the brief time allotted. First a definition is in order to spell out what is generally meant by a flexible barrier material. The best definition I know of is this: A flexible barrier is a continuous packaging material which tends to conform to the shape of its contents. It may be homogeneous or a combination of two or more materials. This rules out squeeze bottles which spring back after pressure is removed. It also removes from consideration all rigid materials such as metals, plastics and boxboard and fibre.

It retains in the family all of that enormous group of papers, thin plastic films, metal foils, and combinations thereof. Textiles could also be included, though for discussion purposes, we would limit textiles to their use in laminated and coated structures.

The history of flexible barriers is long indeed. In fact, it seems likely that the flexible skins of animals were the first packages for military men, antedating pottery as containers and far more suitable and efficient for roving bands of fighters than the heavy and breakable earthenware of those early days.

We will move on quickly to modern times, to World War II and Korea though many of the problems and solutions of those recent times have already become dated because of new scientific developments in logistics, in strategy, in fire power, and in packaging. However, though revolutionary changes are taking place, that old military axiom of "getting there fastest with the mostest" is as true today as when it was first promulgated and light weight, compact packaging obviously contributes to that desired end.

The development and production of concentrated emergency and field rations reached new peaks during this recent period. Various flexible packaging materials were employed including laminated and coated aluminum foils, polyethylene by itself or coated on paper, wax combined cellophane, glassine and waxed paper, coated kraft etc. to preserve palatability, sanitation, and nutritional values.

Many of you men are alive and healthy today because of this development and the work continues in an effort to provide more palatable and more nourishing and even more condensed food elements not only for military personnel but for civilians as well when war-time emergencies cut off normal food sources or contaminate existing stocks. This is only one of the many areas in which these versatile materials have played a major role.

Flexible barriers especially fit into a war of movement, of air transportation, of shipment for great distances because they can be engineered to provide any degree of protection required with a minimum of bulk and weight. Flexible barriers might be thought of as the skin of a package with rigid materials, lumber, boxboard or metal providing the skeleton where needed. They are versatile and cooperative. They may appear inside or outside. They may be used alone or in conjunction with other materials to provide useful new properties.

For instance polyethylene bag liners inside metal or fibre drums or shipping cases prevent contamination, provide sanitation, avoid deterioration while they permit handling liquid and solid foods and chemicals in a wide variety of shipping containers which otherwise, might not be suitable for the purpose. Pourable spouts may be incorporated in the liner design. A variety of flexible barriers may also be used as laminates in lining fibre drums and cartons. We recognize that many factors are involved in deciding the packaging requirements. Among them are the following:

1. Level of protection afforded.
   Flexible barriers run the whole gamut of protection from paper bands or wraps on toilet tissue to almost completely impervious barriers such as the MIL–B–131C type made of a lamination of aluminum foil and cloth and plastic films and widely used for long term storage of metal parts and assemblies. There are many intermediate types permitting a wide range of choice of performance and cost for any package. As a safety factor or to counteract and nullify slow moisture pick-up, desiccants may be employed.
2. Permanence of protection.
   Work is still going on to determine the permanence of protection afforded by various packaging materials. Accelerated aging tests, though a necessary device, do not give all of the answers. While generally not much information has been released to civilian channels on field performance, it is apparent that flexible barriers have stood up remarkably well and they are constantly undergoing improvement under increasingly demanding specifications. We understand that when the Korea action started, we were seriously short of field equipment but, stored in caves and warehouses in Japan, was a huge supply of parts which had been protectively packaged in 1944 or 1945, perhaps earlier. The fact that much of this stock was in good condition and ready for prompt use was, no doubt, an important factor in helping us maintain our foothold in Korea.
3. Ease and economy in applying the proper packaging technique to achieve the required level of protection.
   In case of emergency ration components like coffee, soups, sugar, dehydrated drink powders, etc. it would be hard to imagine a more efficient packaging technique. Fully automatic machines form the packages from rolls of laminated and coated aluminum foil or coated or combined paper, deposit a metered amount of material inside, then complete and seal and deliver the package. The protection record for emergency rations established during World War II was outstanding. Somewhat similar techniques to those described for packaging rations are possible for nuts, bolts, screws, fasteners, watch parts, surgical instruments, etc., using several different types of heat-sealing barrier materials.
   At the same time, if small quantities of a container are required, they can be economically produced. On need not order huge quantities to achieve a reasonable cost. Nor need one anticipate one's requirements many months ahead of time. Any size barrier can be fabricated with heat sealing equipment by combining strips of material. Many depots are set up for this operation and there are well equipped fabricators of flexible barriers in every large use area within the United States.
4. Comparative procurement cost of packaging materials involved, including labor factor.
   Flexible barriers are tailored to the protection requirements. A gasket doesn't normally require the protection of a precision part. An adequate, but much less expensive type of flexible barrier can be employed. Different barrier types vary widely both in their cost and their performance. In general, it can be stated that they are less expensive than alternative methods giving equivalent protection. The dominant role played by flexible barriers in the last 15 years is evidence of their overall economy. First cost of the packaging components is not the only criterion. The weight and the shipping and handling costs are equally vital.
   A comparison of prices of converted flexible barriers for the past 5 years indicates that prices today average little more, and in some cases less, than they were in 1952. In the same period of time, other packaging materials have risen in price from 10 to 60 percent according to Department of Labor statistics.
   To be specific, between 1952 and 1956 prices of bleached Manila Lined Chip Board rose 61 percent, number 2 sanitary tin-plated cans were up 20.3 percent; metal containers were up 16 percent, boxes and shipping containers were up 10.3 percent.
   In comparison, most flexible barriers showed very nominal increases, though undergoing specification changes during the period, which tightened requirements materially.
   During this same 5-year period, printed cellophane declined about 6½ percent and polyethylene bags dropped about 42 percent due in part to sharp reductions in polyethylene flake prices.
   Whatever happens to national price trends, keen competition and wide availability of facilities would seem to insure excellent values for all types of flexible barriers.
5. Comparative tare weight and cube.
   In this category, flexible barriers are unquestioned leaders. Since the flexible barrier conforms generally with the shape of its contents, its cube is reduced to a minimum. It leaves no expensive and wasteful air spaces which take up needless shipping and storage space.

The weight of the flexible barriers is almost negligible. This combination of properties creates spectacular advantages. It was once stated that a C–47 plane could carry eight jet engines on skids, protectively packaged in flexible barriers, but only three in fabricated steel containers. Though the transport planes used may be different now as well as the size and type of jet engines, we would expect that relationship to still hold.

With air freight rates to Japan in the neighborhood of $2 per pound, savings can be fantastic.

We have read recently, with great interest, of the "Strip-Down" procedure for overseas Air Freight shipments being conducted at the Travis Air Force Base. This consists of removing shipping containers from any small items going to a single destination and consolidating them in lightweight footlocker type of containers; secondly, in removing heavy solid cases from larger assemblies such as wing sections. The object of course is to reduce bulk and weight. In some cases, weight savings of 40 percent or more and bulk savings of ⅔ have been accomplished. According to Col. Robert L. Mason, stripping down to bare essentials has resulted in a total additional capacity of 2,000 pounds per day on planes departing for Pacific overseas installations.

This brilliant improvision certainly makes sense and must result in major savings. Such savings could be even greater if more of the original packing and packaging was designed with this operation in mind and with lightweight inner packs bearing all markings and identification normally shown on the outside case and only a shipping label required after removal of the outside pack. Logically then, the outer case could be stenciled: For Air Shipment Overseas Outer Case May Be Removed.

We offer these suggestions with no pride of authorship but fully convinced that right now, some of you gentlemen are working vigorously in this direction.

6. Comparative ease or difficulty in unpackaging.

   On this score, flexible barriers must always rate very highly. Access to the packaged part requires only opening the outside crate or case and cutting the barrier. No special tools are required. Availability is immediate.

7. Relative availability in emergency.

   There is enormous civilian demand for the papers, plastic films, aluminum foil and textiles which are adaptable for military packaging uses. The packaging film industry alone has grown over 50 percent in the last 5 years, and will touch a billion pounds in 1961. Aluminum foils, and papers of all types have shot up nearly as rapidly. Flexible barriers are a multi-billion dollar industry with manufacturers and converters widely distributed across the map.

In addition to qualifying under each of the stated criteria, flexible barriers have another unique advantage. This is storage compactness. If in bag or pouch form, they are delivered flat with inner surfaces in contact requiring only a minimum of storage space. In roll form, similar space economies occur. In either case, with air excluded, inner surface contamination is avoided and cleaning of the packaging material is unnecessary. What compact storage can mean may be shown by a simple example. A pouch made of a flexible barrier, size 18 inches by 24 inches, would open up to dimensions of 10 inches × 8 inches × 12 inches or 760 cubic inches. A rigid container of these finished dimensions would require this space full or empty. The space required for 10 rigid containers would accommodate about 1,000 empty pouches of the same capacity, a 100 to 1 ratio. Every factor of storage, handling and freight is affected by this substantial advantage.

What the future holds, we do not know. Recently man achieved a new height of 17 miles into the stratosphere, supported by a balloon made of a flexible plastic barrier. We read too of inflatable structures and of hutments and buildings made of such materials.

In packaging, new developments are coming thick and fast. Antioxidant coatings may be applied which slow down oxidation of fat-bearing foods. Some types of nonfogging films are now in commercial production. New, much stronger types are now available.

Several types of high temperature flexible packages are in commercial use which permit sterilization in a package or the cooking of foods right in the package either in the oven or in boiling water.

What was impossible 5 years ago is now standard practice. Much that is impossible now is probable tomorrow. Whatever your problem or your dream, challenge the inventive and versatile flexible packaging industry. It will be happy to work with you. It will keep pace with your needs by ever thinking flexibly.

Mr. Cecil D. Young

Mr. JOHN D. FARRINGTON, JR. Thank you, Mike. Our next speaker has been connected with packaging and transportation for the past 20 years. During World War II he had charge of the military packaging of vehicles and spare parts for the Trailmobile Co. For the past 9 years he has supervised the design and specifications of spare parts packaging for the Aircraft Gas Turbine Department of the General Electric Co. in Evandale, Ohio. He is concerned currently with the advanced package design and development. He is chairman of the Defense Products Packaging Group of the General Electric Packaging Council and has been very active in the organization of the Ohio Valley Packaging Association, of which he was president in 1956. Our speaker will speak on a subject that we really don't need around here today, but nevertheless it is on humidity indicators. Mr. Cecil D. Young, of General Electric:

Humidity Indicators

Mr. CECIL D. YOUNG. Within the past 15 years we have experienced an extended growth of dehydrated packaging or controlled relative humidity in packaging and fortunately during this period we have experienced excellent progress in development of indicators to meet the demanding needs of the packaging industry.

You have seen and used the crystal type or envelope style and have readily accepted the blotter-type indicator card developed just a few years ago.

These card-type indicators or elements offered many advantages in that activation would take place in a relatively short period of time over the crystal type, but still required opening the container to determine a safe package, unless the container or barrier was equipped with a window for visual inspection.

As early as 1954, we at General Electric Evendale Plant recognized the need for exterior indicators and proposed to Qualify Control of AMC and also to WADC several applications of exterior indicators and we believe that these proposals prompted the development of some of the exterior indicators used today.

The indicators now available under MIL–I–26860 are certainly the best offered the packaging industry thus far and both military and industry should be complimented for these developments.

Under the specification there are principally two types of indicators—

Type I—for mounting in the threaded boss or flange.

Type II—for mounting with self-locking device and in Flexible barriers.

The Type I indicator plugs in figure 68 are made of brass zinc-plated, 1 inch across hexagon face, ½-inch face thickness, 1 inch overall length, threaded 18-mm; indicator element calibrated for 40 percent relative humidity ±5 percent, designed for internal pressure up to 20 pounds per square inch gage and equipped with gasket for mounting.

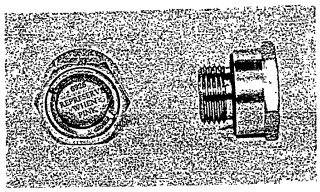

Figure 68. Type I Humidity Indicator Plugs

This indicator is generally used on aircraft engines shipping containers, missile cases, etc., and as a replacement for AN-4062 crystal type indicator plug. Figure 69 illustrates the type I indicator mounted into the port hole of an engine container.

There are actually two styles of type II indicator plugs. One style plug (fig. 70) is made of anodized aluminum—Size 1⅜ across hexagon face, ⅛-inch face thickness, ¾-inch overall length, with ¾-inch standard straight pipe threads. This indicator is designed so that the gaskets fit into a recess in the plug and in the locknut, to retain gasket compression, thus effecting a leak-proof seal. The plug and locknuts have rounded corners to eliminate the possibility of puncture on installing to the barrier. The weight is less than 1 ounce. The indicator element is calibrated for 40 percent relative humidity ±5 percent or, as specifically shown, and will withstand pressure up to 20 pounds per square inch gage.

Another style, Type II indicator plug is practically the same (fig. 71) except made of zinc-plated brass. A flat zinc-plated brass washer and nut are used if application is other than mounted into threaded flange or boss in a container.

Both styles of indicator plugs are easily installed into flexible barriers or rigid containers using simple hand tools.

The indicator element itself consists of cobalt chemical solutions impregnated into special blotting

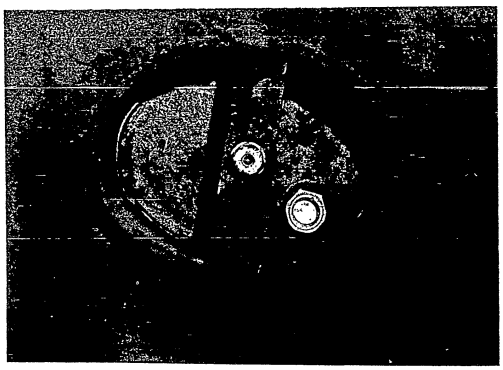

Figure 69 Type I Plug Mounted in Engine Container

Figure 70. Anodized Aluminum Type II Humidity Indicator Plug

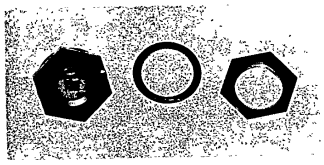

Figure 71. Zinc-Plated Brass Type II Plug

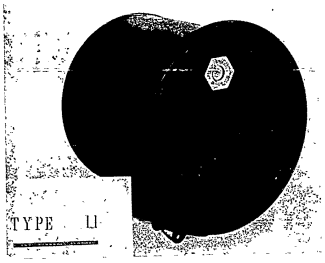

Figure 72. Type II Indicator Mounted on AN 8209 Drum

paper, and it is possible to vary the solutions so that the spots will cover a wide range of humidities from as low as 8 percent up to 75 percent and will react with excellent accuracy.

In use, the indicating elements are blue, when the humidity is below the predetermined indicating level. As the humidity rises to the predetermined level, the color changes to lavender. When the humidity is above the predetermined indicating level, the color is pink, and this process reverses as the relative humidity lowers.

Most indicator elements are marked, "Represerve when pink," thus indicating the desiccant is no longer controlling the relative humidity in a corrosion-safe condition in the package.

These indicator elements are easily read and can be considered a permanent indicator, and of course reusable unless the indicator paper is wetted with water or exposed to 100 percent humidity.

In application the type II indicator made of zinc-plated brass is applicable to submethod IID and IIF of MILP 116C.

The indicator may be installed by punching a 1-inch hole in the desired location of the container and installed by adding the washer and nut as the locking device. Figure 72 illustrates application in AN 8029 series drums and figure 73 illustrates in fiber containers MILC–3955.

By having a ¾-inch bung or threaded boss installed into drums, this type II plug may be used by just tightening into thread (fig. 74). This application has merits, in that a ¾-inch pipe plug drilled to accommodate an air intake valve, may be used for conducting the pressure retention test in lieu of the costly leak test (fig. 75).

This type II indicator may also be used in engine containers as shown in Figure 76, or rectangular metal or fiberglass containers (fig. 77).

You can readily see the advantages of this plug-type indicator in reusable containers over the previous plexiglass inspection window (fig. 78), permanent and lower cost.

The aluminum constructed type II indicator is applicable to submethods IIA, IIB, IIC, and IIE.

This plug can be easily installed by punching a hole in the barrier and tightening the nut as shown in figure 79.

The primary advantage for use of these indicators is the exterior mounting and being readily visable. From a study made by the military, cost of inspection by opening the package as high as $75 each

Figure 73. Type II Indicator Mounted on Fiber Container

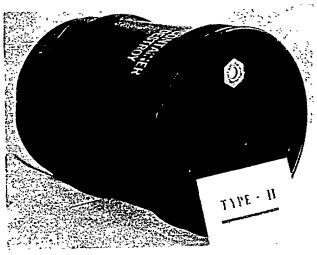

Figure 74. Type II Plug in Threaded Bung

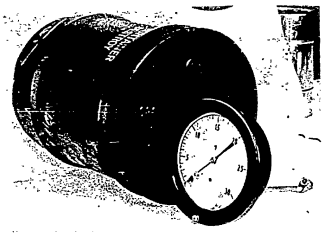

Figure 75. Indicator Testing

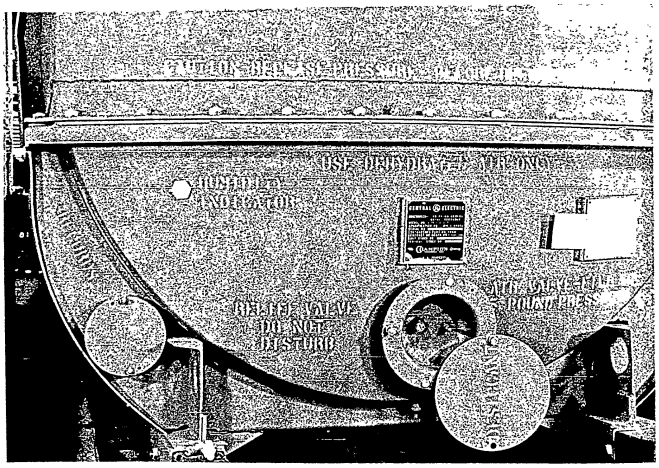

Figure 76. Type II Indicator in Engine Container

Figure 77. Type II Indicator in Rectangular Container

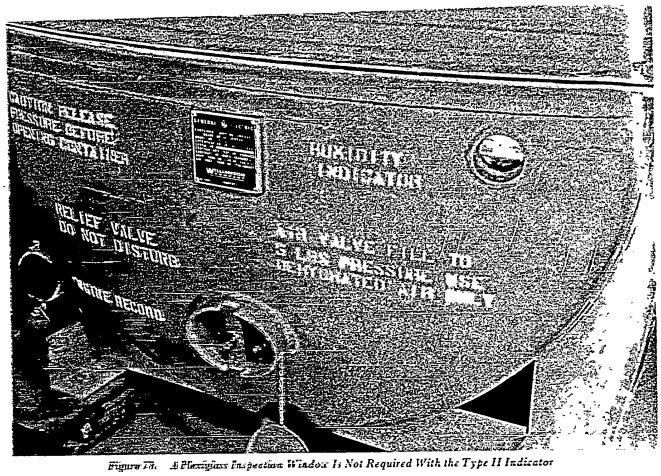

Figure 78. A Plexiglass Inspection Window Is Not Required With the Type II Indicator

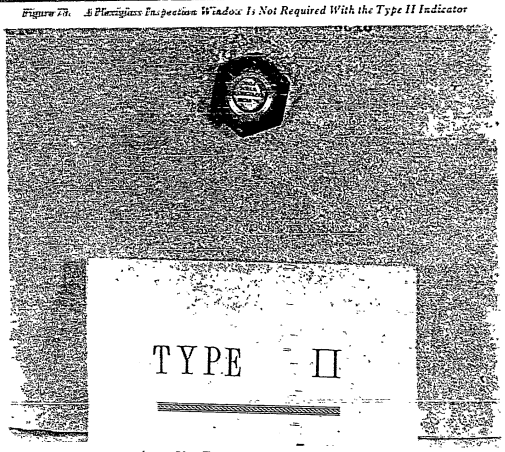

Figure 79. Type II Plug in Barrier Material

whereas inspection through the external mounted indicators about $0.17. In addition, there are no doubts on the part of the contractor or military personnel as to the safety of the pack when shipment is made or received.

Several special indicator plugs have been developed for mounting in rigid containers, and are being used for guided missiles, rockets, and electronic equipment.

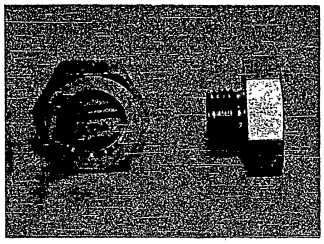

Figure 80. Special Indicator Plugs

The basic design of these indicators is illustrated in figure 80. These are zinc-plated brass—7/8 inch across the hexagon face, 3/8-inch face thickness, 11/16 overall length and equipped with 1/2-inch uniform fine thread and are available with gaskets and locknuts as accessories for mounting. The indicator element is calibrated for 30 and 40 percent relatively humidity or available in the three spot element calibrated for 10–20–30 percent relative humidity.

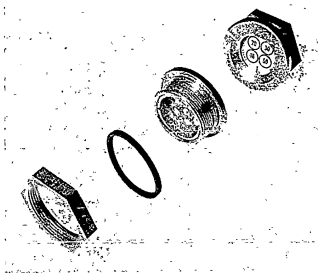

Figure 81. Four-Spot Variety Indicator Used by AEC

The Atomic Energy Commission utilizes the 4-spot variety indicator as shown in figure 81 with mounting arrangements similar to previous indicators mentioned.

There has been considerable experimental work accomplished on plastic type indicator plugs and it is possible that we may have this type of plug accepted for military use in the future.

You will have to agree that the progress made on indicators has been excellent and only through the combined efforts of industry and the military can we expect these accomplishments.

Mr. FARRINGTON. Thank you very much, Mr. Young. Our anchor man is Mr. Clare E. Bacon. Currently he is Manager and Sales Promoter of the Reinforced Plastics Division of the Owens-Corning Fiberglas Corp. A graduate of William Penn College, he has been involved with the development of reinforced plastics since 1942. The entire time with the Owens-Corning Fibreglas Corp. he was manager of their Research and Development Organization for 10 years and later became manager of their Technical Sales Service. He is currently chairman of the Reinforced Plastics Division of the Society of Plastic Industries. It is a pleasure to present to you one of the pioneers of the reinforced plastics field, Mr. Clare E. Bacon, who will bring you up to date on developments in the reinforced plastics field as they concern packaging. Mr. Bacon.

MR. CLARE E. BACON

Reinforced Plastics for Military Packaging

Mr. CLARE E. BACON. We are all well aware of the rigid requirements in packaging for the military. Much has been accomplished to satisfy these needs by our comparatively new industry. Evidence of this fact is certainly borne out in the exhibits at this meeting by the various molders and fabricators.

The physical properties of a reinforced plastic product can vary widely depending upon the percentage of reinforcement incorporated (usually fibrous glass), the direction of the reinforcement and the process used. The resin itself can be compounded to impart very rigid or flexible characteristics to the molding. An example of high impact strengths attainable is evidenced in the use of reinforced plastics for armorplate during and following World War II. This material was known as Doron.

With the advent of the polyester and epoxy type resins, new and unique processes were developed to handle these newer type materials. Today's reinforced plastic components have been adapted to most of the conventional molding and fabricating processes in the industry. In summary, the following is a list of the processes which are used in the industry:

1. Contact molding.
2. Vacuum bag molding.
3. Vacuum injection molding.
4. Pressure bag or autoclave molding.
5. Flexible plunger molding.
6. Preform and matched die molding.
7. Continuous rod extrusion.
8. Continuous laminating.
9. High pressure laminating.
10. Compression molding.
11. Transfer molding.
12. Injection molding.
13. Centrifugal casting.
14. Potting or casting.
15. Filament winding.

It might appear as though it would be difficult to choose a process to produce a given product. This, however, is not the case; and as long as all of the requirements of the performance of an end use product are known, the selection of materials and processes is fairly straightforward.

Evidence in other fields of the suitability of reinforced plastics for similar rugged usage as packaging is borne out by its tremendous growth, over the last few years, in boats, boat covering, sports car bodies, luggage, protective housings, bus seats, portable TV cabinets, truck body components, and safety helmets.

The Reinforced Plastics Industry is made up mostly of small and intermediate sized companies, or smaller divisions of large companies. Close management supervision and quality control is necessary because of the ever rapid progress and change in materials and processes.

Reinforced plastic products offer wide latitude to the designer. The use of polyester and epoxy type resins, along with advanced preforming and molding techniques, makes possible the mass production of large complex shapes. Using proper design, much can be accomplished in the molding operation which results in a minimum of finishing, assembly, painting, etc., sometimes necessary with other materials.

Since reinforced plastics are easily molded and complex configurations present no serious problem, it is possible to design containers and packages which conform closely to the shape of the instrument or material contained therein. On occasion this lends better support and protection to the contained article and eliminates extra material not needed in the package.

