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SPARE PARTS

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COLONEL KOCH:

Gentlemen, it is customary to introduce the guests who are invited by The Industrial College to speak to you from this platform. I think it is in order to introduce myself as the speaker who has been assigned the task of discussing the problems of spare parts of the three armed forces. By way of introduction may I say that the speaker does not pretend to be an authority, nor an expert, on the subject.

The definition of the word "authority" is "One who can settle all doubts and solve all difficulties." An expert is "One who is thoroughly informed in every phase of the subject from broad experience." It is unlikely that anyone fits these molds insofar as spare parts for the three Armed Forces is concerned. However, I may be classed as an expert in having contributed my share of G. I. gripes about the too little and too late stock status of spare parts in the field. It may be granted that several years of experience in dealing with repair of Ordnance materiel as well as supply of spare parts and the problems they represent lend some authority to my remarks. In that classification I shall attempt to diagnose briefly some of the problems of spare parts. This I am going to do from the comfortable position of the Monday-morning armchair quarterback who has not been exposed to the emotional strain or the physical stress of the game.

For your information, my source reference for this report, rather than lecture, is the rather limited recorded history of spare parts and the conversations that I had with a number of you gentlemen on the spare parts situation overseas, as well as with other representatives of the services. From the varied expressions of opinion as to the causes, effects, and proposed remedial action, it appears desirable that the facts of active theater experience should be collected, recorded and evaluated as promptly as practical. Such facts would serve as a basis for future study and establishment of policy, procedure and basic factors.

In the necessarily broad treatment which I have to give to the subject, I hope that I can give it the emphasis to which it is entitled. Probably some of you gentlemen will recall some of the local exceptions or specific instances contrary to the broad generalized statements which I will make.

Representatives of the Army, the Navy, and the Air Forces could discuss the problems of spare parts for their respective services more in detail. Members of the respective services of the Army, the Navy, and

the Air Forces, will meet with us in this room this afternoon, and serve as members of the panel for the seminar, at which time it may be that you will wish to ask questions and get authoritative answers from the detailed experience which these gentlemen have had.

In presenting the problems of spare parts for the maintenance and repair of munitions of war and to appraise the frequently unrecognized importance of that subject, one may be tempted to elaborate on the short stock status of the proverbial horseshoe nail. The late Ernie Pyle, in one of his celebrated articles written during the war, focused attention on spare parts when he wrote:

> "This is not a war of ammunition, tanks, guns and trucks alone. It is as much a war of replenishing spare parts to keep them in combat. A thousand tanks or a thousand trucks are as good as no tanks or trucks if the butterfly valve, no larger than a quarter, is missing. The gasket that leaks, the fan belt that breaks, the nut that is lost, the distributor point that fouls, or the bearing that burns out will delay GI Joe on the road to Berlin just as much as if he didn't have a vehicle to start with."

That the problem was so dramatically recognized by a layman focalizes its importance.

It is generally conceded by all levels of military command that the spare parts supply situation was critical throughout the war. A few times could it be said that spare parts supply satisfactorily balanced demand. The logistic history of the war will no doubt record that the determination of requirements of spare parts was one of continuous effort to refine and attempt to perfect the methods for the computations of requirements so that they would reflect more promptly and adequately the constant shifts in strategic and industrial conditions. It must be definitely recognized that the many phases of the problems of spare parts of the Armed Forces were executed sufficiently satisfactorily to wage a successfully concluded global war through the ingenuity and resourcefulnes of the personnel involved, both military and civilian, to improvise correc ive action. Nevertheless, even after the end of hostilities and today, there are still many problems and much is still wanting in the clarification of the work that lies ahead, relative to computation of requirements, distribution, and supply as well as controls, which are begging for solution.

Let us look back over the war years and review some of the issues.

One of the primary causes for later problems was the high level executive emphasis on the completion of tremendous quantities of major munitions of war, within specified periods without full consideration or intentional disregard of the lead time factors involved.