Like all other materials, reinforced plastics can be damaged. Reinforced plastics are nonductile; therefore, a dent or a tear with protruding sharp edges is not a problem. Even though a container is damaged or punctured, its contour is maintained and repair is accomplished with less effort than in metal or wood. The damaged area is sanded and a patch is applied which cures and hardens without the application of external heat, resulting in a repaired area every bit as strong, if not stronger, than the original material. This simple technique of repair is of prime importance when you envision the problems encountered in field and emergency repair of containers containing valuable equipment, with not only the usual shortage of manpower, but possible time limits involved.

The storage of containers, sometimes outside, always presents a serious corrosion problem. Reinforced plastic materials eliminates this problem and it has been found that in most cases, salt water presents no more of a problem that does fresh water.

I have tried to stress the advantages of the flexibility in design of our materials and the importance of close liaison between the individuals concerned with the establishing of requirements in packaging with those individuals who actually understand the materials, the processes involved, and what can be done with them.

Mr. FARRINGTON. Although your talk is very good, I think you missed your calling, Mr. Bacon. I think you should write a dictionary. Gentlemen, the past 45 minutes we have raced through five speakers in an attempt to prove to you that the field of packaging is ever changing and ever progressing. In conclusion, may I say only that regardless of one's place in the packaging field, he cannot sit back and feel that he has found the best way to package. There is always a better way.

Lieutenant Colonel MIRRAS. Thank you, Mr. Farrington, and thank you, members of the Industrial Panel on Packaging for your fine presentations.

SECTION 3, INDUSTRY MATERIALS HANDLING PANEL

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SECTION 3, INDUSTRY MATERIALS HANDLING PANEL

Lieutenant Colonel MIRRAS. The last panel for today is the materials-handling panel under Mr. A. V. Blatz. Mr. Blatz is chief packaging and materials-handling engineer on the manufacturing staff of the A. O. Smith Corp. He has been exclusively in engineering work since his graduation from the University of Wisconsin in 1908. His first 12 years were spent in supervising the operation, designing new equipment, revamping plant layout for one Milwaukee and four Chicago breweries. For the next 13 years he operated his own company specializing in the development of high-speed, mass-production of parts, chiefly for the automotive industry. After 3 years of civil engineering, he joined Harnischfeger Corp. in 1936 becoming chief engineer of the Houses Division in 1937, then superintendent of the Weldrod Division in 1938, and for the next 3 years was chief plant engineer. In December 1942, he started with A. O. Smith Corp. as project engineer of its then new Propeller Division. After World War II he was appointed to his present position. He has held many high offices in various technical societies and has been with N. S. I. A. almost from its inception, having served on many of its task committees, and is currently the chairman of the Materials-Handling Advisory Committee of N. S. I. A.

It is a pleasure for me to now call upon Mr. Blatz.

MR. A. V. BLATZ

Materials Handling

Mr. BLATZ. Thank you, Colonel Mirras. I am sure everybody can hear me. The three prime essentials of any material-handling problem are a maximum of safety to person and product, a minimum of time and a minimum of effort. In fact, there is an old saying that no material handling is the best material handling. Materials handling is the basic element of automation. The governing thought in solving any material-handling problem is to disregard the accepted material-handling methods. Obviously, if the accepted method were perfect, there would be no problem. So boldly visualize the impossible, and it is just that simple. Truly any thorough study of any stellar development in material handling will show daring originality. I am sure all of you will recognize this as you listen to our panel.

Mr. Cyril B. Rogers, chief engineer, special development section of the Clark Equipment Co., Battle Creek, Mich., will open our panel discussion.

Mr. Rogers is a graduate of the University of Detroit holding a bachelor's degree in aeronautical engineering. He has had 14 years experience in the aircraft industry in structural analysis and mechanical design, and has worked with and directed the activities of engineers responsible for the development and design of fixed and rotary wing aircraft plus their associated ground handling equipment,

both civilian and military. He has also been responsible for the preliminary structural designs and research programs on missile air frames. At present he is directing the engineering efforts in the design of new lift trucks and allied material-handling equipment for the Clark Equipment Co. Ladies and gentlemen—Mr. Rogers, whose subject will be "Carrier and Personnel Pods." Mr. Rogers.

MR. CYRIL B. ROGERS

Carrier and Personnel Pods

Mr. CYRIL B. ROGERS. Air transportation is a growth industry. As the Air Age continues its rapid growth, one of the problems the airlines must solve, that of satisfactorily handling the paying passenger and his baggage from the terminal to the airliner, shall continue to grow. Clark Equipment Co. has believed for some time this is essentially a material-handling problem. It must be solved to the satisfaction of the air transport industry and their customers, if the industry is to continue to enjoy its present growth rate and the customer acceptance it has worked so hard to achieve.

Various means of solving this problem have been tried. Some are the Whiting Loadair, moving the airplane under an overhang of the terminal roof, passenger walkways—both stationary and mobile, ramps, and conventional buses. No one method has proven satisfactory. All have been grudgingly accepted since no better method was available.

We believe that a handling system concept approach would evolve a method which would be satisfactory to the people using it, and to the people and the agencies responsible for its acceptance. Some of these agencies are the airframe manufacturers, airline operators, municipalities, C. A. A., C. A. B., and the military. This system must be so fundamental and adaptable that it can be used with today's airports, terminals, aircraft, and passenger traffic, as well as those of tomorrow's Jet Age. The system must be able to expand with and meet all demands of the rapidly growing Air Transport business. In addition, it must cater to the comfort and whims of the passenger and provide ground transportation with a minimum of lost time and cost.

As a result of following a handling system concept approach to the problems of loading passengers, baggage, food and cargo, and keeping in mind the requirements that this system would have to satisfy, Clark Equipment Co. conceived the "Mobilcruiser" (fig. 82) as part of the over-all system. This concept was first presented at the Air Transportation Seminar in May 1956 at Clark's Materials-Handling Development Center in Battle Creek. After suggestions were made by Air Transport people, the concept was revised and then presented at the Air Transport Association of America meeting on October 8, 1956, at Miami Beach, Fla., by Glen R. Johnson, Director of Clark's Materials-Handling Development Center.

The Mobilcruiser represents the basic materials handling principle of unit loads as it would be applied to passengers and their baggage. The handling of this unit package by an industrial truck, such as the straddle carrier (fig. 83), provides the flexibility necessary if this system is to satisfactorily meet all requirements. This flexibility can be partially visualized (figs. 84 and 85) by looking at the varying heights of the door openings of some of the existing and future airframes.

To determine if this approach was feasible and to obtain factual passenger reaction to this method of transportation, two pilot model passenger pods were built and put into limited use in May 1956, using standard model straddle carriers as the prime movers. One of these vehicles will be on display tomorrow afternoon in the exhibit area. Passenger reaction has been favorable. This equipment could

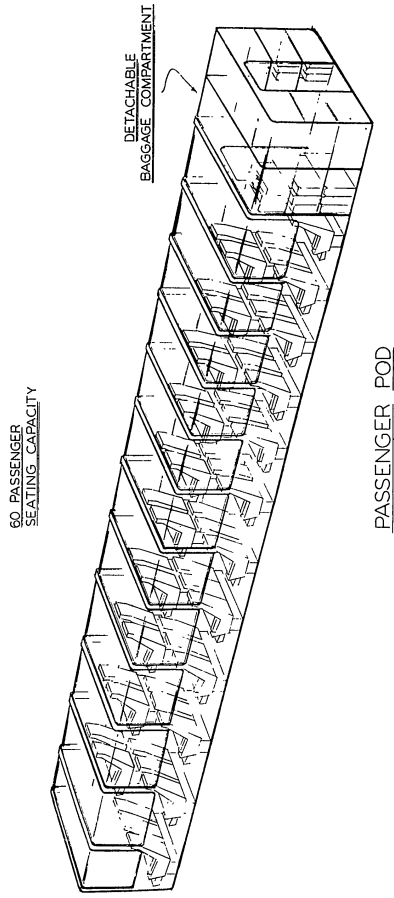

Figure 82. The "Mobilcruiser"

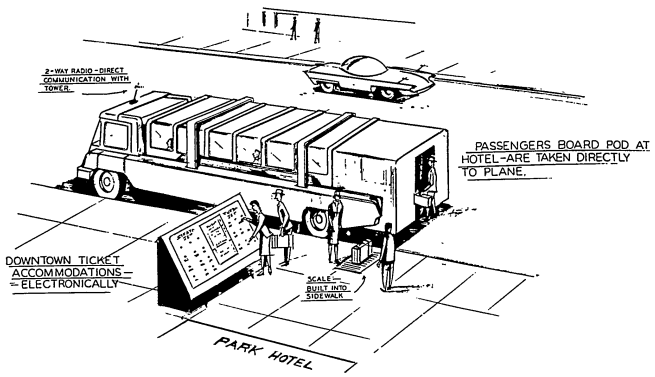

Figure 83. Mobilcruiser on Straddle Carrier

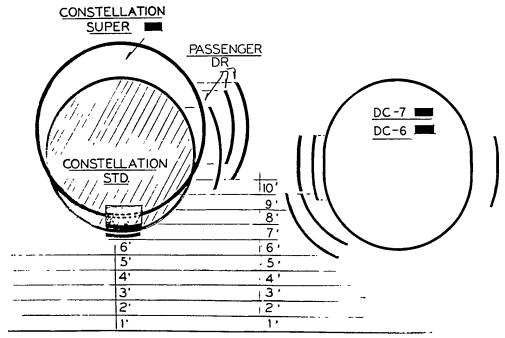

Figure 84. Varying Heights of Door Openings

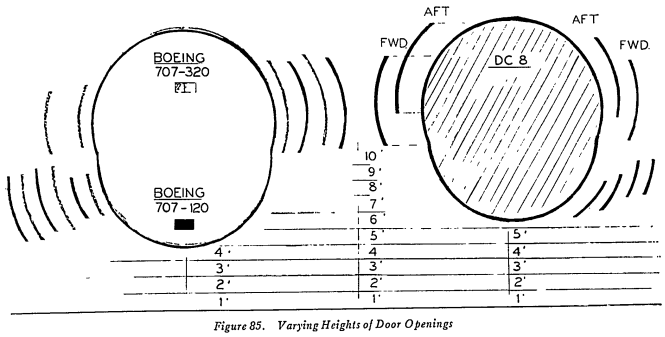

Figure 85. Varying Heights of Door Openings

be used to advantage today and has the potential to meet the airline requirements of the future.

If this method, as conceived by Clark (fig. 86) were to be used at today's existing airports—no costly additions being required—for servicing present-day airliners, the following benefits could be obtained. The vehicle could place a passenger pod at any vacant passenger gate in the terminal (fig. 87), thus preloading passengers for a given flight and relieving terminal congestion. The passenger's luggage could be preloaded with him, either by carry-on, or within a detachable baggage container, which would minimize the problem of lost luggage. On originating flights, the passengers and their luggage would be transported to the airplane and loaded at a point remote from the terminal (fig. 88), which would leave the ramp area available for smaller aircraft or additional passenger pods (fig. 89). The airplane would be loaded in a minimum time and taxi to take-off position without the time-absorbing maneuvers necessary to clear a congested ramp area. On through flights, the aircraft ground time would not be much more than is now required to taxi from one end of the runway to the other, since the enplaning and deplaning passengers would be carried by the same pod which would rendezvous with the airliner at an area on the taxiway for the purpose of transferring passengers and baggage. Traffic control would be maintained by means of radio communication with the tower operator. Thus the benefits of minimum discomfort to the passenger, minimum ground time for the airplane, minimum airport and terminal congestion, and an extended useful life of existing facilities would be obtained today, through the use of Clark Mobilcruisers.

In the air-travelling world of tomorrow, the problems mentioned here will be magnified many times by the increasing speed and physical size of the coming jet airliners, larger airports with their longer runways and therefore longer taxi strips, increased passenger traffic, and increased distances from the centers of cities to airports. The jet-speed-conscious public will be less tolerant, than today, of the time-consuming trip to the airport, the walk through the terminal to a counter, the wait in line for a ticket and baggage check, the boring wait in an overcrowded terminal for a flight to make up or arrive, and the long walk and climb up or down a loading ramp to the waiting airplane. Added to this will be the distasteful odor of kerosene or other jet fuel fumes and the deafening roar of tens of thousands of jet horsepower adjacent to the terminal building. These difficulties also are overcome by the passenger pod concept since these pods can be transported from a downtown loading terminal directly to the airline (fig. 90), where the pod, elevated to passenger door height, would allow the passengers to board the aircraft without passing from airport bus, to terminal, to counter, to loading ramp, to airliner. Other configurations of this vehicle might look similar to those depicted in figures 91, 92, and 93.

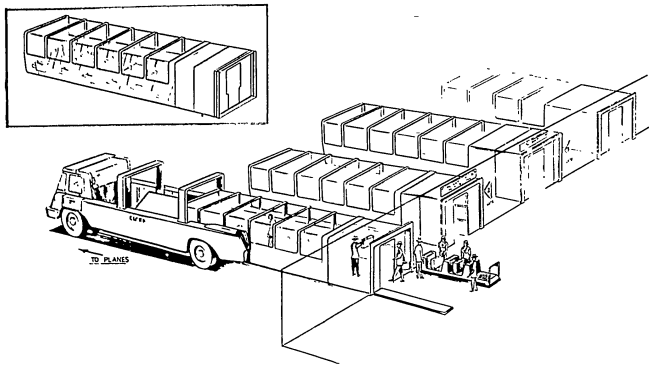

Figure 86. Passenger Pods

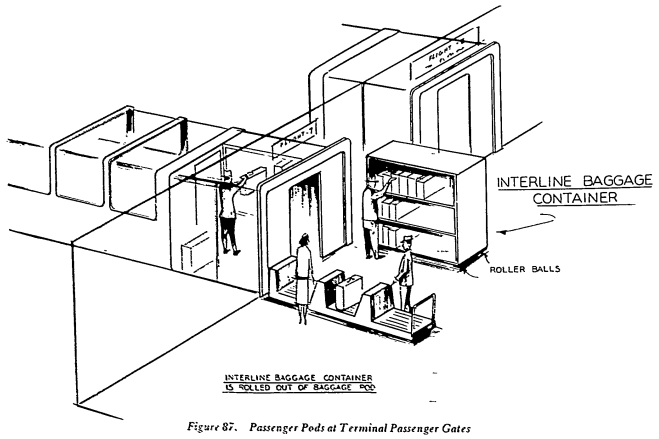

Figure 87. Passenger Pods at Terminal Passenger Gates

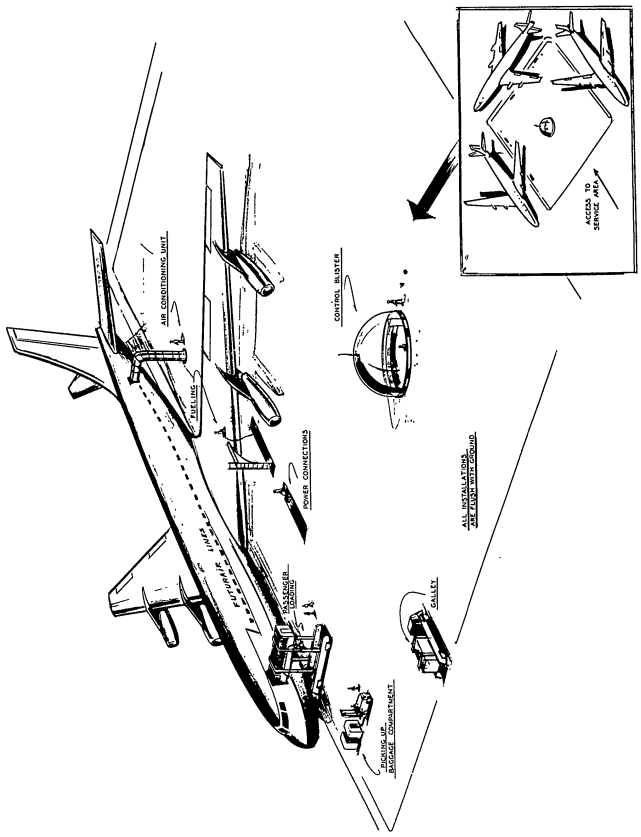

Figure 88. Loading Point Remote from Terminal

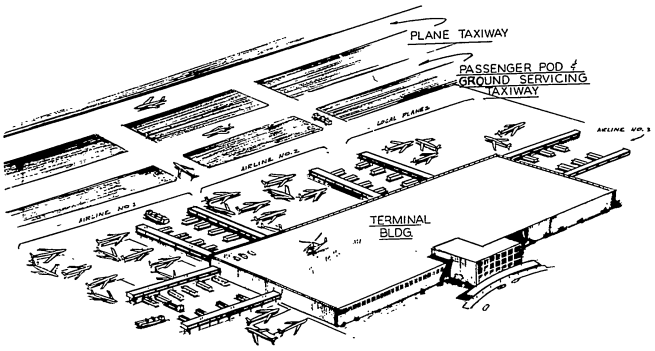

Figure 89. More Room in Ramp Area Results

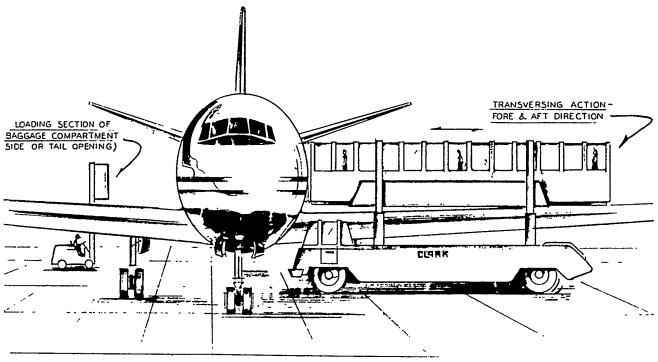

Figure 90. Pods Being Transported from Downtown Loading Terminal Directly to Airline

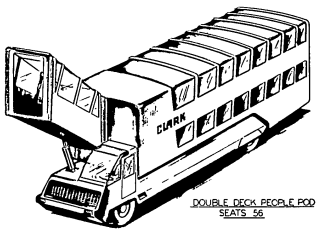

Figure 91.

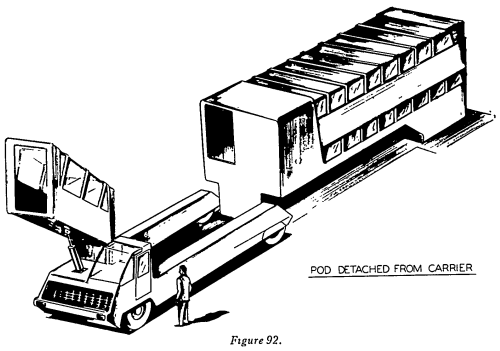

Figure 92.

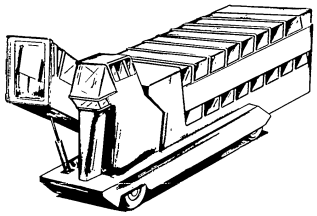

Figure 93.

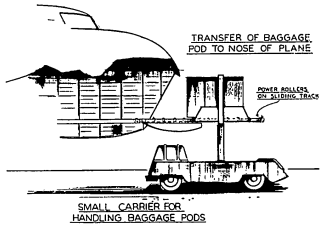

Figure 94.

So far we have discussed the Mobilcruiser as a passenger and baggage-carrying vehicle but it is a more versatile unit. By containerizing baggage (figs. 94 and 95), cargo (fig. 96), maintenance equipment, fuel (fig. 97), galleys (fig. 98), and lavatories, the basic prime mover can pick up, transport and elevate to the required height any package that might be needed to service an airplane at any location on the airport. Therefore one carrier would perform many functions and the expensive portion of the vehicle could be kept working a majority of the time.

If the difficulties that exist today in the handling of passengers and their baggage, due to the lack of adequate facilities at our major airport terminals, are to be overcome and be prevented from becoming one of the factors limiting airline growth, we believe that some handling system concept such as the Mobilcruiser will have to be adopted. In principle, the elements of the Clark Mobilcruiser concept exist today, and they can be put into practice whenever their need is recognized.

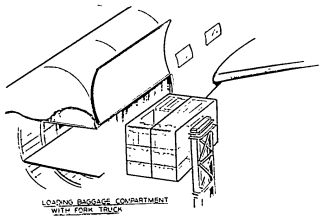

Figure 95. Containerized Baggage

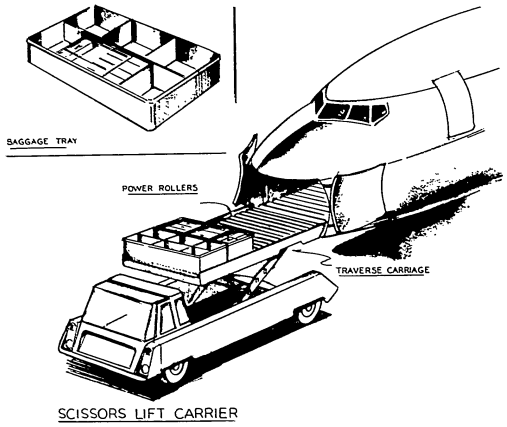

Figure 96. Containerized Cargo

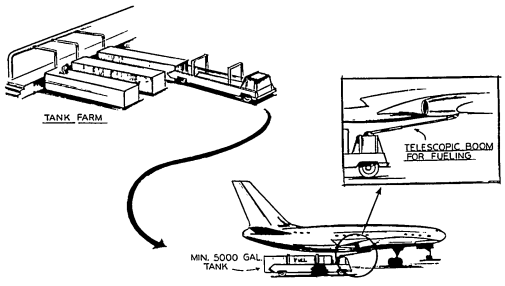

Figure 97.

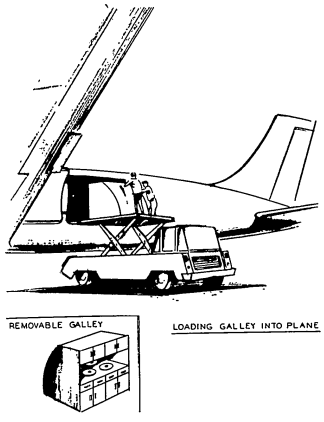

Figure 98.

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Mr. BEATZ. Thank you, Mr. Rogers. We will now hear from Mr. John M. Turner.

Mr. Turner completed his formal education at Western Reserve University, class of 1928, entering the United States Army shortly thereafter. He was retired from the Corps of Engineers in 1950. He spent the next 2 years in the Motor Freight industry, joining Southern Lumber and Manufacturing Co. in 1952. He was assistant to the general manager

Mr. JOHN M. TURNER

in charge of wooden pallet sales at Ellijay, Ga., from 1952 to 1956 when he became president of Tier-Rack Southern Corp. of the same city. His subject will be "New Pallet Design and Racks—Reusable and Expendable." Mr. Turner.

New Pallet Designs and Racks

Mr. JOHN M. TURNER. There have been a number of new developments in the field of pallets and pallet racks since early 1956. Outstanding amongst these have been the Tier-Rack, Pallet Guard, and Short Deckboard Design Pallet, all of which should be of paramount interest to both industry and military agencies.

Vertical stacking to the maximum extent has been a boon to those concerned with warehousing ever since materials handling had its start. However, many types of items do not lend themselves well to vertical stacking, because of their lack of stability or their shape. The use of selector lines in warehousing has also presented problems to high stacking.

During World War II the United States Navy experimented with a method of achieving vertical stability in stacking with a device known as a "picture frame" pallet. This device accomplished its prime purpose satisfactorily, but was found wanting in other respects, and was superseded by permanent-type racks for pallet loads.

Early in 1956 a portable stacking frame for pallets, known as the Tier-Rack, was introduced. It provides stability to materials packed in bags, or in crushable cartons, and to shapes normally not adaptable to high stacking, and permits access for shipping to any vertical tier in an area assigned to solid stowage without fear of disturbing the stability of tiers beside or behind it. The Tier-Rack provided an additional advantage possessed by no other type of moveable pallet rack at the time of its introduction, and this was the fact that it was the only stacking frame that could be applied directly to standard pallets. This means that only one inventory of pallets is required to provide movable rack facilities.

The Tier-Rack makes it possible to achieve maximum vertical height in any given storage facility, and provides mobility and flexibility not attainable with permanent-type rack installations. It eliminates the aisle required for access by forktrucks to permanent-type racks, and can increase storage space by as much as 40 to 45 percent within the same floor area when using the solid-stowage system. Where solid stowage is already in use, a comparable increase can often be realized through the ability of Tier-Rack to surmount height limitations imposed by the crushability, instability, irregularity, or other adverse characteristics of the material. The Tier-Rack pallet stacking frames have gained a widespread acceptance as a means of stacking unstable products four or five tiers high, as well as protecting the bottom pallet load from container or product damage.

A set of Tier-Rack consists of two metal frames that quickly snap onto a regular pallet converting it to a single portable pallet rack. All the same size frames are identical; any two pieces fit together and are joined at the top center forming an X design, thus giving rigid support to the pallets that rest on them. The frames are available to fit pallets of any size, and can be attached to any standard wooden pallets. No bolts, pipe, bars, tools, or loose hardware are used with Tier-Rack. It takes one man less than half a minute to snap a set of frames on or off a pallet. Because the racks are attached to the pallets, it is a simple operation to build or dismantle any section of racks, and to relocate it when circumstances dictate, or store it out of the way nested on a pallet, when it is temporarily not in use. One man with a forktruck is all that is required.

Tier-Rack is also available with various types of containment sides for the vertical stacking of unpackaged or loose articles. These containment sides are completely removable from the stacking frames, when not in use, and are available in both wooden-frame and wire-mesh construction.

The most outstanding development in pallet design in recent months has been the introduction of the pallet guard, a device that can greatly increase the use-life of wooden pallets, and materially reduce maintenance costs to a bare minimum. One prominent user of pallets has called it the "life insurance for pallets."

The pallet guard is a device made of either round or square seamless steel tubing, which fits over the ends of stringers or blocks on wooden pallets to protect the end deckboards from constant fork entries. They can be installed on present pallets, if in sound condition, or pallets can be purchased from most reputable pallet suppliers with pallet guard already installed.

Actual experience has shown that at least 75 percent of the damage that occurs in pallets is located in end deckboards or in nail failures occurring in end deckboards. Industry tests show conclusively that pallet guard can provide maintenance free life for wooden pallets almost indefinitely.

A well made wooden pallet that is used properly without abuse will last indefinitely without a pallet guard. However, if warehouse operations call for speed where abuse is unavoidable and pallets are subjected to continuous rough treatment, then pallet guard is the answer to your problem and the savings in maintenance costs through its use will be many times its initial cost.

The most recent development in the field of pallets is the short deckboard pallet design. The purpose of this design is to provide a means of using short lengths of boards, which develop in pallet manufacturing operations, without loss of structural strength in the pallet itself. To date three different constructions of short deckboard pallet design have been developed.

In all of these constructions the end deckboards are of one piece regular length lumber, as are the inside bottom deckboards. Short deckboards are used only for the top inside deckboards. Different methods of joining these deckboards may be employed by the use of nail fastenings.

All of these new designs of pallets and of pallet racks are on display at Booth Number 8 in the industry display area here at Fort Lee, and may be viewed tomorrow, October 2. The speaker and other association representatives will be happy to answer any questions concerning these developments, when you call at the display. Literature will also be available on these products.

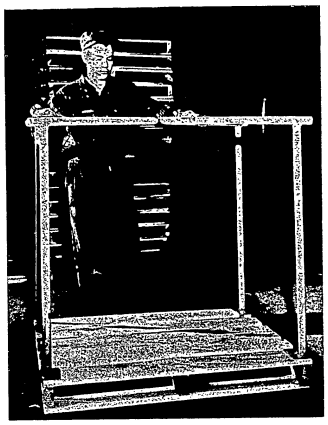

Figure 99. This shows the ease with which one man can snap on or off the Tier-Rack stacking frames to standard wooden pallets Note there is no hardware or attachments on the pallet other than the stacking frame.

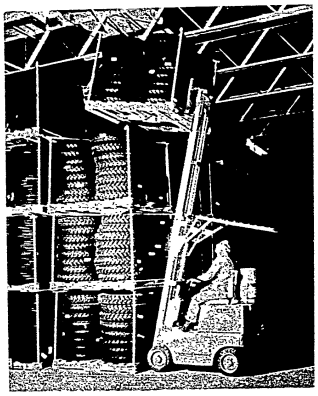

Figure 100. Rubber tires and hose are shown stacked four high in a Midwest warehouse operation with the use of Tier-Rack. No compression is exerted by the loads above due to the support given by the stacking frames.

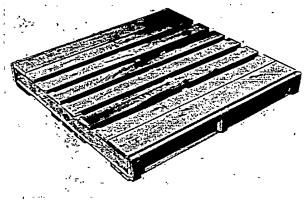

Figure 101. The Pallet Guard applied to the ends of stringers protects wooden pallets against end deckboard breakage and nail failures. The use-life of a pallet is increased many times by the Pallet Guard.

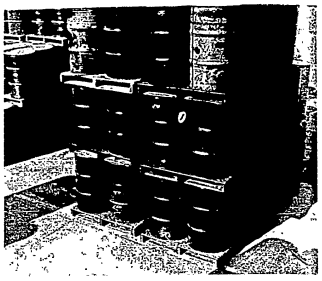

Figure 102. This photograph shows graphically the benefits of the Pallet Guard device. All of the pallets are equipped with Pallet Guard except the one on the top tier on the left. Note the end deckboard breakage in this pallet and the perfect condition of the pallets equipped with Pallet Guard, which are used to handle the same heavy drums.

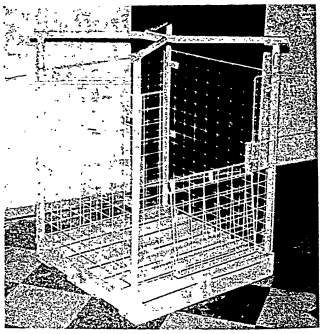

Figure 103 This is an example of the new wire mesh containment sides for Tier-Rack which permit the high stacking of loose or unpackaged articles. Note the door in the front, which may be raised or lowered for selector purposes.

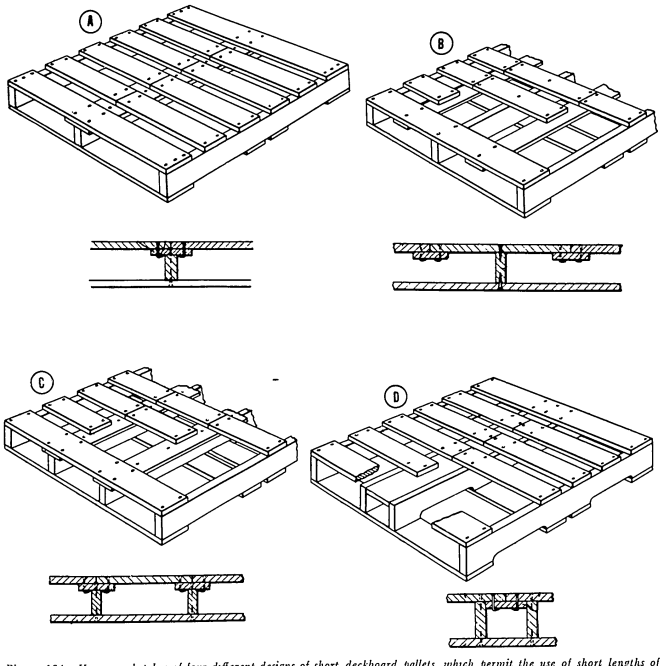

Figure 104. Here are sketches of four different designs of short deckboard pallets, which permit the use of short lengths of lumber in pallet construction without use of structural strength.

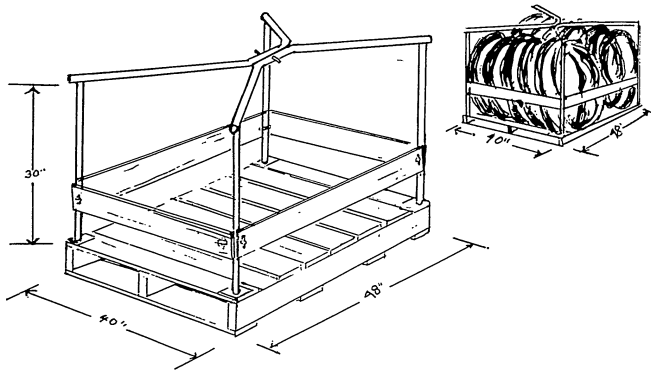

Figure 105. Here is an example of a wooden frame containment side used with Tier-Rack for storage of coils of steel wire. The frames and sides are completely removable from the standard pallet.

MR. ROBERT J. LAWS

Mr. BLATZ. Thank you, Mr. Turner.

Our third panelist will be Mr. Robert J. Laws, a Major in the United States Marine Corps Reserves. He is Manager of Sales Engineering of Baker-Raulang Co., Cleveland. In 1943 after serving 3 years in the Marine Corps, he entered the Naval Academy at Annapolis graduating in 1946. Between 1950 and 1953 he enrolled as a post-graduate at the University of California. Since then he attended various schools including those for High Speed Radio Operators; Chemical Warfare; Radiological and Biological Warfare; Amphibious Staff School; the Joint Military Officers Guided Missile School, and the Basic School for Marine Corps Officers. He holds membership in the Society of Automotive Engineers, the Cleveland Engineers Society and is a Fellow of the British Interplanetary Society. He is also an industry representative in both the American Ordnance Association and the National Security Industrial Association.

In 1955, Mr. Laws joined Baker-Raulang Co. as assistant chief engineer and recently was named manager of sales engineering. He will describe "New Concepts in Specialized Materials Handling." I am happy to introduce Mr. Laws. Mr. Laws

Handling of Specialized Loads

Mr. ROBERT J. LAWS. Thank you, Mr. Blatz. I am sorry to find out that jokes aren't the order of the day today, because I had several prepared. However, I would like to take the opportunity to tell you a true story. My boy came home from school the other day with some of his new-found knowledge and asked me if I knew the difference between "unlawful and illegal." Well, I didn't want to appear ignorant on the subject, so I told him that I would give him an answer later and after searching out a few Supreme Court decisions and opinions, I came up with a pretty well-developed answer. I confronted him the next morning with the answer and he was quite disappointed because he had learned in school that "unlawful" is an act against the law and "illegal" is a sick bird. That is kind of far afield from our subject, specialized loads, however, I do like to hear standardized firms being one who is always involved in specialties.

Although the art of material handling is still in its infancy, we are already beginning to see several specialties develop within this field. As a matter of fact, even within the classification of the powered industrial forklift truck there are certain strong and definite trends indicating the requirement for specialists and for special equipment. It is about this subject of the special industrial forklift truck that I have chosen to talk today. This may seem a matter of getting the cart before the horse in that the subject is the handling of specialized loads; however, I find, from my own personal association with the solution of these specialized handling problems and the solutions which have been derived by others, that the industrial forklift truck in one form or another has been the common denominator.

Because our time is limited and this subject in itself is so broad, I will attempt to present a concise analysis of the problems encountered, the solutions which have been derived to solve the problems and a statement of some of the problems which unfortunately still remain. I say "unfortunately" the problems still remain—they remain only because time has not permitted us to solve them or the full requirement has not been made known. I feel that by exposing them before a group such as this, gives us the opportunity to overcome the obstacle of time by pooling our combined knowledges where required and in the cases where time is not a controlling factor to face the problems before they become emergencies and through our normal course of developments have the solutions ready at the time that they are required.

To state the problem then of handling specialized loads, I would like to submit that the loads themselves create half of the problem and that the handling requirements create the other half. Examining the loads for a minute, I believe we can state that there are two factors which cause certain loads to fall in a specialized category—these are the shape or physical dimensions of the load and secondly, the characteristics of the load. A further subdivision of the shape of the load leads us to the following major subcategories. There are the loads which have one dimension many times greater than the other two dimensions commonly referred to as "long loads," the bulky or low-density loads and the irregular shapes. A further subdivision can be made of the long loads; those with beam strength and those without beam strength. Examples of the second factor which makes certain loads specialized are the load characteristics and in this category we have the loads which are vulnerable to shock, those vulnerable to vibration, those loads which when handled constitute a hazard to safety, and lastly, loads where low unit contact pressure is required in handling so that the load is not damaged.

The other portion of the problem is the handling requirements which are imposed as a result of these load characteristics or of the positioning and control that may be required in picking up, transporting, and depositing the loads. For example, there can be requirements for controlled articulation, either powered or unpowered, in the proper registration of a load, or the requirement for placing loads such that the optimum use is made of available space and, lastly, there is present the requirement in many instances that the cycle of handling these loads be accomplished in a limited period of time.

I know that in hearing these factors you can immediately visualize many of the loads which fall into these categories. For example, the guided missile in many instances is described by one or all of the factors mentioned above—for example, the very load shape—i. e., a long load, perhaps with or without beam strength—a load which is vulnerable to shock, vibration, and perhaps creates a safety hazard and, lastly, one that requires controlled articulation for registration on a launching device and, in many instances, requires the handling within a limited period time. Or, for example, the handling of atomic power reactor elements. These, of course, are specialized loads so dictated by their shape, their

characteristics and their handling requirements, with perhaps the controlling feature being the requirement for remote control operation. Or, for example, the handling of bulky, low density, electronic packages such as unit packs from test or checkout equipment, radars, or computers—items which almost always are vulnerable to shock and vibrations.

These are but a few examples of the specialized loads and the specialized handling requirements, but I have chosen them because they are all common to the military and are almost without exception manufactured for the military by private industry. This, of course, makes this very definitely a joint military-industry problem, in that handling is required on both ends of the line and the solution at one end will probably be valid at the other end with the possibility of other restrictions imposed by tactical conditions.

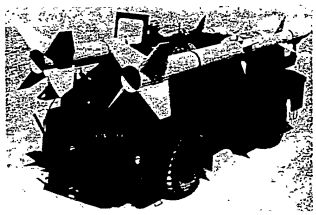

Figure 106. Side-Loading Forklift Truck Handling Marine Corps' TERRIER

I have chosen three examples of the specialized handling problem solutions to show you the three degrees of effectiveness mentioned earlier. The first of these is the handling of the guided missile which I classify as a good solution to the problem. In figure 106 we see an adaptation of the side-loading forklift truck handling the Terrier guided missile for the Marine Corps, Terrier Battalion. Let us examine for a moment the points which make this a specialized handling problem, and see how the specialized requirements were overcome. First, the long load was a "natural" for the side-loading forklift truck in that for the most part the load itself could be kept within the dimensions of the vehicle and thus operate within a standard aisle or roadway. Secondly, the lack of beam strength in the missile itself was compensated for by the use of a "strong back"—in this case, an I-beam to which the forks of the truck were secured for transporting the load. Third, the chance of shock loading or vibrating the missile beyond its tolerances was eliminated by incorporating two features in the vehicle—a nitrogen accumulator in the hydraulic system to reduce the shock loads when traveling and large high-flotation type tires. Fourth, the positioning of the missile to the launcher required several degrees of freedom and a closely monitored control of the motions. This was accomplished by introducing, in addition to the normal hoist and tilt of the mast itself and the lateral travel, in this case transverse travel of the mast, a pitch motion such that the carriage could be rotated about an axis through its center. Fifth, the execution of the loading cycle within a limited period of time was solved by the incorporation of solenoid control valves which were operated in sequence through a program by cam-actuated limit switches. This sequencing when incorporated with the acceleration characteristics of the vehicle permitted the operator to merely press one button, proceed on his loading run, cause the load to go out and down to a preset

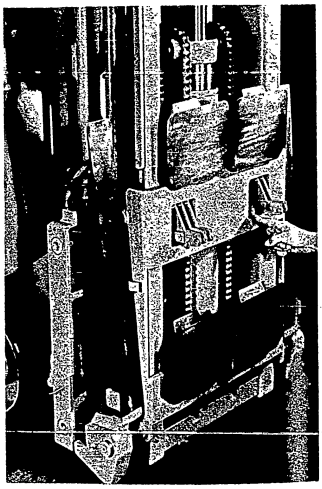

Figure 107. Frontal Attachment for Forklift Note Sawblade-Type Fingers

Figure 108. Specialized Load Handling

position such that only minor manual adjustments were required for the final registration.

And now, an example of a fair solution. For this example, I have chosen the handling of electric appliances although this same type of thinking can be extended to the electronic components which were mentioned earlier. I call figures 107 and 108 a fair solution in that you see the problem of handling the appliance is not completely solved by the material-handling engineer, but rather he is dependent upon the packaging engineer. In this particular case, we are showing refrigerators and air conditioners which have been packaged in the cap-and-tube-type carboard carton. The specific points that make this a specialized-handling problem and their solutions are, first, that the load is bulky and that this was solved by the use of a frontal attachment on a forklift truck which has been designed to handle a load regardless of its bulk. This particular attachment incorporates carton lips for engagement in the cap—of a cap-and-tube carton or sawblade-type fingers for engagement in the stringers of a wooden crate and, in addition, the attachment has folding forks to add to its versatility in the cases where some of the unit loads may be palletized.

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The second specialized problem is the shock loading during transportation and this has been a joint solution furnished by both the packaging engineers and, again, an accumulator in the hydraulic system of the vehicle.

Thirdly, the optimum use of space is a requirement and the vehicle incorporates an additional mast to afford the extra high lift and a side-shifting carriage so that the load itself may be positioned once up in the air rather than moving the vehicle and thus reducing the cycle time.

The third example which I have chosen is at the bottom of the list as far as satisfactory solution is concerned in that it falls in the category of future development. However, as you will note from figure 109, the proposed solution to the problem is merely the adaptation of existing components. This artist's sketch shows a remotely controlled electric fork truck designed for servicing and maintenance of an atomic power reactor system. In addition to the normal fork truck components there is mounted on the main frame a television camera for viewing the path of the truck, a remotely controlled manipulator, and a television camera for viewing the actions of the manipulator. As explained earlier, this is a specialized handling problem in that it requires remote control as the paramount feature. However, in addition to this remote control, any of the other load characteristics might be imposed on the system requiring the solution to the shock and vibration problem, the bulky, low-density load problem or, in certain cases, the long load and time problems.

What I have outlined for you today is merely a brief analysis of the handling of specialized loads. I am certain that we all agree that further categories and subcategories could be developed; however, the principle remains the same—i. e., problem and problem solution. The question is, "Are we as material handling engineers and manufacturers keeping up with the problem?" "Do we have the solutions ready when they are required?" I feel that we are doing fairly well; however, better solutions can be worked out if we are all aware of what the other fellow has done. It is meetings just such as these that give us the opportunity to share this information and I trust that these few examples can be of benefit to us all, particularly if we can share our knowledge of the problems and solutions.

Mr. BLATZ. Thank you very much, Mr. Laws.

Our next speaker will be Mr. A. M. Barrett, Jr., of Northbrook, Ill. During the war years 1942 to 1944, Mr. Barrett did research work on the mag-

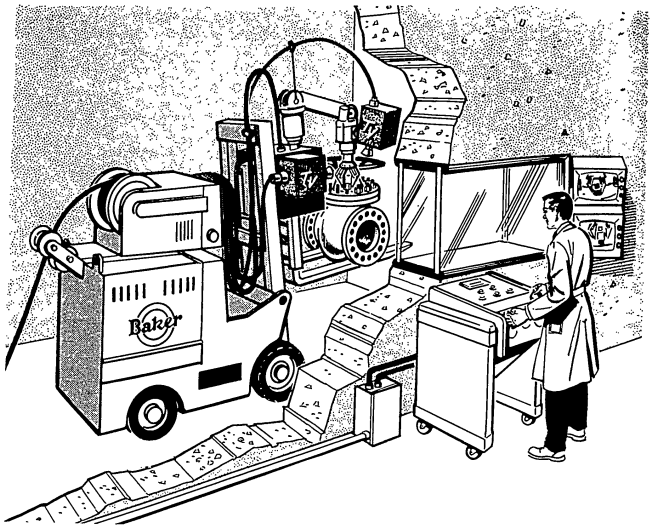

Figure 109. Futuristic Remote Controlled Electrical Fork Truck

netic separation process of uranium on the atomic bomb project in the radiation laboratory of the University of California and then at Oak Ridge, Tenn., on the production process improvement methods and the separation of uranium isotopes. He was then transferred to the Los Alamos Laboratory in New Mexico doing preliminary work in preparation for the first Bikini atomic bomb test. In 1946 he was associated with the Air Corps Coordination Group from Los Alamos, whose problem then was to handle the complete timing and firing of that first Bikini test. In the fall of 1946, he entered the Engineering College of the University of Illinois, graduating in 1949 with the degree of bachelor of science in electrical engineering. Since graduation he has been with the Barrett-Craven Co. and was elected its president in 1953. At that time he organized the Barrett Electronic Corp. for investigation, development, research, and manufacturing of electric remote control devices for industry, specializing in materials-handling equipment. He is therefore eminently qualified to tell us about "Radio Controlled Tractor Trains." Again I am happy to introduce Mr. Barrett. Mr. Barrett.

Radio-Controlled Tractor Trains

Mr. A. M. BARRETT, JR. Mr. Chairman, gentlemen: It is a pleasure to be able to present to you today a new concept, opening vast new possibilities in the field of materials handling.

This new concept is based on the idea that if we could and can eliminate the driver of a material-handling vehicle, we will save considerable expense. In order to honestly evaluate this expense and resulting savings, it is necessary, of course, to sum up all the factors including salary, fringe benefits, such as health and accident insurance, sickness pay, unemployment compensation, overtime, vacations, general off or loss time, coffee breaks, and so forth. In many plants the sum of these run from 20 to 25 percent of the truckdrivers base salary. More indefinite and difficult to evaluate but still a big factor is the time lost through stopping at the drinking fountain, wondering what the ball score is, who's running in the seventh, and so forth. These penalties to efficiency apply about equally to both industrial and military material-handling operations.

MR. A M. BARRETT, JR.

With these thoughts in mind, our company conceived and designed the system we term "GUIDE-O-MATIC". This is actually the automatic guidance of a vehicle and to date has been widely applied with success to tow tractors for moving trailer train loads throughout manufacturing plants, warehouses, and between buildings. This unit actually operates without a truckdriver.

In order to understand the proper application of this system, let's start with an understanding of how the device works. At the present time, there are two basic types of Guide-O-Matic guidance equipment. One is the type that follows a wire laid in the floor and the second type of Guide-O-Matic is one that follows a painted white line or a white adhesive reflective tape on the floor surface. The basic principal and most of the equipment of each is interchangeable and it is easy to convert from one type to the other.

Although the optical type, the one that follows the reflective white line, offers some initial economy, it is probably impractical for general outdoor service and imposes some limitations even to indoor installations, such as keeping the guidance line clean. This problem is particularly troublesome at corners or points where trailers tend to cut across or other mobile units cross the white line, causing it to black up or wear off. This loss of guidance path identification can make the tractor inoperative.

The other type of Guide-O-Matic tractor, that which follows a signal wire in the floor, has become more popular by usage and actually is considered much more reliable. Using the wire system of guidance allows for ease of switching, stopping, and starting and remotely operating indoors or outdoors in almost any type of weather. For the wire system, a converter is necessary to generate a high frequency current into the wire, which creates the guidance path. In the optical type that follows the reflective white line, there is no converter necessary but we sacrifice some reliability. In either case, the tape or the wire is put along the desired path of travel and there are many basic advantages to an automatically guided truck system which are not apparent initially.

First of all, an automatic guidance path precludes the possibility of the tractor being driven into merchandise or other equipment by accident because of an unskilled or inattentive operator. Many users report this to be one of the main advantages of the unit. Outside of eliminating the cost of the driver, other advantages are offered. There is no cowboy on the unit to abuse it and thus shorten its life. Users say that their Guide-O-Matic tractors have far less total maintenance requirements than any other piece of materials-handling equipment in their operations. In the early stages of development and application, this was an item that was somewhat overlooked, but histories now show actually and conclusively that when they take the cowboy off the tractor, tractor life goes up considerably and tractor maintenance goes down considerably.

The installation of the optical type of Guide-O-Matic tractor systems using the painted or taped white line is, of course, very simple, requiring only the necessity to paint or tape a 2- or 3-inch-wide line over the course to be followed. Turns can be made as sharp as trailing equipment will permit, but

generally speaking are not less than 6 feet in radius. The installation of the wire-type systems requires an concrete cutting saw to slot the floor to a depth of one-fourth to one-half inch and a width of approximately one-eighth of an inch. The wire is then laid in the slot and connected to the converter and you have a permanent installation, which requires no further maintenance, whether indoors or outdoors. Covering the slot is not generally practiced and there is no real necessity for us to do so with very few exceptions.

Automatic or preset programming equipment is available for these tractors, which will cause them to perform any required set of functions such as stop at any desired location, blow a horn, wait 1 minute, or almost and prescribed program that you may require. Other and additional equipment for the tractor consists of a safety bumper which stops the tractor on contact with any object and a rotating red light to warn of the tractor's approach. Special equipment available is all based on the building-block style, add-on-type design, and almost any reasonable degree of complexity can be incorporated in or added to a standard Guide-O-Matic tractor.

Although this tractor was not designed primarily as a towline device, there are installations where several tractors continue around in a loop and are used exactly in the same manner that a towline is used. The trailers are put behind the tractors, coupled on, and taken off at the desired location similar to the operation on a towline. In this case, the tractor does not necessarily stop moving and several tractors on the same line are automatically synchronized so that they stay spaced at any distance required or automatically respond to block signals and stop and go sequence operations.