The Navy, through experience gained by their large scale, long distance maneuvers prior to the war did develop and establish requirements factors and usage data, as well as a workable distribution system for the then existent fleet. However, the tremendously expanded shipbuilding program made it increasingly evident during the war that such requirements factors and distribution channels could not meet the demands of the thousands of additional ships operating over tremendously expanded lines of supply.

The Army Air Forces as well as BuAer were confronted not only with the enormous increase in quantity of major items but also the tremendously increased tempo of the new developments of aircraft. Such usage and attrition data as was available applied only to peacetime use on relatively few planes and engines.

The Technical Services of the Army had a backlog of decades of development of their strictly military materiel as artillery, small arms and ammunition and had given thought to spare parts supply from limited usage data. Standard nomenclature lists had been prepared for the then existing munitions which included spare parts and quantities to be supplied to the several echelons of maintenance and repair. These quantities, however, had not been estimated for a global war with the extended pipe lines which "soak" up an appreciable percentage of available stock, nor the considerably increased number of supply points.

While it was generally recognized by the Armed Forces that spare parts had to be procured and had to be distributed, the important factors as to what, how much, when, where and who were not known. The answers to these factors could not have been known until the procuring agencies could have received, developed and reflected in their computations and programs the necessary information relative to usage data, estimated life of major item, identification and interchangeability, as well as stock dispersal and pipeline absorption. As additional and detailed information on these factors became available, each revision in requirements became more realistic and comprehensive in scope. However the lack of knowledge of these factors had resulted in critical shortages, excesses on contract, excesses of slow moving parts on hand and clogged storage.

A direct and important influence on available supply of spare parts is thorough and properly timed preventive maintenance. The more effective that preventive maintenance is performed by the using personnel or organization mechanics, the less is the need or demand for spare parts. With a few probable exceptions the lack of enforcement of prescribed organizational preventive maintenance was a continuous problem thoughout the war.

The situation relative to Army maintenance and repair, in general, was considered unsatisfactory for a considerable period of the war. Reports from the field, in early 1943, indicated that approximately 75 percent of deadlined equipment suffered from a lack of spare parts.

Several factors were involved in this shortage. For many major items, no spare parts lists were available to the field, which made it impossible to fill out requisitions correctly and efficiently. In other instances, no provisions had been made for supplying spare parts, or, if they had, the quantities stocked were entirely inadequate because of lack of necessary data on the part of responsible agencies to determine requirements correctly. It is apparent, too, that more attention could have been given to distinguishing between the so-called "fast-moving, high mortality" parts, and the "slow-moving" parts.

Due to the fact that some of the technical services had not established maintenance divisions, many activities relating to spare parts were not coordinated with any specific maintenance policies, and the dividing of responsibilities between the services led to duplication in procurement of some items.

The problem facing the Army Service Forces was one of coordinating the improvement of seven or more different systems without interrupting any of their activities.

Deficiencies in supply of spare parts which were actually hampering maintenance had to be corrected, but bringing the entire Army Service Forces Catalog to a state of theoretical perfection appeared to be impossible within the limits of time, available personnel, and capacity for reprinting unsatisfactory publications. Therefore, attention could be given only to details which were brought to light in reports of field shortages, intelligence reports and through personal contacts with the using units.

As the early study of spare parts lists and depot inventories progressed, it was seen that many spare parts not likely to need replacement had been procured.

Contrary to expectations, it had developed that maintenance of automotive equipment presented the most difficult spare parts problems. The variety and mechanical intricacies of this type of equipment, heavy usage not experienced in the civilian automotive industry, the complexity of supply channels and many other factors were involved.

One of the causes of shortages first discovered was the practice of making up kits of repair parts. Under this system, delivery of many parts in a kit were delayed because one of them was difficult to procure. Also, when a kit was opened in the field to obtain one part that was needed, the remaining parts were likely to be lost or left to deteriorate for lack of protection.