One big advantage of this type of operation is that the customer can change his towline arrangement at any time by putting in additional loops over different desired paths and simply by throwing a switch in the wall change his complete towline routing at will. Of course, all tractors and most of the guidance equipment can be moved very easily and reinstalled elsewhere as in a new building when and if a desired move is made.

Many essential and important features are inherent in the design and operation of the Guide-O-Matic system other than economy. Foremost among them are safety and reliability.

Among the particular featu[illegible] contributing to plant and personnel safety relativ[illegible] their operation, Guide-O-Matic tractors have [illegible]mally both dynamic service brakes and automatic positive mechanical dead man control brakes. Inherently a Guide-O-Matic unit fails safe if for any reason internal or external conditions become dangerous or out of normal control. If the guidance signal fails or if the unit is diverted from the path of guidance, it stops. If it contacts an obstruction, it automatically comes to a crash or emergency stop. It will not operate on automatic control with personnel on the platform and conversely will not operate under manual control unless the operator is in position on the platform. The flip of a switch and an operator on the platform instantly converts the unit to conventional manual control operation.

It continuously beams a sharp focus rotating red light ahead and on both sides as it runs or during the time it is stopped for automatic program arrangements. It will sound a sharp claxon blast at regular intervals or at specified points along the route. It is under safe speed limit control and braking even on ramps, either ascending or descending with load. This we feel, is true safety.

Only rugged conservatively designed components are used in the construction of Guide-O-Matic equipment. They are carefully protected and shock mounted, simple in operation, and designed and arranged with full consideration for inspection and maintenance when required. Case history after history has abundantly proved the Guide-O-Matic to be one of the most reliable material-handling units on the market.

Consideration of this practical, reliable Guide-O-Matic system in your present and future material-handling plans offers flexibility, and possibilities by its new concept of efficiency never before available to material-handling engineering.

Mr. BLATZ. Thank you, Mr. Barrett.

Our fifth and last panel member is Mr. M. S. Reutter, manager of special products sales and merchandising of the communications products department of the Radio Corporation of America.

Mr. Reutter attended Iowa State Engineering College. Prior to 1941 he was communications supervisor for the City of Winona, Minn., where one of the earliest FM communications systems had been installed. He joined RCA in 1942, since which time he has held posts in field and design engineering in radar and communications. He entered commercial activities after World War II and was district sales manager at Kansas City, Mo., until 1950, when he transferred to the home office. Under his present assignment he is in charge of development and merchandising of all miniature 1-way and 2-way communication products. He will describe "Radio and Personal Communication in the Materials Handling Field." Ladies and gentlemen, Mr. Reutter.

MR M. S. REUTTER

Personal Communications in Material Handling

Mr. M. S. REUTTER. Mr. Chairman . . . . Attendee's of the Third Joint Military-Industry Materials Handling Symposium:

When we speak of "Radio and Personal Communications in Material Handling Activities," we refer to the kind of communications that is now provided between a central radio dispatcher . . . . under control of a foreman or supervisor . . . . to operators of moving vehicles. This can be applied in transportation . . . . maintenance . . . . production support . . . . warehousing and security . . . . but in addition to 2-way radio on vehicles, we can extend it to personnel afoot . . . . so that no area of your communication requirement need remain unserved.

Before going into the details of the personal uses . . . . I feel that not enough emphasis of the potentials of 2-way radio as a whole, has been made . . in industry . . and the military fields . . toward enhancing overall material handling efficiencies.

It is true, that hundreds of industries and military establishments now use 2-way radio . . . . but this is only a fraction of those who could justify its use economically.

Even those who now use radio, have expanded uses to be served . . . . and there are the countless thousands of organizations who haven't analyzed their operations in the light of what radio communications can do for greater efficiency.

Someone has said, "Radio control in material handling is the most important concept since the unit load principle" . . . . and I'm sure, you all agree with "The Unit Load Principle."

Telephones and intercommunications systems serve your purposes at fixed locations . . . . but much or most of your important activities dealing with split second timing, concerns moving vehicles or personnel afoot.

How are we going to provide this important segment of your organization with fast, accurate communications? Well . . . . many things have been tried and used . . . . most of them are expedients at best . . . .

Klaxon Horns . . . Flashing Lights . . . Public Address Systems

These systems impart very little information . . . . annoy other workers . . . . and fall short of doing a total job.

Two-way radio between a central dispatcher and material handling trucks, tractors, cranes . . . . whether they be in a warehousing, production support, or maintenance activity . . . . affords instant direction to increase efficiency in a great many ways . . . . and provides secondary benefits of emergency nature.

This ability of providing greater efficiency comes at a time when we are all trying to squeeze the greatest amount of effort out of every dollar expended.

THE SQUEEZE IS ON IN INDUSTRY . . . . AND THE SQUEEZE IS ON IN THE MILITARY

I would like to make some quotes from industry, in the areas of important savings that can be achieved by better communications in material handling. Here's one from Allegheny-Ludlum Steel Co.:

"Our transportation department realizes up to 50 percent improved efficiency . . . by keeping our equipment working. Before radio, trucks cruised

the length of our property without stopping . . . . now, they get instructions enroute, and handle 4 or 5 orders all going in the same direction."

Here are some additional typical statements from users:

First about OVERALL INCREASED EFFICIENCY: "Before radio, the maximum time it took to get a truck to a specific location could easily be 30 to 45 minutes. Now . . with radio . . it is no more than 5 minutes."

SECONDLY . . . . RADIO BOOSTS PRODUCTION: "With swift delivery of raw materials and partly finished pieces to machines, bottlenecks have been broken . . and production boosted."

ANOTHER EXAMPLE . . . . RADIO SMOOTHS OUT SERVICE PEAKS: "Mondays' and Fridays' requirements for material movement at Rohm & Haas Co.'s 46-acre plant, completely overtaxed available handling equipment capability. Now, with radio, the problem has been licked."

ANOTHER IMPORTANT BENEFIT: LESS PAPERWORK . . . . resulting in accurate inventory control: "Before radio, four forms were required to make a material move. Now . . . . with radio . . only one form is required . . . . in some cases, none at all."

OWENS-ILLINOIS GLASS CO., of Bridgeton, N. J. . . . has established a two-way radio system for positive up-to-the-minute inventory control. All material movements are immediately reported verbally . . . without paperwork . . to a central record location for posting.

Previously, because of the amount of paperwork involved . . . posting of material movements might not take place for 2 or 3 days. In the meantime, subsequent relocation moves may have taken place. As you can imagine, much confusion was created by the continual efforts to track down missing lots of merchandise.

A trial installation that started out in March of last year, with a central dispatching base station and 3 radio-equipped forklift trucks, has since been expanded to 27 forklift trucks and tractors. We think this is an excellent testimony of how Owen-Illinois Glass Co. feel about radio communications in a basically warehousing operation.

Radio, of course, is used in plant maintenance functions . . . . and plant security . . . and provides auxiliary benefits of having roving reporters . . . able to sound emergency alarms for fire, operational hazards, or perform civil defense functions.

While we have portrayed a very optimistic story for the use of radio in the material-handling field, I want to emphasize that with each situation, there is need for application study . . . because each case has individual requirements that must be met. In most cases, a shift from decentralized to centralized material-handling equipment control is often a common requirement. It is at this point that the industrial or material-handling engineer must step into the picture and fit the radio tool to the job.

Recently, a new dimension is being added to the familiar two-way radio system. Miniaturized equipment of such small dimension is becoming available . . that we may say . . THE ERA OF PERSONALIZED COMMUNICATIONS IS UPON US. This equipment can be made so compact and lightweight, that it is easily carried in a shirt or jacket pocket. We can foresee before long, that the radio equipment now installed in the truck or tractor, would be carried by the operator at all times. His communications system is then with him . . . whether he is in or out of the vehicle.

Of even greater importance, is the ability of providing communications to key personnel afoot, such as foremen and supervisors. The simplest system would be a "party line" system where everyone hears all calls and responds only to orders directed to him by the dispatcher. Other requirements can be added . . such as selective calling to subdivide the communications by activity, such as . . . warehousing, production support, maintenance, etc. . . . and further key people need listen only to calls directed to them while still retaining the ability to monitor all calls when desired.

Early this year, in February to be exact, RCA announced that we were embarking upon a program to bring out a complete product line of miniature "personal" equipment, and the first item in the line would be a receiver for the 150-mc. band. This was to be field tested and refined throughout the balance of 1957 before other receivers and companion transmitters would be made available.

Gentlemen, here in my hand, is the all-transistorized pocket receiver, weighing 10 ounces, and capable of operating as an integral part of any existing radio system now operating in the 150-mc. band. So that you can measure its quality and performance, we hasten to add that this is an FM receiver, crystal controlled . . . . double superheterodyne . . . . with excellent sensitivity. Its performance is very nearly comparable to the equipment we now install in trucks and tractors. It will operate over 150 hours continuously on a single battery realizing an operating cost for battery power of about 1.5 cents per hour. Here also are the answers to low-cost operation and maintenance . . . and the size is such, that it is truly "personal" equipment. By the addiiton of a transmitter of roughly the same size, two-way communications is achieved.

I'm sure you'll agree that the age of "Dick Tracy" wristwatch radio is almost here . . . and further . . . it is easy to visualize the contribution "personal communications" can make in the material-handling field.

Thank you for the opportunity of appearing on your program.

Mr. BLATZ. Thank you, gentlemen. I know that all of you are very anxious to get to the reception, but I would like to just take 1 minute of your time in order to explain what I feel is the greatest restriction to proper material handling and that is the fear of the word "automation." For that reason, I would like to read to you, word for word, the statements of one of America's most powerful labor leaders, John L. Lewis.

"Modernization of coal-gathering techniques is important for humanitarian as well as economic reasons. Anything that can be done to take slavery out of the daily toil of the human being is a contribution toward improvement of the race, towards modern goals of culture and toward developing the better individual man. Mechanization in the United States has robbed the coal industry of some of its elements of slave toil. If, in addition, the utilization of energy, machinery, improved techniques, can become an economic advantage in lowering cost of production, in which the investor, the worker, and the public as a consumer can participate, then it, indeed, becomes not merely an opportunity but an obligation."

Those are the words of John L. Lewis. I think the bugaboo of automation has long since passed on, and I think that if we in our daily talk and in daily thinking try to eliminate the human hand we are bringing advantages to many of mankind which in the long run will bring this Nation way beyond that of any other country in the world. Gentlemen, I thank you.

Lieutenant Colonel MIRRAS. Thank you, Mr. Mr. Blatz, for an inspiring and timely summary, and thank you members of the Materials Handling Panel.

Just a few announcements, please.

. . . . . Announcements . . . . .

Lieutenant Colonel MIRRAS. Ladies and gentlemen, we will reconvene here at 8 o'clock tomorrow morning. Thank you for your kind attention.

SECTION 4, AIR FORCE PANEL

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Let's Take the High Road

SECTION 4, AIR FORCE PANEL

MORNING SESSION, 2 OCTOBER 1957

Lt. Col. PETER W. MIRRAS. Good morning, ladies and gentlemen. The first panel this morning will be the Air Force panel entitled "Let's Take the High Road."

Col. Sam P. Triffy, who is chairing this panel, was born in Meadville, Pa. He majored in aeronautical engineering at the University of Detroit

COLONEL SAM P. TRIFFY

and worked briefly with the United States Rubber Co., Briggs Manufacturing Co., and Chrysler Corp. Colonel Triffy graduated from flying school at Kelly Field, Tex., in 1937 and has served in Puerto Rico and numerous stations in the United States. During World War II he served as a fighter pilot with the Ninth Air Force in Europe. For the past 2 years Colonel Triffy has been assigned to Headquarters, United States Air Force, where he is the Chief of the Packaging and Materials Handling Division of the Directorate of Transportation. So now, "let's take the high road," with Colonel Triffy. Colonel Triffy.

Let's Take the High Road

Col. SAM P. TRIFFY. Thank you, Pete. Good morning, ladies and gentlemen. Looking through the audience I would like to compliment some of you on your wonderful embalming jobs. Almost a year has passed since we were gathered together to express our opinions and exchange views (some fact and some fiction) on the subject of mutual concern—packaging and materials handling.

Relating our subject to that well-known cliché, "Time heals all wounds," I can report that since our discussion at least year's symposium, some wounds have healed completely; some are slowly healing; some have left ugly scars, and a few are still bleeding quite profusely.

As many of you will recall, last year I emphasized the packaging and materials-handling problems as they relate to the air freight operation. Again, we are choosing this area for our discussions today.

Almost without exception, in every article and report we read from both industry and military we find increased emphasis on air cargo or airlift, indicated by significant increases in "ton-miles" of operation.

The shift is to movement by air—"the high road"—which means, of course, that the spotlight is being focused more and more on the packaging and materials-handling operations because of the very evident economies that can and must be derived from these two functions.

The greatest gains are to be made through the reduction of tare and cube, and the improvement of our handling procedures and systems through mechanization and utilization of loads.

The most significant step that the Air Force has taken in this area in the past year is the adoption of a General Operational Requirement, which we refer

to as a GOR, for a materials-handling support system. This represents, for the first time, an attempt to approach the problem on an Air Force-wide systems basis. This paper represents the best thinking in the Air Force and has been adopted as the ultimate objective in reaching a modern, streamlined air freight handling system.

Essentially, the GOR establishes the principles and concepts around which a materials-handling support system is to be built. The system encompasses all phases of cargo handling from the manufacturer, or original supplier, to the user when aircraft is to be used and takes particular cognizance of the following phases:

a. Packaging with emphasis on minimum tare consistent with protective requirements.

b. Utilization at source or as soon thereafter as practical.

c. Design of air freight terminals to include mechanized materials-handling systems within the terminal.

d. Bridging the gap between terminal and aircraft.

e. Provision of rapid loading and tiedown, and quick release and unloading equipment within the aircraft.

f. And finally, the GOR emphasizes that the system must be flexible enough to operate satisfactorily with side and nose loading aircraft presently in the Air Force inventory, but must be optimized for aircraft with straight in loading features and truck bed height cargo compartment floors, such as the C–130 and C–133 types.

The improvements, as we all know, must come from the operating level, and the job cannot be accomplished unless the operators buy the concept. There are many packaging and materials-handling programs underway in the Air Force today that give cause for optimism that the concepts and principles of the GOR are being accepted by the operators. Here are a few examples:

A finger pier has been built at the Dover terminal. Initially, it will be used in conjunction with the operation of the C–133.

MATS service-tested a unit load and conveyorized handling system for the C–124 at the MATS terminals at Travis and Hickam. Some rather amazing loading times were accomplished. For example, 28,000 pounds were loaded in 27 minutes and off loaded in 23 minutes. Here it becomes obvious that the present 4–5 hours loading times are ridiculous.

USAFE is adopting a so-called "speed load" system in their Air Logistics service. This is based on unit load and conveyorized aircraft floor and bridge concept, together with net tiedown.

As a point of interest, for the first time, an airframe manufacturer is including a roller conveyor floor and net tiedown system in the production model of cargo aircraft.

Tactical Air Command is doing some experimenting with skate conveyors and net tiedown in the C–130 aircraft.

Late last year, AMC established a stripping and consolidation team at the Travis Air Freight Terminal. Tests indicated that some reduction in tare weight and improved turn-around time was realized. As a result, the same type of operation is being established at the other MATS terminals.

AMC has established a program known as STRIP T's at all of its depots. Essentially, this is a stripping and consolidation program at the depots for air shipment.

I want to elaborate a little on these two depacking and consolidating operations. We all, of course, realize that reduction of tare and cube through stripping operations at our aerial ports and at our depots is not the solution to the problem. These two programs must be considered as interim measures only.

One thing that is too often overlooked is the fact that airfreight is in the cargo compartment of the aircraft a very limited portion of the total distribution time. In most cases, this cargo moves by surface means at both ends of the pipeline and is subject to storage at both ends.

This means, as we see it, that the long-range solution lies in the development of packaging materials and techniques and give us minimum weight and cube penalty for movement by air, and yet give adequate protection for movement by surface means and storage. This is a real challenge to all of us.

All of these things are in consonance with the General Operational Requirement for a "materials-handling support system," which I discussed earlier.

These items and others will be discussed in detail by our panel members. I do not want to leave the impression that through the adoption of these programs we have solved our packaging and handling problems. To the contrary, this is only the beginning. We are making some progress and have made a start toward our goal of a modern airfreight handling system.

Our panelists have been selected from two of our operational commands, TAC and MATS, with the express purpose of giving you the operators viewpoint. I might add that we have attempted to tailor our exhibits, static displays and dynamic demonstrations along the same lines.

Essentially, the air cargo mission breaks down into three segments: The AMC LogAir System, the MATS point-to-point or intertheater lift, and the intratheater airlift mission.

Our panel was supposed to have had a third member, but I think you have all heard about budgetary limitations and restrictions. This is an example of it.

Our panelists have been selected from two of our operational commands, the tactical air command and the military transport service for the purpose of giving you the operators viewpoint. I might add that we have attempted to tailor our exhibits, static displays, and dynamic demonstrations tomorrow at Blackstone along these same lines. Essentially the air cargo mission breaks down into three segments—the air materiel command, LOGAIR system, the MATS point-to-point or intertheater segment, and the intratheater airlift service.

I will cover the air materiel command, LOGAIR operation.

The LOGAIR Operation

LOGAIR is a relatively recent addition to our logistic system, having been added to Air Materiel Command around 1954 as their logistical airlift distribution system. This system is made up of four commercial airline contractors using the C–46 and the C–54 aircraft. The contractors furnish the aircraft, the maintenance, and the crews, with AMC providing the management aspects and ground support. In the beginning it started as a high speed transportation system designed to service the various air depots throughout the United States with priority items. Eventually, it branched out to the service of Strategic Air Command and from there went into a regular scheduled customer-service-type operation. Starting with 16 aircraft and 12 customers, it has now branched out to 47 customers and uses 55 aircraft—all devoted toward keeping the users of the B–52, F–100-type fighters 100 percent combat ready against any national emergency.

Now, all airline operations are beset with the same problem—Are we getting sufficient utilization of aircraft? Maximum payload? Is our loading system good enough and fast enough? This is where you people come in. You, the designers and builders of containers, have the prime responsibility of controlling tare weight. You, the makers and inventors of handling equipment have the prime responsibility of devising equipment and methods that will enable us to load aircraft and place the loads within the aircraft in the minimum amount of time. We don't want to keep an aircraft on the ground one minute longer than it takes to fuel and service the aircraft. For example of what I mean—by the end of December 1956, Log Air system was hauling 10,500 tons per month at the cost of around 14 cents per ton-mile. Nevertheless, studies showed us that we were wasting a lot of carrying capacity by hauling excessively heavy boxes, crates, and containers. From this project Strip T's was born—I know what you are thinking, but in this case, I mean the reduction of tare and cube for air freight by stripping excess packaging and crating. Under this program, all AMC depots depackage and consolidate in lightweight air pack containers, to the extent possible, all known "immediate use items" that are to be moved by air. That this was necessary was shown by the fact that within 2 months, we saved enough weight to load 42 C–54's. Dollar savings for the period have been estimated at $990,000—this has increased the carrying capacity to 11,000 tons a month and has reduced the costs to a little over 13 cents per ton-mile. Why am I telling you this? Because stripping is not the answer. The answer lies in you people developing methods of packing that will give us sufficient preservation from the elements, be rigid enough to stand the rigors of surface transportation, and light enough to go by air without wasting our weight-carrying capacity. This is a big problem.

At the present time, the Air Force is using a conglomeration of nonstandard items of equipment, methods, and techniques in the handling of cargo. The present system is obsolete and inconsistent with the requirement for rapid flow of supplies to the field. Packing is excessively heavy, and each item is handled individually many times in movement of supplies from the source to the user. The system requires more personnel and heavy equipment than is necessary and consumes unnecessary resources and potential aircraft flying time. The documentation system is cumbersome and consumes excessive time and manpower. These are the areas in which improvement can and must be made. We must, if we are to survive any emergency or even meet the nor-

mal requirements for expansion, develop a materials handling support system that will encompass every element of packaging and handling to assure that we are getting the best use of our aircraft and existing facilities.

As I mentioned a moment ago—first, we have to start with the basic package in terms of preservation and in terms of damage protection. Preservation is in pretty good shape, and I won't dwell on it during this limited period of time, but packaging for "damage protection," this is something I wish I had 3 more hours to discuss with you. We still pack most of our items as if we were going to throw them off the Empire State Building. Our basic policy sets out three levels of pack which in effect says "If you don't know *all* the storage, handling, and climatical conditions of the item in transit, and at destination—then wrap everything you can find around the item." I just don't like this term of packing for air shipment—and packing for surface shipment. Through the use of different materials we should be able to arrive at a method of pack that will withstand surface handling without a 50-percent penalty on tare weight. We should strive for a tare-weight ratio of no more than 15 percent that we could send by van, rail, ship, or airplane with minimum damage. We should review all our SOP's, Tech Orders, and Specifications and limber them up a little.

Secondly, you handling people have to think up ways of moving material in unit loads and no damage. We have to get away from the handling piece by piece, manually and go into a full system of handling large unit loads mechanically. Terminals have to be mechanized throughout based on the concept of handling unit loads—future design of terminals must have maximum unobstructed floorspace so that we can put in conveyor systems tailored for unit loads. Ramp devices have to be developed that will give us continuity of movement out to the aircraft. Devices have to be developed that will get the item up off the ramp and into the aircraft—we even want semiautomatic devices within the aircraft to move the large unit loads and to secure them to the floor for load stability.

To give you the story on the Intertheater Airlift, I shall call on my friend, Lt. Col. John P. O'Connor. I don't know John too well but I can tell you he was born in Milwaukee at a very young age. He attended West Side School, I think, and I heard this morning a discussion between Colonel O'Connor and Mr. Blatz, whom you heard here yesterday at the Materials Handling Panel, and there was a little discussion about I think the west side having the muscles and the east side having the brains. John has been in the service quite some years, has spent some time in the Military Transport Service and he is extremely capable in bringing you the MATS story. Colonel O'Connor:

These and many other problems exist in the Log Air operation—some of which are being solved and others are unsolved. As I mentioned a few minutes ago, LOGAIR operation is one and the first segment of the airlift pipeline. Along with the customer servicing of the 47 different depots and bases, the system also ties in with the MATS overseas airfreight terminals. So that some of the burdens such as lack of consolidation and excess tare of packing are passed on to MATS and the intratheater segments of the pipeline.

LT. COL. JOHN P. O'CONNOR

Inter-theater Airlift

Lt. Col. JOHN P. O'CONNOR. Thank you, Colonel Triffy. Ladies and gentlemen. Just to set the records straight, I was born in Milwaukee, attended West Division High School and the University. Wisconsin. I am a made-over coast artilleryman (I should say made-over infantryman), then coast artillery, and finally ended up in my present love—the Air Force.

Gentlemen of the conference, on behalf of the Commander, MATS, Lt. Gen. Joseph Smith, I would like to take this opportunity to express our gratitude for having been given this invitation to outline MATS Airlift Mission to you. We of MATS feel that a conference of this type is most opportune for those mutually concerned with packaging and materials-handling problems to reach a meeting of the minds. We feel that if occasionally we are given the opportunity to portray some of our advancements in the military concept of packaging and materials-handling, some of the difficulties that we encounter in our day-to-day operational duties can be resolved to our mutual satisfaction.

One of the major lessons learned by the military in World War II was that airpower is not exclusively combat power, but a composite of combat aviation combined with support aviation. During that time the air logistic support requirements of the Department of Defense were provided mostly by two separate components, the Air Transport Command of the United States Army Air Force and the Naval Air Transport Services. As a logical outgrowth of the National Security Act of 1947 it was determined that the Air Logistic Support Mission could be more economically and efficiently provided through consolidation of the two transport services. This determination became a reality in June 1948 with the establishment of the Military Air Transport Service as a major command of the United States Air Force. This directive provided mainly for the consolidation of the transport operations of the two services.

Another important step taken by the Department of Defense was the directive to establish a "single manager" operating agency for airlift service hereafter referred to as MATS. The primary mission of MATS is to maintain in being, within its assigned area of responsibility, the military air transport capability, augmented as appropriate from civil air transport resources, that will meet the Department of Defense wartime airlift requirements established by the Joint Chiefs of Staff.

The secondary mission of MATS is to employ, during other than wartime, the military airlift capability generated by the wartime requirement, in a manner that will most contribute to the combat readiness of technical units and provide effective airlift service for other Department of Defense establishments. This mission is to be performed by optimum use of military resources available in order to provide adequate wartime readiness, with augmentation from civil resources as required and authorized.

As an additional mission, MATS will continue to operate those technical services and functions that it has presently assigned, i. e., Air Weather Service, Air Rescue Service, Air Photographic and Charting Service, Airways and Air Communications Service, and Flight Service. These are nonairlift functions which are unilateral responsibilities of the Air Force.

Additionally, MATS provides military air evacuation and special air transport missions as assigned by the Air Force. MATS is also charged with operation of assigned domestic airbases and aerial ports of embarkation and certain national interest bases outside the United States. MATS develops and coordinates plans and requirements for air transportation equipment by civil, government, and military agencies and plans for the emergency use of assigned resources, particularly for the integration, as appropriate, of the civil air resources of the United States under emergency conditions.

As a major air command, MATS reports directly to the Chief of Staff, USAF, in the execution of both the air-transportation and technical-service missions. For the discharge of these responsibilities as they pertain to air transportation, MATS has been assigned both Air Force and Navy elements. Navy and Air Force personnel constitute an integral part of the command working side by side in MATS headquarters and at all echelons throughout the command. Both Navy and Air Force transport units operate in performance of the mission. The technical service responsibilities, however, are discharged completely by the Air Force and all transport divisions and technical services report directly to MATS.

MATS scheduled transport missions involve flying over 100,000 miles of global air routes with aircraft touching down on bases in many countries and island bases in the Atlantic and Pacific Oceans and virtually every point of the globe where United States troops are situated or where there is American interest.

MATS is a trunkline operation in that it normally provides direct service from the United States to main distribution points within overseas theaters of operation. Intratheater air movement of traffic is accomplished by the theater command through short-haul service provided from its own resources.

Fountainheads of MATS overseas movement are from aerial ports of embarkation located at Travis Air Force Base, Calif., McChord Air Force Base, Wash., Charleston Air Force Base, S. C., Dover Air Force Base, Del., Washington National Airport, D. C., and McGuire Air Force Base, N. J. In its basic concept, MATS is prohibited from competing with commercial air carriers within the United States; one exception to this exists in a system of air routes operated for the purpose of evacuating sick and wounded military personnel between hospitals throughout the country. This service provides a capability which civil air carriers cannot accomplish inasmuch as the MATS fleet of air evacuation aircraft is configured specifically to meet this requirement. In addition to transport support mission to overseas theaters MATS aircraft are involved directly in supporting deployment of Strategic Air Command units throughout the world.

The present MATS fleet is composed of many types of aircraft, some of which are comparable to those used by commercial carriers. The C–54, C–118, C–121, and C–97 provide mixed or specialized cargo/passenger/air evacuation capability, while the C–124 has the capability of carrying more than 90 percent of military inventory of supplies. Although primarily a cargo-carrying aircraft it will carry 200 troops in emergency operation. The C–131 is configured for air evacuation of troops. The C–133, a turboprop transport, provides a long-range, high-speed, large-capacity cargo capability.

There is a constant challenge imposed on any air carrier, civil or military, by the need for developing procedures and techniques to be employed in expediting the movement of cargo. The future indicates a continuation of the great postwar growth in the use of commercial air transportation. It has been proven to the satisfaction of military planners, that the use of air transportation for long-range movement of personnel and supplies is economically feasible, even necessary, considering the tremendous reduction of pipeline time for cargo and also that required to transfer personnel between stations.

From the inception of air transportation a primary problem that has plagued the management of both the military and civil air carriers has been that of devising means of expediting the movement of cargo through the warehouse, from the warehouse to the waiting aircraft, positioning within the aircraft, and securing adequately for airlift to final destination.

The Department of Defense has recognized the advantages of air transportation in reducing pipeline time for delivery of supplies between the Zone of the Interior and overseas bases. Reduced pipeline times in turn mean greater reductions in supply inventories with the resultant savings of large sums of money that heretofore would have been involved in procurement and storage. Thus, there will be in the future a concerted effort to reduce the amount of time that a piece of cargo remains on the ground or is delayed in transit to the minimum consistent with safe economical operation. The logistic system of delivery involves several elements, all of which are of importance within themselves and all of which interact upon each other to produce the end result—rapid delivery.

The Commander, MATS, is of the opinion that the military has an unparalleled opportunity to develop an optimum materiel transportation system. The military controls the shipment and storage of material from the manufacturer's plant to the point of use; it determines the method of packaging; and the kinds and capacities of all materials-handling equipment. The military can, over a period of years, adjust the dimensions of its aircraft, trucks, rail cars, and shipments to suit the requirements of any standardized system which is feasible to adopt.

Future developments must include methods of unit-size packaging which will allow transshipment of cargo via, and between, all carriers with a minimum expenditure of time and effort for repacking, altering, or manhandling. This can only be accomplished through joint study and review of military and industry, packing and materials-handling procedures, which exist or are in the process of revision.

In preparing to meet the requirement which will be imposed for moving greater volumes of cargo within more restrictive pipeline times, MATS has established the basic criteria that a high speed internal cargo-handling system is necessary and that this system must be as automatic as possible, commensurate with economy. Every possible operation must be performed mechanically if a mechanical system can perform the operation more economically than a man. This reduces the number of employees required and greatly increases the productive responsibility of the individual employee. A program such as this has been developed in which the documentation of cargo, mail, and passengers is mechanically accomplished by means of IBM punchcard system. This has resulted in a great savings in traffic processing time in all areas thus far involved. By the end of this year it is anticipated that mechanized documentation will have been implemented at all Air Materiel Command depots in the Zone of Interior, all aerial ports of embarkation, and major MATS installations overseas, and throughout the Far East Air Forces and United States Air Forces in Europe intratheater airlift systems.

To further expedite delivery the consolidation of packages weighing 20 pounds or less at MATS aerial ports of embarkation was instituted. We in MATS have always handled a large volume, numerically, of small cargo pieces, literally thousands, per month at each APOE. Of necessity, this has been a time consuming, laborous job. We have recently completed a service test wherein small packages, with few exceptions, were consolidated at the APOE's by destination into unit containers and moved as a unit piece of cargo in accordance with the highest priority included. Test results from virtually all areas concerned express complete satisfaction and records proved that the cargo spent less time in the pipeline and that damage and loss were reduced to a minimum.

Another area being explored for future implementation is the procedure for reducing pipeline time for cargo, the 2-category priority system. For many years the practice has been to assign any of four priorities to cargo, depending upon its importance. This has frequently resulted in lengthy and unmanageable logjams at our air terminals as shipments of lower priority remain for as long as 2 or 3 weeks while being bypassed by higher priority cargo. Service tests are currently underway wherein all priority 1 cargo moves on the first available aircraft and the remainder goes on a first-in first-out basis. Reports of the results of this test are encouraging and indicate that priority 1 cargo is averaging less than a day and a half at our APOE's and all other cargo is moving in a little over 4 days.

To further simplify warehousing a procedure for palletizing cargo, which involves the simple and logical consolidation of several individual shipments of cargo into a unit load and securing to an air transportable pallet, is another step in the streamlining innovation by MATS. Pallets are assembled at the receiving dock at the air terminal, the point where they enter the MATS system, and many individual pieces, once consolidated, are thereafter handled as a unit piece. The advantages realized from palletization are conclusive, some of which are:

Reduction in the number of times the individual piece is handled as such.

Reduction in aircraft loading time.

Reduction in manpower required to load aircraft at any given time.

Better utilization of available cabin space.

Less damage to cargo by reducing the times handled and elimination of rough handling because of size.

MATS is currently studying another system in warehouse operation where mechanization is vital. In this system an electric wire is strung overhead along routes to be followed by a tractor train. An electronic brain mounted on a tractor senses the electric current transmitted from the wire and is unerringly guided by its impulse. In operation, the cargo would be placed on trailers in the receiving area, the tractor picking up the trailer(s) delivers it to the proposed section in the backlog area where it is dropped and stored. When an outbound load has been determined the warehouseman assembling a load operates the trailer throughout the warehouse, assembles his chain of trailers and guides it to the load buildup area. The advantages of this system, not readily available in a fixed-type conveyor system, are:

It can be quickly installed in existing facilities.

Guidelines can be easily rearranged to meet changing situations.

A central control station can remotely direct the movement and direction of all trailer units in operation. It is estimated that the productivity of manpower can be improved by as much as one-third through the use of such a device.

Another method of cargo handling within the warehouse under experiment, which will provide mechanization, is one of powered-roller conveyors. In this method parallel conveyor lines are installed in the warehouse in a manner which will provide straight directional flow of cargo movement from the receiving area to the final load assembly area. A review and comparison of all systems in effect or being contemplated will provide valuable guidance in developing future systems for both military and industry.

It has long been recognized that movement of cargo between the terminal and the aircraft has been expensive in terms of manpower, time consumed, and vehicles required to do the job. Improved aircraft flying-hour utilization and insistance on reduced ground-handling times dictate that the gap between the aircraft and the loading dock, i. e.,

actual placement and tiedown in the aircraft, must be reduced. There are two pieces of ground-handling equipment which should help resolve this problem:

One is the Aerobridge which is a piece of equipment consisting of a main span supported by two towers mounted on carts or dollies. The inner cart is so designed and guided along the face of the dock that rotary and transitory motion of the bridge can be accomplished by power and steering arrangements installed in the outboard cart. The forward end of the main span can be extended and retracted to fit various aircraft and to compensate for varying parking arrangements of aircraft. It is adjustable in both length and height. It is self-powered for rotation through an arc of 180° and for movement along the dock area. The maximum extended length of this piece of equipment is 89 feet. The width of the prototype model is 10 feet. All elements of the bridge can be disassembled for transport on 70-foot rail flatcars. The prototype of the Aerobridge is currently being service tested and the future development problem, within MATS, is to find a loading bridge type of device which will be readily adaptable to the loading problems of the C–124 and the newer low-cabin vehicles.

Another is the self-powered, portable-ramp conveyor, which is a fully assembled ramp that telescopes from 83 feet extended to 35 feet retracted. It may be retracted or extended by a self-contained power unit, and all control is exercised from the operator's station. The airplane end can be adjusted in height by power-driven jacks incorporated in the wheel mounts. The forward platform is fully adjustable and automatically leveled by means of synchronized power drives. The aft end is adjustable in height by means of hand jacks incorporated in the wheel mounts. All four wheels are equipped with brakes. Cargo transport is provided by means of a full-length conveyor comprised of a rubber-surfaced belt approximately 7 to 8 feet wide. The conveyor is power-driven in either direction at the rate of speed of about 85 feet per minute. As a further advantage, this conveyor will be fully demountable and can be carried in a C–124 aircraft.

It can be used either in a dock-to-aircraft or ramp-to-aircraft cargo-transfer operation. This item may provide the answer to the problem of loading through the nose of the C–124 aircraft where the two angles of incline have made other loading measures extremely difficult.

Within the near future MATS will begin to take delivery of the long-range, turboprop C–133 cargo transport. This aircraft is designed to carry large cargo loads for great distances at relatively high speeds. For this aircraft, with its increased lift capacity and cabin loading space, existing aircraft loading and discharging methods are far too slow and costly. High deck aircraft, such as the C–124 are now loading with great expenditures of time and manpower. Douglas Aircraft Co. has developed, for use with the C–133, a special arrangement of removable, free-rolling, lightweight conveyors that can be used with all types of cargo, particularly palletized loads, yet set aside for peculiar vehicle loadings. By use of these conveyors on the floor of the aircraft it is possible to transfer heavy loads of cargo in a minimum amount of time using a reduced loading crew. In an actual demonstration, a 70,000-pound cargo load, premounted on conveyors, on flatbed trailers was transferred into tiedown position aboard the aircraft in 14 minutes, ready for tiedown. MATS can foresee use of the portable loading ramp being used in conjunction with this loading method to effect maximum speed in load placement and discharge.

In conjunction with the conveyorized loading system, Douglas has developed a method of securing cargo that is integral with the aircraft. This consists of an arrangement of nylon web nets strung along the cabin of the aircraft in an overhead position when not in use. When the cargo load is in place to meet weight and balance requirements, the overhead net is simply released and dropped, shroud fashion, over the cargo load and secured to the standard fittings in the floor. Pressure on the load is supplied by takeup devices built into the straps. A series of spring clips will hold the net in overhead position when not in use, obviating the time consuming folding and unfolding required. A feature to provide additional security will be a series of fore and aft restraint barriers set at intervals throughout the cargo load. These will, in effect, develop an element of island loading.

The entire air transport industry today stands on the threshold of a new era which will see the advent of new designs in aircraft. Jet, turbojet, and turboprop aircraft will provide a capability of air movement far in excess of existing vehicles when measured in terms of payloads, range, and rate of speed. These advanced aircraft will generate new problem areas to both civil and military management.

MATS, as the major direct support logistics air carrier of the Department of Defense, anticipates that the most acute problems in the field of traffic movement will arise in the handling of cargo.

I have, in the time allocated to me, attempted to outline for you the measures currently in effect, or anticipated, for early future development by which these problems will be met. All of us in MATS are keenly interested in working jointly with industry in the development of materials-handling procedures for our mutual benefit, which are vital to our national defense. I would like to close in quoting Field Marshall Montgomery's famous passage, "Air transport is the *best* means to get supplies to most places, it is the *only* way to get supplies to some places, and it is the *fastest* way to get supplies to any place." Thank you.

Col. SAM P. TRIFFY. Thank you, Colonel O'Connor. The Tactical Air Command operation, the Intratheater Air Logistic Service, will be presented by Lt. Col. Roland K. McCoskrie, who was born in Walla Walla, Wash., and attended high school in LeGrand, Oreg. His service dates back to 1939 when he enlisted in the Army Air Force. He was commissioned in 1942, graduated from the flying school in 1949. During World War II he spent most of his time in the Pacific, Iwo Jima, and other Pacific islands. He has been in troop carrier throughout his entire career. At the present time he is Chief of the Transport Movement Control Section at Headquarters, Ninth Air Force, Shaw Air Force Base, Sumter, S. C. It is a pleasure to introduce to you Colonel McCoskrie.

Intratheater Airlift

Lt. Col. ROLAND K. McCOSKRIE. I am here this morning representing Tactical Air Command and specifically, the Combat Airlift Forces of TAC—the Troop Carrier Units. We are the last formally organized airlift force using this air transportation "High Road"—operating out where the aerial freeways of Log Air and MATS have degenerated to rut filled narrow trails full of tight turns, unmarked fields, and particularly barren of the "Packaging and Materials Handling" facilities which are points of interest here today.

In the 5 or 6 months preceding this symposium, I have had several injections from Colonel Triffy's "motivation" needle. Most persistent among his requests has been to have these panel presentations represent the operator's views on the many syllabled subject of this symposium—the grassroots approach, if you will. Unknowingly, perhaps, he was playing right into my hands. Frankly, this packaging and handling problem, explained in highly technical engineering terms, loses me somewhere out on the downwind leg. The problems Troop Carrier has to face arise on the bare ground airstrip, and must be solved either back in stateside laboratories and warehouses or suffer the "big hammer" application of frontline ingenuity. In my allotted time this morning, I would like to present to you our customers—the men our Tactical Air Command airlift serves; a

Lt Col. Roland K. McCoskrie

brief illustration of where we find them and how we get to them, and then relate our mission to the subject at hand.

In the combat airlift business, intratheater airlift, we serve two individuals who have peculiar packaging and handling problems—one the frontline ground combat man, and the other the forward airstrips crew chief. True, intratheater airlift many times involves routine logistic operations, from and to fixed terminals. In these operations, troop carrier can accept the AMC–MATS developed facili-

ties and equipment as long as it can be laid down, by air, where it is required. But, these other two individuals, the ground fighter and the crew chief are the men we are most concerned in helping. To help you understand the problem, I have asked two people to be here today.

First, I would like to introduce Sergeant Pack, an Air Force Combat Controller. Yes, the Air Force has ground fighters, too, and you will find Sergeant Pack the first man on the ground in many airborne operations, ready to provide a communications system for the troop carrier serials, and also do a little shooting, if necessary, to protect his position.

Next, I would like to present Sergeant Blanton, an F–100 crew chief who depends on us for tools, parts, and fuel to keep his fighter operating from a forward airstrip.

I would like you to observe the equipment these men carry—the tools of their trade, and with which they must finally unpackage and use what we in the Zone of Interior have so firmly bound together. Keep this in mind as we take a look at where we will find these people working.

(FILM STRIP HERE—Lights down)

This first scene is a little gem of a one-way forward airstrip—one-way because there is only one way to get in and use the same way to get out. This picture illustrates the use of the C–124—not in the troop carrier inventory now. The strip is in Alaska—and is typical of what we will have to use for dispersal bases should activity develop in that area.

The next scene shows a typical cold-country operating base—this one happens to be at McMurdo Sound, near the South Pole, but is typical of all the Arctic and Antarctic regions. Again, illustrating the C–124, but equally applicable to all troop-carrier operations.

Will your carry-lift operate effectively in snow and on ice? Is the package easy to open in temperatures of minus 50° and below? These are typical troop carrier problems.

This last scene shows where we find the ground fighter—austere, I believe, is the word we use to describe the facilities in the technical papers. On the scene, austere means move it with what you have at hand—what of your base equipment lent itself to coming in by air, and which was rugged and versatile enough to do the job.

(Lights up)

You have met our customers and looked at their working environment. Now let's relate that to the packaging and materials-handling problem.

To preface any discussion of this problem, we must first present our delivery methods. An egg can be transported and be usable on delivery without any special packaging if it doesn't leave the carrier's hand. If he has to throw it 1,500 feet to the customer, this calls for a little more preparation.

In troop carrier, we deliver either by air landing or aerial delivery. Each method poses distinct problems, but unfortunately we can't segregate the two until a day or two, sometimes an hour or two, before the requirement becomes a reality. We must be prepared for any contingency. This doesn't mean revert to the old philosophy of "We don't know how we'll deliver it, so prepare for the worst." Rather, let's start at the other end. All the crew chief on the ground fighter wants is the bare item, ready to install or use. If it is reasonably rugged, can be bounced a few times without damage, and lends itself to stacking, don't put anything on it. If it needs some protection from the elements, start with a plastic bag that only weighs an ounce or two, and can be easily torn open. Give the item the minimum amount of protection necessary to insure its safe arrival, but keep in mind that it is nothing but a useless object until it gets to some crew chief who is going to have to carry it across the ramp in his hands and open it with a screwdriver and a pair of pliers.

The aerial delivery container is a problem in its own area, and is worthy of some special attention. The requirement is for a package that provides the greatest carrying capacity to container weight ratio—versatile enough to deliver a 1-pound thermometer on a 7-ton vehicle, and is simple to unload and handle on the ground.

I would like to report some significant progress in this field to you here this morning. We have made some gains, and they are illustrated in our exhibits at Fort Lee, and some will be demonstrated tomorrow at Blackstone. TAC is not a development agency, so we are dependent upon you manufacturers and your researchers, and upon you procurement people in the military, to provide us the raw materials to make our system work.

One of the most astute evaluations of the air freight business I have ever heard came from a much-harried traffic officer at one of our northern stations. I had just landed and been informed that I was the 11th airplane in line to be unloaded. After telling the man in a few, probably ill-chosen words, what I thought of the situation and the prospects of having to RON, I calmed down a little and expressed the observation—

"Well, I guess you do have a problem here." He said, "No, Colonel, we don't have any problems. The problems in this business were all solved 10 years ago. All we got here is conditions."

We in the TAC have the conditions, many and varied. We thank you for this opportunity to present some of them to you. We look to you to use foresight and imagination to give us the wherewithal to effectively and efficiently serve our customers under these conditions.

However, in spite of what Colonel Triffy said in his presentation, I watched a 30,000-pound load loaded aboard a 124 at Dover—loaded and tied down in 14 minutes flat. We are making progress.

We had hoped to pull a flyby of the 133 at the demonstration at Blackstone Army Airfield tomorrow. However, as is always true of new equipment, we have run into prop-gear trouble on the 133 and we will not be able to fly the big bird by. I am truly sorry and apologize to you because I think you would have gotten a kick out of it. Thank you.

Col. SAM P. TRIFFY. Thank you Colonel McCoskric.

In summary, we have presented a brief but thorough coverage of the airlift pipeline—"The High Road"—yesterday you heard the Army's presentation of its Project MASS—a test operation of supporting its Seventh Army of essential items by use of airlift. This speed of delivery reduces inventories, increases flexibility, and improves customer service. Many of you are aware of the Navy's Project FAST—a similar test operation using fast delivery primarily by airlift in support of its Sixth Fleet in the Mediterranean. The Air Force had its test projects—some of you may remember "Red Head". As a result of the Air Force Air Council decision in 1955, air transportation was declared a normal mode of transportation—so airlift is a routine and normal mode of distribution with emphasis on high value and critically needed items.

The Air Force's announced goal to improve its logistic system—by building a fast, responsive, and dependable distribution capability that will reduce procurement and save dollars and eliminate obsolescence to the greatest degree—and eliminate warehouses and storage depots by having our needed *materiel intransit—in the pipeline*. This capability can never come to reality without great advances in packing to drastically reduce tare and cube and retain adequate protection—and the development of highly mechanized handling procedures and equipment that will encompass all modes of transportation but compatible with the requirements for airlift—with the premium carrier—the airplane. We have a big job cut out for us—in the past year we have made some progress but not to the extent that we can be proud—in fact, we've only scratched the surface—so with your indulgence I would like to repeat last year's statement—"let's get off our asphalt ramps and fly that airfreight."

In behalf of Colonels O'Connor and McCoskric, we thank you for your attention—hope we have contributed and hope to see you at the exhibits on this base and Blackstone Airfield tomorrow.

Lieutenant Colonel MIRRAS. Thank you, Colonel Triffy, Colonel O'Connor, and Colonel McCoskrie for your stimulating presentations.

Gentlemen, let's take a break. Coffee is being served in the lobby. Please be back in your seats at 10 minutes of 10.

(Whereupon a short recess was held.)

SECTION 5, NAVY PANEL

Now Hear This

SECTION 5, NAVY PANEL

Lieutenant Colonel MIRRAS. Gentlemen, next is the final panel of our symposium. This is the Navy panel entitled, "Now Hear This," chaired by Comdr. Harry E. Stirling.

Commander Stirling is currently Head of the Standardization and Packaging Branch in the Office of Naval Material.

He graduated in 1940 from Worcester Polytechnic Institute with a B. S. in mechanical engineering. The following year he entered the Navy as an ensign. During World War II he served in amphibious operations in the Pacific. Commander Stirling has had duty with several naval shipyards on the east coast and with the Inspector of Naval Material for Petroleum, Middle East. He was Bureau of Ships Technical Officer at the Submarine Supply Office, and until a year ago he was responsible for standardization in the Research and Development Division of the Bureau of Ships. Commander Stirling.

Now Hear This

Comdr. HARRY E. STIRLING. Yesterday morning General Magruder pointed out that the widespread dispersal of troops, necessitated in the eventuality of nuclear warfare, will affect package quantities and handling systems. The Marine Corps plan of "Vertical envelopment" in landings on hostile shores is an outstanding example of the magnitude of the handling problem which may be upon us any day in one of the "little wars" which the newspapers hint are inevitable, even if we can avoid a major upheaval and its resultant devastation. Lt. Col. William H. Costello of the Logistics Section of the Marine Corps Development Center, Quantico, Va., will tell you of the Marine Corps plans and its needs. Colonel Costello was born in Portland, Maine, and graduated from the University of Maine. He was commissioned a second lieutenant and subsequently designated as a naval aviator in 1942. During World War II he served as a fighter-bomber pilot in the First and Third Aircraft Wings in the Pacific. Since the war he has served on various aviation staffs

COMDR HARRY E STIRLING

of the Fleet Marine Forces. I am very happy to present to you Lieutenant Colonel Costello who will deal with the subject of "Marine Corps Developments." Colonel Costello:

Marine Corps Developments

Lt. Col. WILLIAM H. COSTELLO. The primary mission of the Marine Corps is to provide Fleet Marine Forces of combined arms, together with supporting air components, for fleet operations— to conduct amphibious operations.

The magnitude and complexity of the logistical support required for any modern military operation has increased immeasurably since World War II. In amphibious operations the precise planning and timing required makes this support even more critical.

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With the advent of nuclear warfare in the closing days of World War II, it became apparent that many of the techniques of amphibious warfare, so recently perfected by the Navy and Marine Corps, were rendered obsolescent. We could no longer concentrate our assault and resupply shipping in an area of limited radius and our landing forces on well-defended beaches, as was done with success during World War II. To do so would subject our forces, assault and support, to decimation.

Lt. Col. William H. Costello

Consequently, in 1946 the Marine Corps initiated action to completely review the concept of amphibious operations.

The problem was subjected to intensive study by a small group on forward-thinking officers at Marine Corps Schools, Quantico. Dispersion of ships, men, and equipment and vastly increased tactical logistical mobility provided the answer. But how to gain this dispersion and mobility? Consideration of this question led to an entirely new concept of the amphibious assault—a vertical envelopment employing helicopters.

This concept of amphibious assault permits our forces to attack an *area* of our own choosing as opposed to having to assault a well-defended *line* on the beach under terms dictated by nature or the enemy. Furthermore, forces are permitted to disperse to such distances that large-yield nuclear detonations will not lead to their destruction.

Rather than delivering our assault forces by slow-moving, 6–10-knot landing craft from a concentration of ships lying a few thousand yards offshore, we deliver these elements by helicopters traveling at rates of speed better than 100 miles per hour from widely dispersed shipping up to 100 miles away.

The concept of vertical envelopment by helicopter thus having been evolved, an intensive helicopter development program commenced. In 1947 the first helicopter assault doctrine was written at Quantico and a helicopter experimental squadron, HMX–1, was commissioned to test and evaluate the doctrine under simulated combat conditions.

These peacetime developments, which began with two-man helicopters, were soon to be battle tested. On August 4, 1950, the first helicopter evacuation of a casualty in the Korean war was successfully executed by Marine Observation Squadron 6. In the summer of 1951 HMR–161, the first helicopter transport squadron in history, was committed to combat in support of the First Marine Division. The helicopter assault doctrine conceived at Quantico was put to the test by such combat operations as: Lifting an infantry unit to the frontlines; the landing of another company at night; the relief of a battalion with full equipment on the main line of resistance; supplying an infantry requirement for a week at the front; and transporting batteries of rocket launchers and crews to firing positions and quickly removing them to new positions before counterbattery fire could be brought down upon them.

The development of the helicopter assault concept, during peace and war, has produced in place of the old two-man helicopter—the latest in combat helicopters, the HR2–S. This twin engine helicopter has the capability of lifting a payload of 5,000 pounds or 20 troops over an operating radius of 100 nautical miles.

Parallel with the advancement of the helicopter as an assault force carrying vehicle, is the development of a technique to resupply the attacking forces with the same rapidity with which they strike. Using the same criteria as was used in developing the new concept of vertical envelopment, a method of resupplying the assault forces by helicopter has evolved. As the helicopter provides for improved speed, mobility, and flexibility of the assault forces, it in turn lends itself to extensive flexibility of resupply.

This need for high-speed mobility has generated the requirement for the development of lightweight durable packaging techniques and a family of helicopter transportable cargo containers, and/or platforms, which will insure that combat supplies and equipment carried are readily available, efficiently packaged in easily handled modules, and are ready for movement as a unitized load to the using unit ashore.

Although our helicopters are designed with the capability of carrying the payload either internally or externally, experience has shown that the most satisfactory method of conducting resupply operations is by external carry. After examination the reasons become easily recognizable:

1. Internal carry requires an excessive amount of time for loading and unloading.

2. With internal carry the center of gravity becomes a critical consideration.

3. External carry provides for more efficient use of helicopter because of faster turn-around time.

4. External delivery minimizes the congestion at the loading and landing sites.

5. Externally carried cargo may be quickly jettisoned in case of emergency.

An automatic pickup device on the helicopter, which would eliminate the requirement for manual hookup would make the external-carry method even more affective.

In the past year we have reached no satisfactory solution in the development of containers for handling unitized loads. The presently used steel wire pallets and steel wire baskets present no lift-carrying problem, but do not provide for adequate flexibility in that they do not lend themselves readily to coupling and uncoupling for use with helicopters of varying load carrying capacities, nor can they be conveniently stacked for storage. The tare weight of 1,400 pounds in the steel transporter makes it much too heavy for use in amphibious operations. The simple platform-type pallet lends itself very well to normal warehouse handling operations, but it is not stable enough for helicopter lift nor rugged enough for ground handling; and, here again, it cannot be adequately coupled to another platform.

Therefore, I would like to take this opportunity to again state our requirements for packaging and handling of materials for an amphibious operation and the desirable military characteristics for products to meet these requirements.

First, the requirements:

1. A lightweight *expendable* unitizing medium for the movement of rations and ammunition from ship to shore and between intermediate points ashore.
2. A lightweight *nonexpendable* unitizing medium for the movement of heterogeneous loads from ship to shore and between intermediate points ashore.

Next let us look at the desired military characteristics of products which will satisfy these requirements:

First: An amphibious platform transporter for carrying rations and ammunition by helicopter.

1. 1,000-pound capacity (minimum).
2. Be capable of stacking when loaded.
3. Expendable and low cost.
4. Weight not more than 25 pounds.
5. Pallet type base 40 by 48 inches.
6. Rugged enough for forklifting, dragging, and stacking; have skids, rollers, or other appropriate means to facilitate movement on rough ground for short distances.
7. Units must couple to each other in tandem or cluster for external carry by helicopter, and must have capability of rapid coupling and uncoupling.
8. Capable of being lifted and carried externally by helicopter.
9. Minimum life of 5 years in open storage.

Rations and ammunition comprise approximately 70 percent of the resupply load for the assault forces. A container that can be prepackaged at the staging area and which will remain in that configuration until the contents are expended by the combat troops is desired.

The military characteristics of a platform transporter for carrying heterogeneous supplies, i. e., all other than rations and ammunitions, are virtually the same as those of the rations—ammunition container, with these exceptions: This second container should be nonexpendable and the weight limit can be increased to 50 pounds.

These supplies would comprise approximately 30 percent of the resupply lift. Supplies carried by these containers would be determined by the needs of the combat troops as the action develops. Reusable containers would add to flexibility in fulfilling requirements for displacement of supply dumps.

Modulized packages with these features will provide for their lift by any of the aircraft in the present helicopter family. The airplane with the lightest

lift carrying capability, the HOK observation-type plane which does have an external-delivery capability, can readily carry one such package. By coupling and stacking, the HR2S, presently our largest helicopter, could successfully carry several of these modular packages.

The method of packaging of combat rations and ammunition presently lends itself very well to preparation for airlift. Until a radical development presents itself in the field of combat rations, improvement of the packaging system for rations is not essential.

However, there is a need for the improvement of ammunition packaging. The present system is sound, but a reduction of tare weight, at no increase in cost and with no loss of efficiency, would be of great value.

This discussion was entitled "Marine Corps Developments." So far you have heard little about Marine Corps developments, but only a restatement of our requirements that were brought to light during last year's assembly.

In addition to the fact that the foregoing problems have been studied extensively, we have been working on other developmental programs peculiar to our own needs.

Our developmental program has not been solely concentrated on helicopter delivery methods. We have also improved the conventional methods of moving supplies from ship to shore by use of landing craft or landing ships in conjunction with helicopter means. Although we have conducted no research and development program in heavy drops from cargo-type aircraft, we do test and evaluate other service developments which are on consonance with Marine Corps requirements. We have the capability to employ the heavy-drop method from cargo aircraft to supplement the delivery of supplies by helicopters and normal means; and, at the present time, test and evaluate equipment which may be used to drop a load up to 25,000 pounds in weight.

As an *emergency* means of supporting combat elements we have in the developmental stage two delivery means for supply of frontline troops, with virtually pinpoint accuracy, from high-speed aircraft. All Marine and Navy tactical aircraft that are equipped with bomb racks have the capability of this delivery. The first of these is the 34-foot Ringslot Parachute. Using this parachute, the standard M3A1 and Mod 4 aerial delivery container can be delivered from tactical aircraft flying at speeds up to 400 knots.

The second of these developments is the Rotochute manufactured bw the Kaman Aircraft Corp. The rotochute, which has a cargo-carrying capability of 500 pounds, resembles a helicopter in principle. The blades are attached to a hub which in turn is bolted to a standard aerial delivery container. Upon release from the carrying aircraft the blades commence rotation and permit the device to descend slowly to the ground. Simply, the principle can be compared to that of a falling maple seed. This device has been successfully dropped from aircraft flying at speeds faster than those for dropping the ringslot parachute.

Again, let me emphasize that these are *emergency* delivery methods.

Packaging and handling of large quantities of fuel for resupply of vehicles and aircraft has long been a major logistical problem. This problem has become enlarged with the modern concept of amphibious operation.

Digressing for a moment, during the first offensive in the Pacific in World War II at Guadalcanal, when fierce enemy air and naval opposition impeded the movement of supplies ashore, aviation fuel was air transported to airstrips in standard 55-gallon drums. This improvised system maintained our planes in the air, but it did require thousands of drums of fuel and uncountable wasteful hours in manhandling. For an excellent example of a time-consuming manhandling operaiton, let us look back on the Normandy invasion. To resupply the assault forces, 2½ million 5-gallon cans of fuel were hand filled, a task which required 30 days to complete.

An expanding developmental program has been directed toward the employment of the commercially developed sealed-bin rubber fuel container. This container, which is helicopter transportable, has a capacity of 525 gallons. It is a rugged item which can be thrown, pushed, rolled, manhandled, or dragged with a jeep to the desired location. Employing these containers with helicopter-carried 10,000-gallon collapsible-rubber gasoline tanks and with helicopter-liftable pumping equipment, small-scale tank farms can be quickly established at any feasible site.

Summarizing, we have developed or tested, with satisfactory results:

1. Two emergency methods of delivering supplies to combat elements by high-speed tactical aircraft;
2. A capability of rapidly establishing tank farms in the battle area, employing helicopter-carried equipment; and
3. The capability of airdrop of heavy loads weighing up to 25,000 pounds from cargo-carrying aircraft.

We have a requirement for:

1. Lightweight amphibious platform transporters, both expendable and nonexpendable, for the airlift of modulized loads of 1,000 pounds weight from ship to shore and between intermediate points ashore.
2. A packaging system for ammunition which retains the efficiency of that presently used, but with a reduction in tare weight at no increase in cost.
3. A hookup device, which is an integral part of the helicopter, that can be operated by the pilot or crew when picking up lifts without a requirement for deck or ground-handling personnel.

In a speech presented to Virginia Military Institute Alumni Association in New York City on May 12, 1955, Gen. Randolph McCall Pate, Commandant of the Marine Corps, stated: "The Nation itself made its beginning not from a reservoir of raw power, but from its resources of courage, skill, and imagination. Those assets are still our greatest wealth."

These vast resources are well represented here today. We look to the future with confidence for the solutions to our problems.

Comdr. HARRY E. STIRLING. Thank you very much, Colonel Costello. Our next speaker is Comdr. Ralph E. Fullam, Planning and Administrative Director of the Naval Supply Research and Development Facility at Bayonne, N. J., who will review the work of that activity in its contributions to the problem of handling of supplies during underway replenishment, that is the underway replenishment at sea you have often seen between supply ship and combatant vessel. Commander Fullam has a wealth of experience in the specialized field of materials handling as they affect ships. His cargo-handling experience dates back to 1936. He entered the Navy in 1942 and has had extensive experience with commander service forces in the Pacific Fleet with underway replenishment at sea. During World War II Commander Fullam saw service both in the European Mideastern Theater and in the Asiatic Pacific Theater of operations. I take great pleasure in presenting Comdr. Ralph E. Fullam, who will tell us about the tools the Navy uses for underway replenishment at sea. Commander Fullam:

Tools for Underway Resupply

Comdr. RALPH E. FULLAM. Underway replenishment as we know it today had its inception during World War II, but its influence on the mobile logis-

COMDR RALPH E. FULLAM

tic support concept was perhaps not fully realized until the outbreak of the Korean war in June of 1950.

During the early months of that war the urgent need for specific materials-handling equipment and the emphatic requirements for newer concepts and techniques in underway resupply were voiced by the logistics staff of the Commander Service Squadron Three then operating in Korean waters.

The ability of a ship to replenish underway is an essential military characteristic, and the ability of a fleet to maintain itself and operate, in any given area, is largely dependent upon the proficiency it can assume during the underway replenishment evo-

lution; hence, the paramount importance of the tools for underway resupply.

The cardinal military essential to be achieved during the underway replenishment operation, has been emphatically expressed recently in an instruction given over the signature of the Commander, Sixth Fleet, and is quoted herewith:

> "In the case of receiving ships, the requirement is that the ship be so organized to replenish at sea rapidly, accepting cargo at the rate of transfer by the delivering ship; and, also, that the cargo be sorted, segregated, and struck below at about the same rate as the cargo is received; while simultaneously maintaining a state of combat readiness approximating that of general quarters."

It is, therefore, self-evident, that without the development of newer techniques and tools for underway resupply, it would be impossible to achieve the standards set forth in that instruction, for the use of manpower alone is not enough.

The vital necessity for proficiency in the underway replenishment evolution and the adoption of newer concepts and techniques in underway resupply is dictated by the fact that in future warfare the definite prospect of the utilization of nuclear weapons confronts us.

For the past several years, the United States Naval Supply Research and Development Facility, presently under the command of Capt. Marion D. Sims, Jr., Supply Corps, United States Navy, has been engaged in the development and evaluation of materials-handling units for underway resupply, many of which are presently in use, both in the Sixth and Seventh Fleets. The type of equipment, developed, evaluated, and fabricated, varies according to their characteristics, and the peculiar requirements which they are called upon to fulfill.

For the transfer of high-tonnage items, between ships underway, the vertical-pocket conveyor has been developed, for moving cargo from the holds of a supply ship to its main deck. This conveyor permits the lifting of cargo from all holds simultaneously. In this method of movement, pockets of rubberized canvas are suspended between two endless chains, one on either side of the belting, the chain being powered by electric motor-driven sprockets. The endless belting is lowered into the hold and the pockets may be loaded at any level, merely by dropping the packaged material into them, as they pass the loading station.

The most significant development in this particular unit of machinery is an automatic ejector at the main deck, which, when combined with efficiency planned loading procedures below decks, increases the discharge rate to approximately three times that previously achieved. Heretofore, the highest discharge tonnage rate achieved, had been 18 tons per hour, but, with the employment of the vertical pocket conveyor, that rate has been increased to an average of 60 tons per hour.

The installation of these units in Navy supply ships is progressing rapidly. A model of the vertical-pocket conveyor may be seen in the facility's exhibit area.

Another version of the vertical pocket conveyor, the overdeck vertical-pocket conveyor, the purpose of which is the loading and discharge from, or to, piers and barges, has been developed by the United States Naval Supply Research and Development Facility, and is currently being tested in Bayonne, N. J.

On one end of this conveyor, there are rubberized pockets dropping down into the hold, in the same manner as those of the vertical-pocket conveyor, but the machine lies athwartships, and the opposite and extends over the side of the ship, resting on the main deck railing and the hatch coaming.

On the end of the machine extending beyond the side of the ship, the rubberized belting extends down to a pier or a barge. With correct operation of the equipment, it is believed that it will be possible to move packaged goods, either into, or from, the ship at a rate about three times the present average rate using cargo nets.

As in the previous machine, the important development here, will be the suitable design of an efficient positive-package ejector, which can be placed at any hold level, or on the pier, or barge. Present indications are that such a design can be evolved. In this, as in many other phases concerning underway resupply, the application of engineering design, and drafting ability, coupled with a definite knowledge of naval requirements, gained from active use of the equipment at sea, under operational conditions, is of the highest importance. Finally, the operation of these machines in each cargo hold, may well permit loading, or discharge, of 7,000 tons of packaged items, from a cargo ship within a period of 24 hours.

With sufficient manpower, and with two machines operating in each hold, it is believed this could easily be accomplished. The present machines are portable, weigh approximately 6 tons, and are 35 feet long, 6 feet 4½ inches wide, and 5 feet 4⅝ inches in height.

A photograph of the overdeck vertical-pocket conveyor may be seen in the facility's exhibit area.

Another type of machine, developed to handle low overall tonnage commodities of high diversity, is the vertical tray-lift conveyor. This equipment varies from the normal tray-type conveyor, in that the trays progress upward, or downward, on the loading side in the normal horizontal position, but tilt to a vertical position when passing along the rear side of the machine.

As the lifting trays approach the top of the conveyor, the attached roller cams, by movement in their restraining channels, force the trays to assume a vertical position for their downward travel. As the vertical trays reach the bottom of their travel, the roller cams move the trays from a vertical to a horizontal position for loading on the upward travel.

This feature was incorporated in the design, in order to conserve installation space, and results in about a one-third reduction of cubic space, which would otherwise be required for an installation of this type. Although this machine is slower in operation than the vertical-pocket conveyor, it has the advantage of requiring less space, and less maintenance than the pocket conveyor.

For installations where maximum tonnage output is unnecessary, it performs adequately. Installations have been made in combatant ships as well as in supply ships, and as many as four units have been placed in a single supply ship, such units varying in length, from 13 feet to 40 feet. The larger units are approximately 45¼ inches wide, by 34½ inches deep, carrying packages 24 inches by 20 inches by 30 inches, weighing 100 pounds.

One of the most difficult problems encountered in the transfer-at-sea operation, was the lifting of cargo from the holds of the supply ship to the main deck, prior to the transfer of that cargo. This invariably necessitated an advance breakout on deck, and repeated manual handling of the cargo; a most undesirable feature. Hence, the original investigations conducted in the field of underway replenishment techniques, and the improvements accomplished had, to a large degree, been confined to delivering ships. The successful development of the vertical pocket conveyor by the United States Naval Supply Research and Development Facility for use on these ships, has eliminated to a great extent, this problem.

Another difficulty involved the movement of cargo from the wing compartments of the ship, to the loading stations of the conveyors. This difficulty has been solved by the use of aluminum lightweight gravity conveyors, of the skate wheel, or roller design. Excellent accessories, for use with such equipment, have been developed and successfully evaluated.

The first of these units is a ball transfer table, originally developed by this facility and now available. This ball transfer table permits incoming conveyor lines to attach to the table, at any desired angularity for rerouting to the discharge gravity conveyor, leading to a vertical conveyor or a loading station.

The ball transfer table is approximately 24 inches in diameter, and features steel balls retained in self-cleaning plastic cups. The use of this ball transfer table eliminates restrictions on angularity, to 45° of 90°, and also eliminates the manual handling and lifting of containers, a method formerly employed, when two gravity conveyors were overlapped to provide different angularities.

A ball transfer table may be seen in the facility's exhibit area.

Improvements have also been made in the conveyor stands. Formerly, each ship fabricated rigid gravity conveyor stands of pipe supports, to raise the conveyors to waist height for convenient loading. A new design permits the pipe supports to be rotated, so that the stand collapses into a flat unit. This is extremely desirable, because the collapsed stands occupy less storage space in the ship.

Another recent development in skate-wheel gravity conveyors has been the substitution of nylon skate wheels, for steel skate wheels. This substitution has been necessary where skate-wheel conveyors are continuously exposed to salt spray, salt-water, and stack gases when stowed topside on a destroyer, or cruiser. The nylon skate wheels weigh approximately one-fifth as much as a steel skate wheel, however, their present cost is about twice as much as a steel wheel. Coefficients of friction are reasonably close for both types of wheels.

Experiments are also continuing on the development of a flexible skate-wheel conveyor, for possible use in replenishment both at sea and in port. Although considerable engineering work remains to be done on this item to make it practicable, preliminary results are encouraging.

In order to expedite the transfer of cargo between the ships, once it has been raised to the deck of the

supply ship, there has also been an improvement in previous methods of cargo movement. In addition to the constant tension devices, which have been, and are being developed by the Bureau of Ships for transfer lines between ships, a considerable change has been made in the cargo nets used for the transfer.

The old-type manilla nets which were difficult to handle, bulky, and subject to mildew and deterioration, have given way to the nylon-web type of cargo net. The nylon-web type of net has about one-half the weight, and occupies one-third the cubic space, of the manilla net, and can be easily handled by one man.

One of the important developments of the nylon-web type of net has been the method of web intersections. By specifying certain weaving constructions, an exceptionally strong and inexpensive web intersection is obtained. The original heavy-duty type of nylon web is composed of 1¾-inch-wide web, with a tensile strength of 6,000 pounds. In this net the mesh intersections are stitched. Recent experiments have been made with a similar net with a 1¼-inch-wide nylon web, with a tensile strength of 4,500 pounds. With the latest type of nylon web, the mesh intersections are not stitched, saving approximately $15 to $20 cost in the fabrication of each net.

Nylon-webbing strips of different color than the remainder of the net, are used to outline the loading area of the net. This latest feature has received a most enthusiastic reception at sea, since it readily permits a more orderly loading of a net. Since the rigging attachment height on combatant ships, and particularly on destroyers, is limited; an orderly loaded net requires less vertical clearances, and hence, such loading in the new net is advantageous in that operational efficiency is improved.

Nylon-webbing cargo nets may be observed in the facility's exhibit area.

It is noted that, due to the investigation of the nylon webbing for use in cargo nets, a knowledge of the potentials of such material, has been developed, which has led to its utilization in other phases of materials handling. One typical illustration of this has been the present development of the flexible conveyors. Another is in the use of the nylon-webbing vertical-cargo chute.

This vertical-cargo chute has been developed to move cargo, on a combatant ship from the main deck, to the storerooms in the lower holds through vertical hatchways, the openings of which are 30 by 34 inches. This chute, as originally designed, had canvas sides, with baffles inserted on two opposite sides, so that containers would drop from side to side of the chute, with individual drops of about 3 feet.

The operation of such chutes was satisfactory, but they were subject to considerable wear, and maintenance, despite the savings in time and manpower, in such movements. Later on, neoprene-impregnated nylon cloth was substituted for canvas, with gratifying results. The latest design incorporates the use of the nylon-mesh webbing for the framework of the chute, with improved methods of fastening the baffles.

This chute has been tested with several hundred tons of cargo passing through it and the observed wear has been practically negligible. These chutes are made in 10-foot lengths and can be hooked together to form any length in 10-foot increments. Four baffles are used in each 10-foot section.

These chutes are presently being fabricated in the laboratory of the United States Naval Supply Research and Development Facility, in order to determine and standardize on best design and fabrication techniques. When this design has been stabilized, drawings will be prepared, and final specifications so drawn, that manufacture can be accomplished by private industry.

In addition to the 30- by 34-inch size, a 48- by 48-inch-size chute is also being fabricated for use by refrigerator stores ships, in inport transfers of supplies to combatant ships. On such operations, the vertical chutes will be rigged over the side of the supply ship with the bottom end containing a final metal deflection chute, discharging into a landing craft. Nets will be arranged on the deck of the landing craft, so that individual containers can be stowed into the nets, for final lifting into the combatant ship, from the small landing craft.

It will be noted that it is possible by using a vertical pocket conveyor, for moving such cargo to the deck of the supply ship, and with gravity conveyors, to move material from the discharge of the vertical conveyor, across the deck directly to the opening of the vertical chute, that material is moved from the hold of the supply ship to the landing craft, with minimum effort, minimum manpower, and with no requirements for successive lifting and moving of hatchboards and hatch-beams, to unload from different levels of the supply ship. Small working models, showing the principles of operation of the vertical baffle chutes, may be observed in the Navy exhibit at this symposium.

One of the major presently remaining difficulties in the transfer-at-sea operation, is the problem of quickly moving supplies from the landing areas on the combatant ship, to the final stowage space in storerooms deep within the holds of the combatant ships. This problem is equally important on all types of combatant ships, from destroyers to the largest aircraft carriers. Until the final stowage of the last container is accomplished, the fighting efficiency of the combatant ship may be impaired, and it is a matter of vital necessity to accomplish this stowage operation as quickly as possible. With the improvements previously enumerated for supply ships, and in the transfer rigging, the amount of tonnage arriving at the receiving ship within given periods of time is presently increasing, and can be expected to increase still further, as additional materials-handling aids are installed in the supply ships.

Considerable effort has, therefore, been expended in our research and development laboratories to provide materials-handling equipment to alleviate the present, and expected conditions, of required rapid movement of supplies on combatant ships, during transfers at sea.

In addition to the vertical baffle chute, development work is being done on a new combination ladder and chute, which can be readily changed from its primary utilization as an access ladder, by suitable movement of a lever. The ladder treads are tilted upward, and the ladder becomes a chute, down which supplies may be more easily passed than being carried manually. The retardant tread on the ladder treads tend to slow the containers down, despite an incline of about 60°, to a speed at which they can be readily moved by personnel.

In regard to horizontal movements on decks, the aluminium lightweight skate wheel, or roller gravity conveyors, are supplied with their various accessories. In some cases reductions in required personnel for materials handling during transfers at sea have been accomplished on aircraft carriers from a maximum of 1,000 to a minimum of 350 men.

Lightweight telescopic aluminum chutes have also been provided for movements between decks, and, on aircraft carriers, nestable pressed-steel pallets have received enthusiastic use. These nestable steel pallets can be stowed in quantities of 10, in the same space that 1 wood pallet would require. Since these pallets are of metal, they are also fireproof, a decided advantage.

The end result of the extensive study in underway replenishment techniques, and the research and development of materials handling devices, to fit the peculiar needs of the Navy, has contributed immensely to the goal of eventually permitting combatant ships to resupply underway, while simultaneously maintaining a state of combat readiness, approximating that of "General Quarters."

These techniques and devices aid greatly in—

1. Permitting the underway replenishment evolution to be conducted with a minimum interference with combat readiness;
2. Permitting the removal of cargo from transfer stations and the stowage of cargo at the highest hourly tonnage rates, consistent with safety;
3. Conducting the operation in a minimum of time; and
4. Conducting the operation with a minimum of personnel, consistent with other considerations.

Many other items of materials-handling equipment have been developed as tools for underway replenishment of ships, but time prohibits their discussion now. A number of these items are included in our Navy exhibit at this symposium, and we suggest that you visit our display, where one of our representatives is available to answer questions. Figures 110, 111, and 112 are some of our display materiel which serve to illustrate the foregoing.

In closing, may I express on behalf of the facility, our appreciation for the opportunity to bring to your attention the work of the United States Naval Supply Research and Development Facility.

Comdr. HARRY E. STIRLING. Thank you, Commander Fullam.

Major changes in operational concepts generally necessitate changes in the tools which are used to carry out the operation. In the packaging field, our fundamental tools are the specifications which govern the products we use and the way in which we use them. The process of specification development and evolution is continuous. When a basic specification is revised a certain amount of confusion is bound to occur, even if the revision accomplishes a very worthwhile result. The balance of the Navy panel will be devoted to alerting you to some recent and forthcoming revisions of our Government specifications. It is our hope that the words of the next

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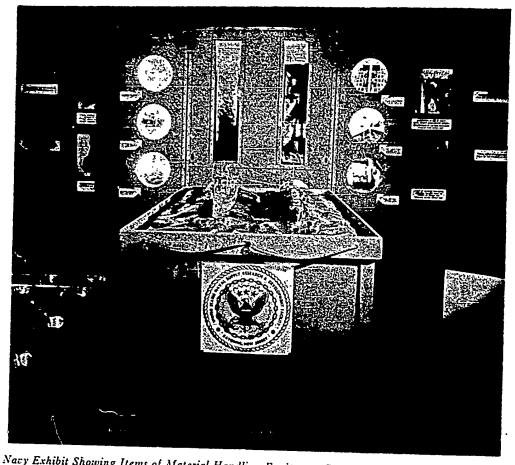


Figure 110. Navy Exhibit Showing Items of Material-Handling Equipment Developed as Tools for Underway Replenishment of Ships

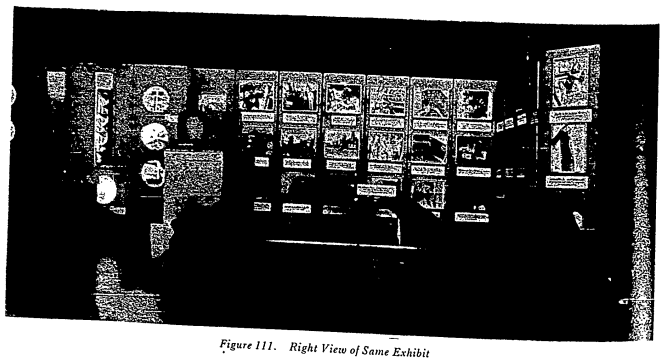


Figure 111. Right View of Same Exhibit

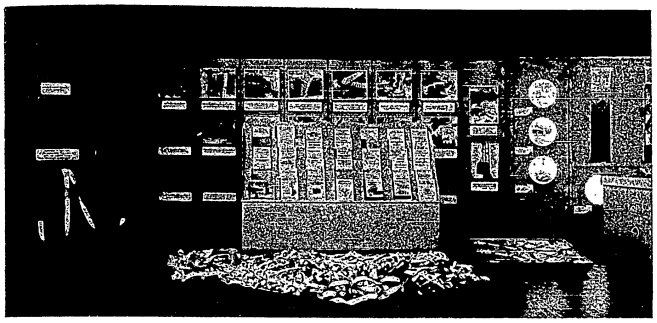


Figure 112. Left View

two speakers will help each of you to make the transition from old to new with a minimum of difficulty. Mr. Anthony F. (Tony) Calapristi is our next speaker and will tell you about several recent developments which are just now being reflected in specifications. Mr. Calapristi is head of the Components Packaging and Preservation Section of the Bureau of Aeronautics, and is no stranger to persons close to military packaging specifications. As early as 1941 he was planning for stowage of equipment aboard naval vessels. Later at the Philadelphia Industrial Test Laboratory he was engaged in a series of tests on the effectiveness of humidity control which preceded the "mothballing" of the Navy's Reserve fleet. He later became a packaging specialist at the Naval Aircraft Factory in Philadelphia and in 1942 journeyed to Washington to take up his present duties with the Bureau of Aeronautics. As chairman of the Technical Committee of the National Institute of Packaging, Handling, and Logistic Engineers, Mr. Calapristi originated the publication *Packaging, Handling, and Logistics*, copies of which have been distributed yesterday and will be distributed again today. He is a committee participant of the American Society of Testing Materials Committee D–10 and a member of the Preservation and Packaging Committee of the Aircraft Industries Association. I take great pleasure in bringing you Mr. Calapristi who will review recent changes to some of the major packaging. Mr. Calapristi:

Review of Recent Changes to Some of the Major Packaging and Materials-Handling Documents

Mr. A. F. CALAPRISTI. The purpose of my talk to acquaint you with the major packaging and materials-handling specification revisions and a few developments within the Department of Defense. Time will permit only a brief review of the selected subjects. It is judged, however, that by highlighting, a wider field can be covered and those seeking more detailed information can have it upon request. Subjects have been chosen that are now in effect or will be very shortly.

PACKAGING

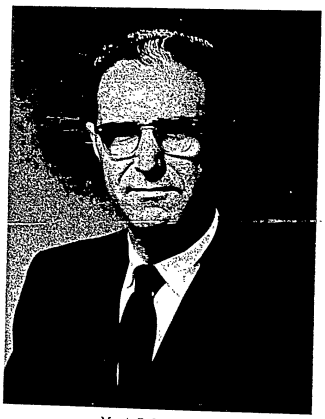
Cellulosic Cushioning Materials

Interim Amendment–2 of PPP–C–843, issued April 18, 1957, deletes the option which allowed specifying preferred basic materials. Basic materials are bonded fibers, natural fibers, and creped wadding. Recently another proposed revision has been prepared by the Forest Products Laboratory of Madison, Wis., for the Air Force. The method of approach for specifying requirements has been entirely changed. Instead of evaluating specific properties of materials, properties based on end-use applications are defined.

The medium absorbing type II materials have been deleted since they are no longer considered necessary. The high-water absorption and low-

water absorption still remain. The present classes A, B, and C which control densities have been deleted in favor of two other classes: Space filling and wrapping applications. For space filling, low tensile materials are allowed, whereas higher tensile materials are needed for wrapping and cushioning applications. Two densities are proposed for wrapping and cushioning applications. A new dusting test based on industrial hygiene approaches, i. e., the determination of dust counts in the air, has been added.

This proposed revision is expected to be circulated for comment very shortly.



Mr A. F. Calapristi

Packaging of Electronic Equipment and Miscellaneous Electrical Equipment

MIL–P–17555D (Ships), Amendment–2 of August 2, 1957, which covers this area, represents the reconciliation of major comments from departmental review of the "C" revision. Essentially it combines the specification for the packaging and packing of electronic equipment (MIL–P–17555C) with the requirements of MIL–P–17652 which covers the preparation for delivery of electronic, electrical, and electromechanical repair parts, and those of MIL–F–17872 Ships) covering Electrical Lighting Fixtures, Electric Lights, Accessories and Parts; Preservation, Packaging, and Marking for Delivery (Shipboard Use). Completed coordination of this document will result in the cancellation of JAN–P–658.

MIL–P–17555D (Ships) includes tables listing major equipment and parts by general descriptive categories and lists guidelines in unit packaging. Wherever end items specifications apply, these are noted. It should be noted that in using this specification the tables listing methods of preservation are guidelines only. In an effort to clarify this, the specification has incorporated, in section 3.1.3, instructions on the application of the methods of preservation. For example, in paragraph 3.1.4.2.2 an alternate method of effecting 1A for equipment having a watertight enclosure is given, using a rubber plug to seal cable entrances, and compressing the gland nut to provide a watertight seal.

Quality assurance provisions in section 4 reflect the requirements which are incorporated in Specification MIL–P–1160. It should be noted that the grouping of tests are short and simplified.

Water Vaporproof Flexible Barrier Materials

The basic specification of this material is MIL–B–131C, dated May 27, 1957. There are no changes to the classification. Two classes are still available. Class 1 is an all-purpose material. Class 2 is a lighter duty material which is recommended for use in packaging of items less than 10 pounds and in packaging operations at temperatures above 32° F.

The revision does contain newly developed evaluation tests which upgrade the performance characteristics. These include more severe resistance to aging tests, a new impact resistance test, and a test water resistance.

Use documents for MIL–B–131 barrier material are the bag specifications MIL–B–117A and MIL–E–6060A. Class "e" bags under MIL–B–117A cover small simply constructed pouches. Large complex envelopes which have junction or double seams, gasketed holes for method IIA floating-bag applications, or envelopes containing inspection windows for examination of humidity indicator cards are covered by MIL–E–6060A.

General Requirements for Packaging Military Aeronautical Equipment

After extensive coordination during the last 2½ years with the Aircraft Industries Association, the Air Force, Marine Corps, and Army, it appears at last that a document has been prepared that will satisfy the combined needs of the Government and industry for shipping of aeronautical equipment. The present draft MIL–P–7936–1 dated September 27, 1954, has been vastly improved and expanded. The Rough Handling Test Requirements (Free-Fall, Edgewise-Drop, and Cornerwise-Drop) are now systematically based on the gross weight and edge dimensions of the container. The height of drop requirement decreases with an increase in weight and increase in edge dimensions. The specification has been reworded so that it can be used also for reference in section 5 of item specifications. For instance, this specification may be referenced in section 5 of aeronautical equipment specifications as follows:

> "The Propulsion Motor shall be prepared for delivery to comply with Specification MIL–P–7936, unit and intermediate packaging to be Level A and exterior shipping containers Level B. Preservation shall be Method IId of MIL–P–116."

This is all that is needed. Rough handling tests on unit and intermediate containers are allowed on an optional basis. Charts showing size and weight limits for containers are also included. MIL–P–7936 has been forwarded to the Department of Defense Standardization Office for approval and printing. It should be noted that when MIL–P–7936 is published, it is planned to cancel MIL–P–60604 Packaging of Lightweight Aircraft Accessories and MIL–P–5633 Packaging and Packing of Aircraft Material in Steel Shipping Containers.

Preservation and Packaging of Antifriction Bearings

Additional requirements have been drafted for inclusion in Specification MIL–F–197B. These are in the form of an amendment. Vacuum formed multiple-compartment plastic containers adaptable for production-type automatic packaging will be used on *an optional basis with the contractor* until such time as tests prove the superiority or inferiority of compartmented containers to vials. At this time, the military will specify whether vials or plastic compartmented packages are to be used for specific contracts. A 15-mil cellulose acetate butyrate film is specified for the fabrication of these containers.

Spirally wound fiberboard laminated cylindrical containers conforming to MIL–C–3955, type I will be permissible as an alternate for methods 1A–8 and 1A–5 when specified by the requiring activity.

Circulation and coordination of this amendment has been completed and its promulgation is expected in the near future.

Reusable Metal Shipping Containers

There are two new developments in this area which I believe will prove worth your time. One is the rectangular container fabricated in two styles, metal and reinforced fiberglass plastic. The other is a circular metal drum with the "twist lock" closure. Both the rectangular container and metal drum have been developed by the Wright Air Development Center, Wright Patterson Air Force Base, Ohio.

The Rectangular Container

The specification covering the requirements for the rectangular container is MIL–C–25305 (USAF) entitled Containers; Reusable, Rectangular, Exterior, Shipping. It was released March 29, 1957. To date, metal rectangular and fibrous glass plastic containers have been furnished to comply with this specification. The metal container supplied eliminates pallets or other stacking devices because of its own stacking features, and further can be stored outdoors without damage to contents. The fiberous glass reinforced plastic container is fabricated by a process known as the "Pressurform Process." It is claimed to be the first high-speed low-cost production process in the fiberglass molding industry, and one where preforms, having variable section thicknesses and uniform densities, can be produced at a higher production rate than other plastic molding processes.

The Metal Drum

The specification covering the "twist lock" closure drum is MIL–D–26943 (USAF) dated May 4, 1956. The drawing covering two sizes of containers is MS24346 (USAF) Rev. B dated January 25, 1957. The container has a closure that requires no locking ring, or nut and bolt, but accomplishes water vapor-proof integrity by twisting the top to a predetermined pressure on an inserted circular gasket placed in the cover which contacts the top rim of the container body. This container and fastener are considered to be the most efficient of any studied to date.

Externally Mounted Humidity Indicators

There are two specifications for these types of indicators. One covers an indicating element composed of a chemically impregnated blotting paper,

and the other a plastic humidity sensitive device which conducts electrical currents in proportion to the surrounding relative humidity. The specifications are MIL–I–26860 (USAF) Amendment–1, entitled Indicator, Humidity, Plug, Color Change dated January 21, 1957, and MIL–H–14410A, entitled Humidity Indicating System, Electrical Resistance, for Packaging dated May 7, 1957. These indicators serve where there is a need to know the internal humidity of a package without opening the package, for ready inspection of the internal conditions of the package and for insurance purposes such as to conduct periodic observations of high value and critical equipment.

The Chemical Type

Tests of these plugs consist of pressure, torque, leak, thermal shock, and sunlight discoloration. The results of test clearly showed the superiority of the metallic plug over the plastic one. For the present, MIL–I–26860 requires that plugs be made of metal with a viewing surface of transparent plastic or glass.

The Electrical Type

The electrical humidity indicating system comprises of an element, an indicator, one or more connecting cords, and one or more mounting assemblies. It is basically intended to be used for method IIa, IIb, and IId packs. One of the unique advantages of this system is that the relative humidity can be obtained for any point near the surface or within the package without opening the package. The engineering development work necessary for devising the exacting requirements and procedures for this system has been performed by the Signal Corps Engineering Laboratories, of Fort Monmouth, N. J. The indicator is required to give direct readings without correction by charts or graphs. Mountings have been designed to withstand a pressure differential of 5 pounds per square inch for method IId packages and a pressure differential of three-eighths pound per square inch for IIa packages.

MATERIALS-HANDLING AND GROUND-SUPPORT EQUIPMENT

Missile-Handling System (Grasshopper Concept)

A transfer dolly used for transferring missiles and associated equipment at sea has been developed by the Washington Technological Associates, Inc., under the direction of the Navy Bureau of Ordnance. It is known as the Grasshopper and is primarily used for handling the Terrier missile. The object is to provide protection from the time of issue at a shore-based depot to final delivery aboard the firing ship via transfer-at-sea operations and introduction into the ship's strikedown system. It consists of a transfer dolly, missile storage and transfer cradle, booster storage and transfer cradle, and disposable water-vaporproof envelope. The transfer dolly and cradles will carry either 1 booster or 2 missiles. The transfer dolly is equipped with a four-wheel "dead man" brake system, locking swiveling casters and a special sling to permit rapid attachment to the transfer line hook.

Fork-lift pockets are provided under the CG of the loaded cradle. Holes are also located in the CG of the loaded cradle for lifting with a single hook under low headroom conditions. Stacking lugs permit keying the cradle for positive vertical stacking. Positive attachment to the dolly is accomplished by four quick release latches.

Procurement specifications for the transfer dolly and cradle (fig. 113) are MIL–D–19706 (NOrd) dated December 20, 1956, and MIL–C–19707 (NOrd), dated March 28, 1957.

Rough-Terrain Fork-Lift Trucks

The Quartermaster Research and Engineering Command, Natick, Mass., is preparing a proposed specification covering 6,000- and 10,000-pound-capacity rough-terrain fork-lift trucks. These trucks are intended to be used for rapid handling of supplies under rugged field conditions. In a very short time, this proposed specification will be circulated to the other military services for approval as standard requirements for this type truck. The proposed requirements are based primarily on commercially available and proven components and systems. Upon complete evaluation of the 15,000-pound-capacity trucks, a specification will be also prepared to cover this class.

The trucks will be required to operate in 5 feet of water, have 2- and 4-wheel drives, front- and rear-axle steering to move sideways up to a 20° angle and travel backward and forward at a maximum of 25 m. p. h. The body is to tilt without disturbing the level of the axles. Hydraulically operated telescoping forks are required for versatility. These trucks are to be also capable of going through and pulling out of, sand, mud, and snow; climb up and across hillsides and climb out of ditches. The loaded truck must be kept level while traveling over uneven and unprepared surfaces.

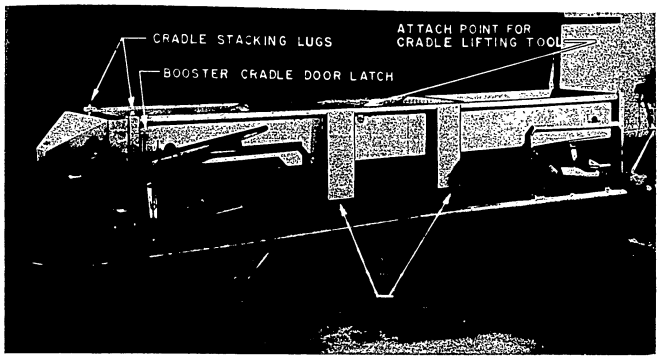


Figure 113. Transfer Dolly and Cradle Used for Transferring Missiles and Associated Equipment at Sea

Typical 6,000- and 10,000-pound-capacity rough-terrain forklift trucks will be shown at Blackstone Airfield.

The next revision to MIL–STD–137A, which covers standard equipment used by the Department of Defense to handle general-stores items, will include the newly developed 6,000- and 10,000-pound rough-terrain forklift trucks. It is also planned to add, in this standard, batteries for propelling electric forklift trucks and battery chargers. The batteries are to be of the nickel-iron-alkaline and lead-zinc types. Proposed MIL–STD–137B is now in the Department of Defense Standardization Office for approval. Its release is expected in the near future.

MIL–STD–147 Palletized Unit Loads

This new document, dated March 1, 1957, which was developed by the Navy Bureau of Supply and Accounts together with the Naval Research and Development Facility, Bayonne, N. J., establishes the latest standard methods, materials, and techniques for palletizing a wide variety of commodities using the 40- by 48-inch general-purpose pallet. It includes storage aids and such bonding agents as glues, glued strips, and strapping for securing units of materials into a consolidated load. Storage aids are materials that are used to protect the shipment against damage or pilferage and such accessories as edge protectors, various types of caps, battens, frames, collars, spacers, fillers, etc. Specific pallet patterns are illustrated as typical for categories of commodities. These are defined as load types. Accordingly this standard will give you an acceptable palletized unit load to overshipments for a great variety of commodities.

In referencing this standard, the load type desired need not be specified if the commodity to be shipped is listed. In this case, only the standard need be referenced. If the item to be shipped does not clearly belong in any of the categories listed, the load-type number should be specified.

MIL–STD–147 is doing much to simplify palletizing practices. The idea to develop this standard was conceived after a study of the handling characteristics of single boxes and unitized loads. It was found that the unit load utilizes handling equipment to the maximum degree, and operations are more rapid resulting in substantial savings in time, manpower, and money. MIL–STD–147 is being referenced in Government contracts and specifications in greater proportions in view of the efficient techniques conveyed.

Air-Log Ground Support System

The Bureau of Aeronautics and the Air Force have evaluated this new concept of ground support equipment for aircraft which was developed by the

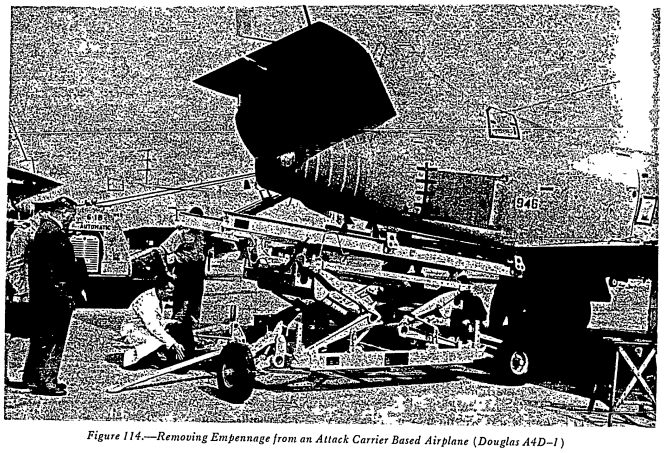


Figure 114.—Removing Empennage from an Attack Carrier Based Airplane (Douglas A4D–1)

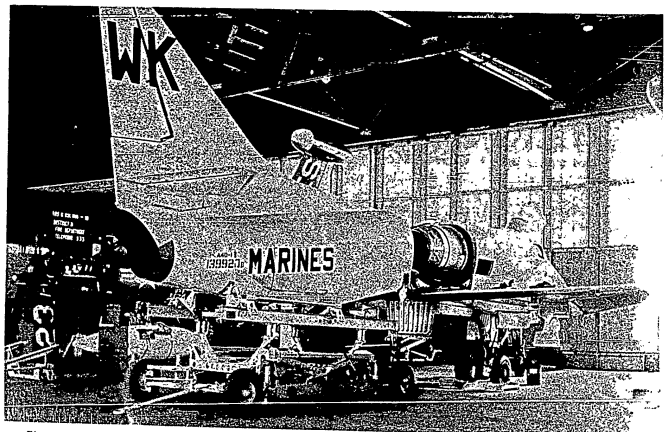


Figure 115. Empennage Removed and Ready for Transfer to Transportation Trailer or Workstand (Douglas A4D–1)

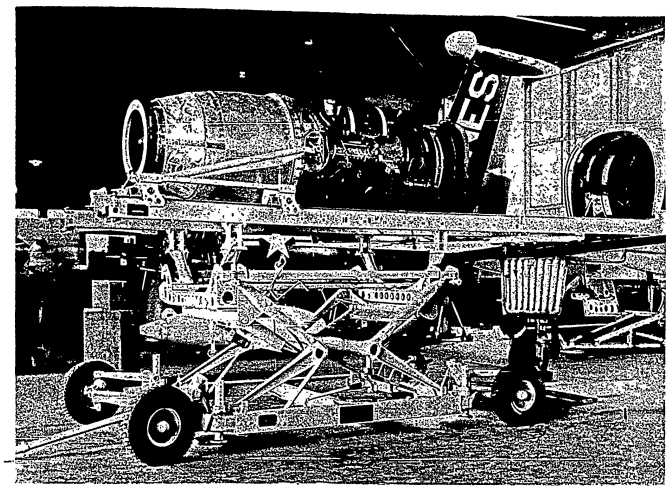


Figure 116. J–65 Engine Removed from Aircraft and Ready for Transfer to Engine Run-U Test Stand or Workstand

Air Logistics Corp. of Pasadena, Calif. This system is now being used to support Navy Bureau of Aeronautics fighter and attack carrier based planes such as the F8U, A4D and FJ–4B.

The system comprises essentially of a high-lift positioning trailer, transportation trailer, workstand, monorail hoist and engine runup test stand. Adapters are used with these units for specific applications.

Sections of airplanes, engines, weapons, and all types of subassemblies and components can be inspected, removed, or installed, and stored completely by rail handling. In other words, transfer of items are made by roller movement and not by hoists.

The basic design objectives have been to make this system as universal as possible so that when obsolete aircraft are replaced with new ones, it will only be necessary to substitute appropriate adapters rather than entire units. The units in use have a maximum capacity of 10,000 pounds. The engine runup test stand is capable of withstanding thrust loads up to 30,000 pounds. The bed of the high-lift positioning trailer can be tilted, rolled, yawed, and moved laterally ±3.00 inches from the centerline. All wheels can be turned 90° for sidewise movement. Positioning is accomplished by a combination of hydraulic and irreversible screw-type activators.

Specifications are now being prepared for the various components of this system.

Comdr. HARRY E. STIRLING. Thank you very much, Mr. Calapristi. Of all of the many thousands of specifications included in the Federal and military series, the one specification most frequently referenced is MIL–P–116, entitled "Methods of Preservation." If any specification can be considered basic, this is the one. Last spring a new issue, MIL–P–116C, became available. It is now being referenced in contracts. The fact that nearly 4 years were required to prepare and coordinate this revision indicates the magnitude of this task which was spearheaded by the Navy's Bureau of Supplies and Accounts. Mr. Herbert H. Lapidus, head of the Technical Section of the

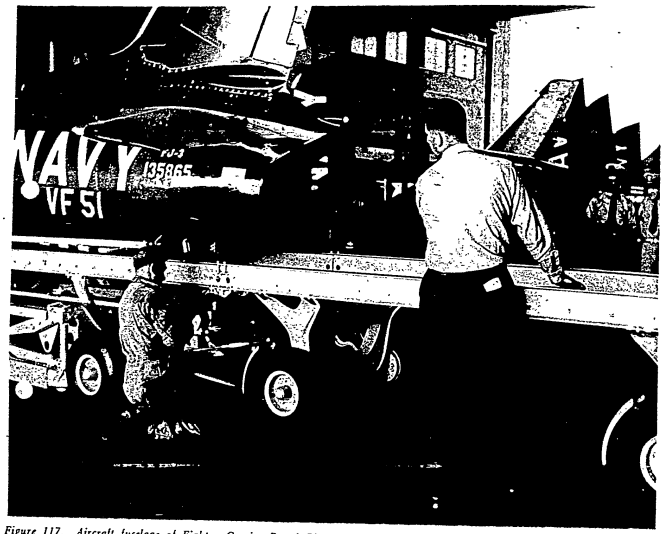


Figure 117. Aircraft fuselage of Fighter Carrier Based Plane Removed and Being Transferred to Transportation Dolly (North American FJ–3)

Preservation and Packaging Branch of that Bureau since 1951, will explain to you the most important of the changes you will find in the "C" revision to MIL–P–116. Mr. Lapidus attended the University of Pittsburgh as a special student and is also a graduate of the Army's Command and General Staff School. He served in the Air Force for 5½ years during World War II and currently holds a Reserve commission as a colonel. He taught a course in packaging at Temple University while he was in Philadelphia working in the Aviation Supply Office in that city. He served as founding president of the Philadelphia Chapter of the Society of Industrial Packaging and Materials-Handling Engineers. I take great pleasure in presenting Mr. Lapidus who will provide us with an analysis of major changes in specifications of MIL–P–116C. Mr Lapidus:

Analysis of Major Changes—Specification MIL–P–116C; Preservation, Methods of

Mr. LAPIDUS. Thank you, Commander Stirling. As anchor man on the Navy team I have a request to make from the audience. If you are directly or indirectly affected by the requirements of MIL–P–116C, or if you have an interest in that document, will you please raise your hand. Thank you. If you have not raised your hand, will you please congratulate the person nearest you who did raise his hand, for he is a charter member of the 116C Club This entitles him to all the rights and privileges which includes adding comments to the thousands that were received by the several custodians on MIL–P–116B In return for your splendid cooperation I have a good number to give you. It is PB 131322—I will repeat that, PB 131322. No, it isn't a Petersburg phone number. As this talk develops, I will explain the meaning and significance of that number.

I call my paper, "Analysis of Major Changes of Specification MIL–P–116C, Methods of Preservation."

Military Specification MIL–P–116 is perhaps the most basic specification in the field of military packaging.

It crosses many lines of interest. It is vital to suppliers in over 40 different industries who preserve and package end products for the military services.

It affects the output and performance of commercial concerns who sell packaging services to both industry and Government.

It is important to producers of packaging materials.

And it is a matter of great concern to activities of the Military Field Establishment who must use and administer the provisions of this specification.

Our objective during this 20-minute period is to analyze the major changes in the third or the "C" revision of 116.

Why should we analyze these changes? There are several reasons:

1. The new changes have a decided impact on procurement, production, and cost.
2. Successful contract compliance depends, to a large extent, on an awareness of these changes.
3. Preservation is a vital factor in assuring a high state of material readiness and thus a higher degree of security for all of us.

What are the major changes in 116C and what do they mean:

First, the format itself has been simplified, thus, the document is easier to use. All of the methods and submethods are listed at the beginning of the document. Each method is followed by a cross-reference to the paragraph which describes the fabrication of the method. A table has also been added to show the relation of methods to tests.

The revised document establishes practical criteria for cleanliness which is based on the premise that—

a. Items inherently clean at the time of manufacture are not required to be "thoroughly cleaned prior to inclusion in a barrier" when a preservative is not used, and

b. Many assemblies (chiefly electrical and electronic items) cannot be subjected to established cleaning processes and require cleaning prior to assembly.

New criteria for cleanliness is based on the nature and condition of the item under consideration, that is—

a. All items shall be free of contamination and shall be capable of passing a visual test.

b. Items to be coated with preservative or plastic shall be capable of passing a wipe test.

c. Critical functioning or close tolerance surfaces shall be cleaned to insure removal of corrosion, soil, grease, and acid or alkali, residues and shall be capable of passing both of the previously mentioned criteria as well as a pH test.

MR. HERBERT H. LAPIDUS

Changes in the criteria for cleaning represent definite economies in this area!

A new drying process know as "D–5 Draining" has been added. The new process is permitted: *a* When petroleum solvent is used; and *b* when the residual film of solvent will not reduce the effectiveness of applied preservative compounds.

Unless otherwise specified, "drain drying" is permitted only when cold-application solvent cutback preservatives are used.

In some cases, drain drying is expected to achieve economies by speeding up production.

The new document lists only 1 column of specifications for preservatives instead of 3 columns as in previous documents. All specifications listed are coordinated with few exceptions which are covered by footnotes.

The specification for hydraulic oil is not referenced because of variations in the requirements of hydraulic systems.

Volatile corrosion inhibitors are added as preservatives under the symbol P–18.

Substantial savings are made possible through volume buying of identical preservatives for use in preserving items of different military services in the same plant.

An attempt has been made to establish more specific criteria for the application of preservatives than in the former document. The critical nature of items is defined and discussed from a chemical and physical point of view. A listing of metals rated in order of their need for corrosion protection is also included.

Six new submethods of preservation have been added; two have been deleted.

The new submethods are IA–13, IA–14, IA–15, IA–16, IC–6, and IIf.

The deleted submethods are IB–3 and IA–12.

A major change for intimate wraps permits the use of neutral wrapping paper in contact with metal surfaces which are not coated with a preservative. The cost of this paper is about one-fourth the cost of barrier material previously used and is especially adaptable for many electrical and electric items where greaseproofness does not apply.

Bag requirements, for some methods of preservation, have been defined in such a manner that automatic packaging machines may be utilized for the preservation of small parts.

The formulae for calculating desiccant have been changed so that quantities can be adjusted to the type of cushioning used. The formula for rigid metal containers can now be used for containers other than rigid metal when the water vapor transmission rate meets a specified standard. This recognizes the use of plastic containers under the new submethod III.

Under method III, requirements for chemical control of barrier materials and cushioning in contact with the item, have been relaxed. It is the intent of the Government that materials used in contact with metal surfaces will not cause or promote corrosion.

Tests for the various methods and submethods of preservation are required as indicated by a special table—either as a normal requirement for the method or as a special requirement which must be indicated in the contract or order.

Based on extensive laboratory testing, nearly all of the tests formerly used have been clarified, simplified, and defined.

Preproduction tests and time-consuming tests such as those for cyclic exposure and rough handling have been placed on a "when specified" basis.

A manual which explains these tests and shows how to do them has been prepared and will soon be available for distribution, through the Office of Technical Services, U. S. Department of Commerce, under manual No. PB 131322.

Definite sampling and inspection requirements are established for the selection and testing of representative packages to determine conformance with requirements. Tests are classified into three groups: Group A (visual); group B (performance); and group C (cyclic exposure and rough handling). The number of samples required for testing varies with the different groups.

Inasmuch as most packaging failures can be detected by visual inspection, emphasis has been placed on group A and a relatively high degree of sampling is required. For group B and C tests, the number of samples required for testing is comparatively low.

For visual inspection, two sampling plans are provided: Lot-by-lot which applies normally and continuously sampling which must be authorized by the Government inspector.

The inclusion of quality assurance plans in 116C is considered by many to be a major step in the right direction; however, the provisions may not apply to all industries in the same way.

The new revision contains certain additional features worthy of mention:

1. The suffix "X" will be used with IA and IC submethods to indicate that a preservative has not been used.
2. Provisions are made for the Government to obtain assurance from bidders that test and packaging facilities are available to him; and
3. Externally mounted indicating devices may be installed in method II barriers on a "when specified" basis.

Our objective during this period was to analyze the major changes in MIL–P–116.

To do this, we covered changes in *nine* major areas:

1. Format,
2. Cleaning,
3. Drying,
4. Preservatives,
5. Preservative applications,
6. Methods of preservation,
7. Tests,
8. Quality assurance, and
9. Additional provisions.

The recent changes in 116 bring us one step closer to our goal of delivering military supplies to consumers in usable condition without costly represervation while in storage.

Comdr. HARRY E. STIRLING. Thank you very much, Mr. Lapidus. I have two announcements. First, I would like on behalf of those from the Navy and Marine Corps here to thank those here at Camp Lee, the commanding officer, officers, and men, who made this program a real success. In addition, I would like to thank those from DCSLOG who have worked so hard to make the program a success.

In closing the Navy portion of this year's presentations, I would like to read to you a press release which has just been received from Washington:

"Assistant Secretary of the Navy, Fred A. Bantz, today announced that the Department of the Navy, in cooperation with other Military Departments and the Department of Commerce, will sponsor the Fourth Joint Military-Industry Packaging and Materials Handling Symposium in Washington, D. C., during the week of September 29, 1958. This symposium will be a continuation of the highly successful Joint Military-Industry Symposium series initiated by the Navy in 1955 and continued by the Air Force and Army in succeeding years. The impact of packaging and materials-handling practices on all levels of the Nation's economy will be considered in setting up the symposium program.

"The theme of the symposium will be: 'Imagineering To Meet Tomorrow's Needs.' Recognizing the tremendous strides that have been made in packaging and handling during the past decade, the Navy intends to explore packaging and handling needs for the coming decade. Highly qualified leaders of industry and Government will discuss these future needs through the year 1968 on the basis of current industrial and military estimates. They will also cover in detail methods, procedures and equipment which are under development or which are being considered as potential answers to anticipated problems of the future.

"The symposium will be conducted as a series of roundtable and conference discussions. A number of the sessions will run concurrently in several of the Government auditoriums.

"A display is planned of newly developed packaging and materials-handling equipment which has Government application.

"Firms desiring to exhibit newly developed equipment and persons wishing to suggest specific topics for inclusion in the symposium are invited to communicate with the Head, Packaging Section, Supply Programs Division, Office of Naval Material, Washington 25, D. C., before January 1, 1958.

Distribution of the final program and advance registration cards will begin in July 1958."

Copies can be obtained on the table outside the door. Thank you.

Lt. Col. PETER W. MIRRAS. Thank you, Commander Stirling, and members of the Navy panel. We are happy to hear that the Navy will carry the ball next year and continue this series of outstanding symposiums.

During the past day and a half, we have heard talks by the Deputy Chief of Staff for Logistics, United States Army; the Assistant Secretary of the Army for Logistics; the Deputy Assistant Secretary of Defense for Supply and Logistics; and the Vice President of the Chrysler Corp. We have heard from panels composed of members of the Army, Navy, Air Force, and industry. The role of packaging and handling has been discussed from many aspects. A great deal of information as to plans, policies, developments, and techniques, has been disseminated. If we have helped each other and have gained a better understanding of our mutual problems, the time we have spent here is indeed a small price.

Our report of proceedings will cover all that has transpired. I know that all of the panel members stand ready to discuss in detail with you any points or phases of their presentations. They are all "high priced" talent. Make the most of it.

We chose the theme, "Packaging and Handling in Action," for this year's symposium primarily because of what you will see this afternoon and to-

morrow. This afternoon you will see many splendid exhibits from the Armed Forces and industry depicting latest developments in packaging and handling.

Tomorrow, we will sit in bleachers at Blackstone Army Airfield and watch field demonstrations. The Army will operate for you its mechanical mule, rough terrain forklift, and driverless tractor trains. You will see the role of Army aviation in the field of logistics. The Army and Air Force will demonstrate the techniques of aerial delivery. The Air Force will show you how its cargo planes have been integrated into its logistical system.

The exhibits and demonstrations will relate field conditions and developments to the speeches and panel talks which you have heard. We know that you will enjoy viewing these activities.

So now, I declare the panel presentations hereby closed.

Let's go to lunch, and I will see you again this afternoon at 1:30 in our exhibit hangar.

PART III

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Exhibits

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The symposium's gathering met in Hangar P–6022, Fort Lee, Va., at 1: 30 p. m., October 2, 1957, to view exhibits and go on conducted tours through the Aerial Delivery Department of the Quartermaster School.

The Department of the Army, on behalf of the Departments of the Navy, Air Force, and Commerce, and the National Security Industrial Association, wishes to express its appreciation of the following industrial concerns who, in addition to the military services and the Department of Commerce, displayed exhibits of packaging and materials-handling products and techniques:

American Car and Foundry Division, ACF Industries, Inc.
Ralph Chaffee & Co.
Clark Equipment Co.
Culligan, Inc.
Fibre Box Association
Fibre Drum Manufacturers Association
The Fox Paper Co.
Gibralter Corrugated Paper Co., Inc.
The Impact-O-Graph Corp.
Jiffy Manufacturing Co.
Kaiser Aluminum & Chemical Sales, Inc.
Kimberly-Clark Corp.
Marsh Stencil Machine Co.
Mosinee Paper Mills Co.
National Wooden Box Association
National Wooden Pallet Manufacturers Association
North American Aviation, Inc.
National Container Corp. (Owens-Illinois)
Paslode Co.
Power Line Sales, Inc.
Pressure Sensitive Tape Council
Reynolds Metals Co.
The Society of the Plastics Industry, Inc.
Spotnails, Inc.
Tri-Wall Containers, Inc.

PART IV

Demonstrations

The symposium gathering assembled at Blackstone Army Airfield at 9:30 a. m., October 3, 1957, to view demonstrations.

These demonstrations portrayed new developments and packaging and materials-handling techniques under field conditions.

The Third Joint Military-Industry Packaging and Materials Handling Symposium adjourned at the conclusion of the demonstrations.

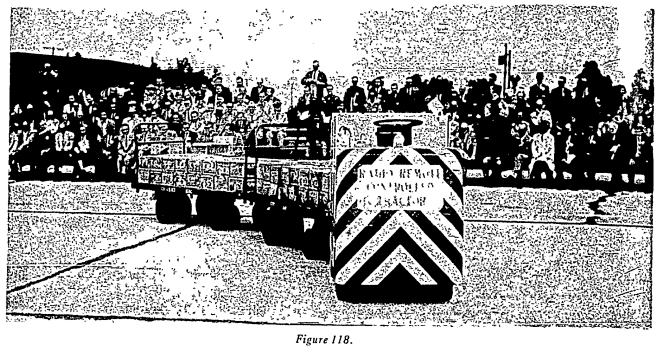

Figure 118.

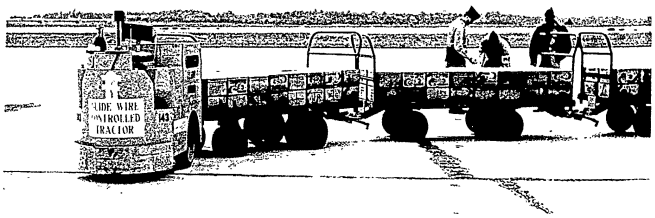

Figure 119

Two variations of the driverless tractor were demonstrated at the symposium. This equipment is currently undergoing user-test under the cognizance of the United States Army Quartermaster Corps. Employing the magic of electronic remote control, this system of intradepot supply movement offers maximum flexibility to the operator with reduced manpower requirements. Once the system is installed, its area of operation can be expanded, almost without limit.

Figure 120.

This 6,000-pound 24-inch load centered rough terrain forklift truck has been designed and developed by the Army, in cooperation with industry. This equipment stacks, unstacks, and transports heavy crates and boxes, aerial supply platforms and containers, and palletized loads of military equipment and supplies over terrain where high flotation and traction characteristics are required. The Army Quartermaster Corps is presently conducting tests of a family of rough terrain forklift trucks, including the 10,000- and 15,000-pound models.

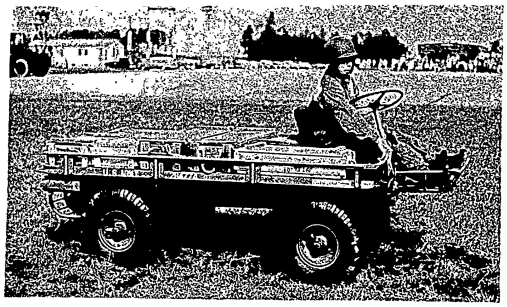

Figure 121.

Figure 122.

The Carrier, Light Weapon, Infantry, ½-ton, 4 x 4, M 274, "Mechanical Mule," was developed to meet the military requirements for a light weapons personnel carrier for use in forward areas. This low-silhouette vehicle enhances the mobility of the infantryman and his weapons and ammunition.

Figure 123.

Army assault troops disembarking through the large, sliding cargo door of an Army H–19 Chickasaw. This utility helicopter carries an internal load of 7 combat loaded troops or 1,800 pounds of cargo. Two thousand pounds can be lifted by use of an external cargo net.

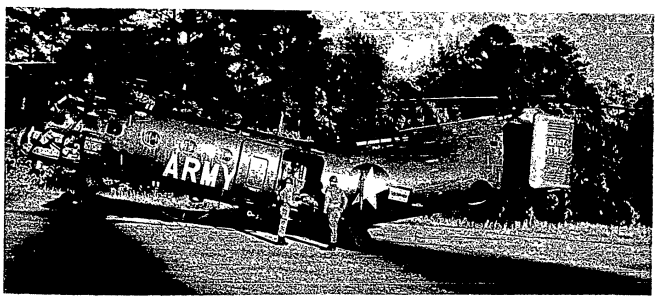

Figure 124.

The versatile H–21 Shawnee, having delivered its supplies, evacuates wounded. All Army helicopters are equipped to perform a dual mission—resupply and evacuation. Army Helicopter Ambulance Units of the Medical Service Corps have the primary mission of aerial evacuation of Army casualties within the combat zone.

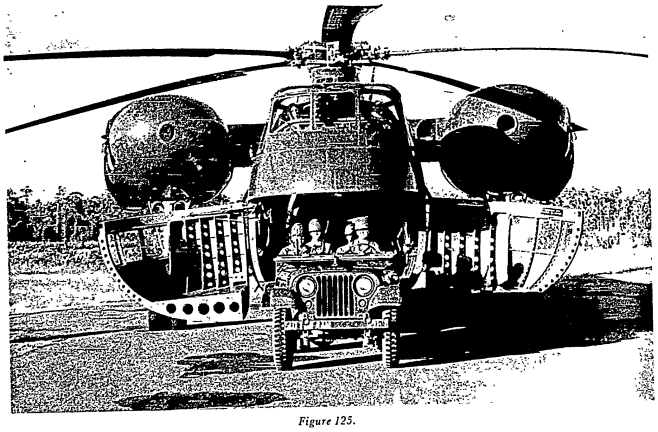

Figure 125.

Army aviation using an H–37 Mojave to bring reinforcements to a frontline infantry battalion. This twin-engine medium cargo helicopter can carry 6,000 pounds of cargo, or 25 combat-loaded troops, or 24 litter patients. Externally, the Mojave can carry 10,000 pounds.

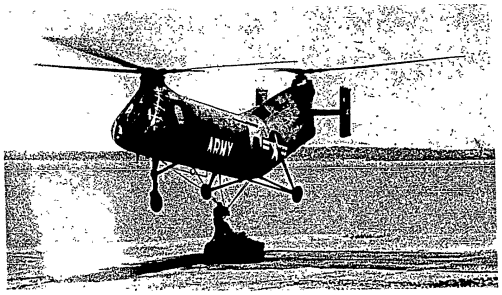

Figure 126.

The Army's H–21 Shawn[illegible] carrying an external sling load of supplies to an [illegible] unit engaged with the enemy. This light c[illegible] helicopter can carry an external load of 4,500 pounds. Internally, it can carry 12 combat-loaded troops, 3,000 pounds of cargo, or 12 litter patients.

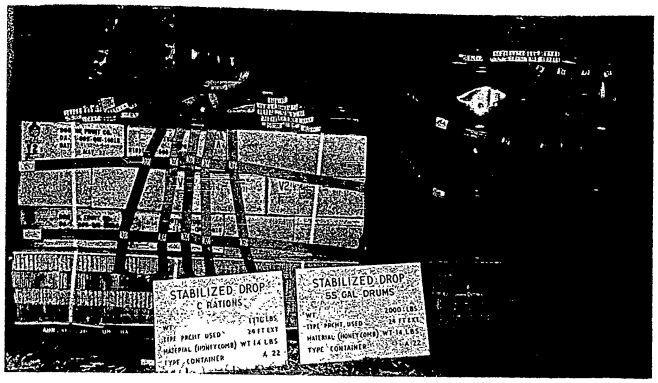

Figure 127.

Rations and gasoline prepared for airdrop. Note the use of paper honeycomb to absorb shock. The Army Quartermaster Corps conducts research and development in the area of aerial delivery.

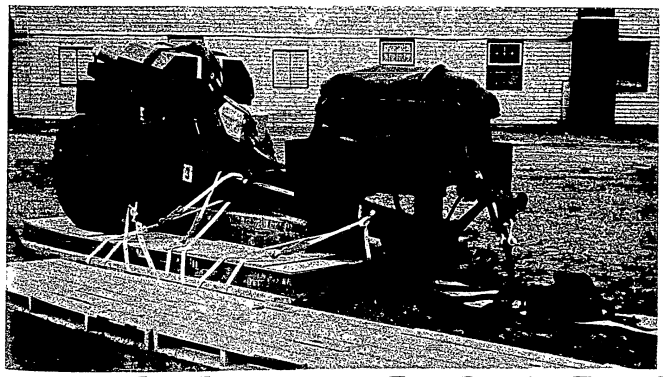

Figure 128.

105-mm. howitzer being readied for airdrop.

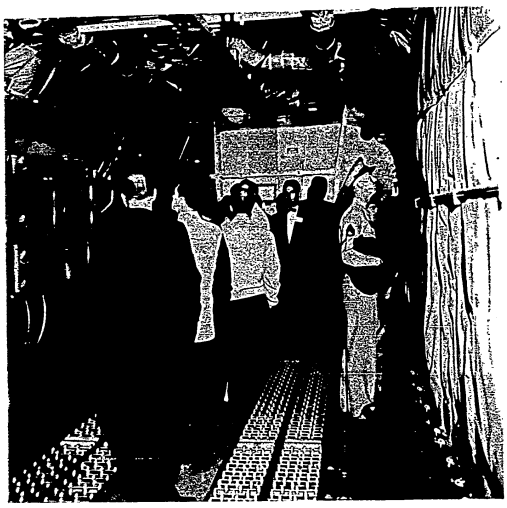

Figure 131.

The C–123 assault transport shown in figures 130 and 131 was designed to insure the continuity of airlift from the point of original pickup to the final destination in the combat zone. It is capable of operating into and out of small unimproved landing areas and being loaded and unloaded without special cargo-handling equipment. The C–123 is a high wing transport capable of continuous cruise speeds up to 200 m. p. h. It is powered by two Pratt & Whitney piston engines developing 2,500 h. p. each at takeoff, and it has a range in excess of 1,300 miles with 19,000 pounds of cargo. The aircraft has a maximum gross weight at takeoff of more than 60,000 pounds.

With a crew of 2, the C–123 will airlift and land 60 combat troops and their equipment. It also can carry 50 litter patients, 6 ambulatory patients, 5 nurses, and more than 1,300 pounds of equipment on medical evacuation missions.

The sharply upswept rear fuselage of the C–123 houses a special two-piece door assembly featuring a built-in ramp for the quick loading and unloading of cargo and troops. The high tail provides vertical clearance for wheeled vehicles and artillery pieces which can be loaded or unloaded without cargo-handling equipment.

The cargo compartment is approximately 37 feet long, 13 feet wide, and 8 feet high. The compartment's treadway for wheeled equipment is stressed for 6,800 pounds axle loading. The remainder of the floor is stressed for 200 pounds per square foot. Heavy duty tie-down fittings stressed for a maximum of 20,000 pounds are laid on a grid pattern throughout the cargo compartment.

This aircraft was designed to take off and land in a very short distance. The minimum takeoff roll is approximately 700 feet, and on landing in unprepared fields the aircraft is able to turn off the landing strip in from 500 to 800 feet. To assist in short-field landings, the C–123 has reversing propellers which permit the pilot to use a maximum of 80-percent engine power in reverse. The hydraulic brakes are quipped with a device that allows maximum braking action without locking the wheels by utilizing a valve that meters pressure to the brakes. An additional aid to short landings incorporated in this aircraft is a stall warning device that allows optimum approach speeds for short landings.

Figures from the Sagebrush maneuver conducted last year show that in a 14-minute period 10 C–123's landed on a short dirt strip, unloaded 96,000 pounds of cargo, and immediately took off. On the return trip, simulated casualties were carried out. The ability to convert from a cargo carrier to an ambulance in a minimum of time is an important requirement of aircraft of this type because it is just such aircraft that will be used to discharge the aeromedical evacuation responsibility of the troop carrier commander. His responsibility in that area includes the establishment and operation of patient holding facilities on airfields or landing zones, the provision of nurses and aeromedical technicians for inflight care, and the processing and movement of patients from point of receipt to final destination. The effective use of aeromedical evacuation has been credited with reducing the death rate from 5 percent in World War II to 2½ percent during the Korean incident.

The C–123 was designed to be a workhorse and has in it only the minimum equipment needed to do its job. In fact the commercial publication Aviation Week stated that "it is about as plush as a freight car."

The C–123 does not have a heavy equipment drop capability, but it has been modified to allow paratroopers to drop from it. This modification adds a great deal to the versatility of the aircraft.

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