Under the policy effective during a part of the war, spare parts were furnished in sets concurrent with equipment or as early as possible after delivery. Like sets were procured, stored, and issued, which meant that individual spare parts were in short supply merely because they had been absorbed in spare parts sets and were not available individually.

A number of other problems were encountered in the reorganization of parts supply facilities. For example, it was soon found necessary to make provision of supplying spare parts for equipment acquired in overseas theaters through other than normal channels, such as Allied Nations and civilian impressment.

Cannibalization of assemblies and/or components from economically repairable end items had been resorted to as a result of shortage of spare parts. Cannibalization, of standard equipment, inoperable due to lack of a few parts, is indeed expensive and wasteful in labor and parts to be permitted as a means to provide for other parts in short supply.

Varying identification of a part by different major item manufacturers and by each of the technical services using the parts greatly hampered the interchangeable use of stocks of spare parts on hand. Duplicate identification caused duplicate procurement, since large quantities of parts would be requisitioned along with a major item when an ample supply of these parts was available in the stock of the requisitioning agency under other manufacturers' part numbers.

When excess stock lists and critical status lists could be prepared, it was shown clearly that a need for cross-indexing existed, since many items were listed under one identification in an excess stock list and under another identification in a critical shortage list. A remarkable proportion of the items short in one service were found to be excess in another.

Deficiencies in preparation of spare parts requisitions were responsible for a great portion of non-supply blamed on depots by other units. In a typical instance, a report furnished by a command headquarters stated that a large proportion of a requisition had been cancelled by the supply agency. Examination of the requisition revealed that approximately half the items concerned were identified on the requisitions by incorrect or incomplete part number, or were obsolete or non-authorized parts.

The need for an Army-wide system of item identification remained. Various systems were proposed, but a system which would avoid extensive reprinting of supply catalog sections and changing of stock records as well as package markings was not found in time to be effective during the war.

In December 1944, a critical shortage of major component assemblies for certain major items became evident. The reason for the shortage apparently lay in the practice of replacing whole units when a simple replacement of a sub-assembly or individual part would have made the old unit serviceable.

Reclamation of spare parts and component assemblies became a most important objective as the supply of these items grew more and more critical. Shortages revealed either as short-stock items or as items of which

large quantities were unserviceable were reported to the appropriate technical services, with the request that they be classified as critical and thereby assured prior handling in repair installations.

It should be noted that there were occasions when supply of spare parts exceeded demand. This, usually occurred when a major item was approaching obsolesence or was being replaced by an improved model.

Having given this cursory review of some of the causes of the unbalance in supply and demand, may I address your attention to the broad factors involved in the determination of requirements of spare parts. Requirements for spare parts, particularly requirements for initial concurrent spare parts, had been determined primarily on the basis of commercial experience, limited military experience and engineering estimates. The information as to usage -- the most reliable measure of need -- which had been collated prior to V-J Day was generally limited in coverage.

No alternative can be offered to the practice of procuring initially a sufficient quantity of spare parts on the basis of engineering estimates, the so-called Navy "Jesus" factor or the Army "Guesstimate" since much of the equipment was new and comparatively untried, and for other equipment there was a question as to the validity of peacetime usage data for war operations. In itself, this procedure could be made reasonably safe provided usage data were developed as soon as possible and the maximun of flexibility had been obtained in adjusting concurrent spare parts procurement lists and estimates of requirements to take into account accumulated usage experience so as to provide defensible calculations.

It appears that only during the last months of the war uniform procedures were instituted within some technical services and bureaus, which required review or revision of concurrent spare parts procurement lists and estimates to take into account accumulated usage experience so as to furnish more satisfactory procurement of spare parts for replenishment of initial issue.

The needed increased quantities absorbed by dispersal of supply points, as well as in transit or pipelines of supply, were not realized nor provided for in initial and replenishment requirements until late in the war. There was, however, a lack of uniformity of methods, and in certain instances there appears to have been a lack of centralized direction and coordination within the technical services or bureaus in establishing spare parts lists or in estimating requirements.

The policy to review at stated periods all authorized allowance lists (or their equivalents) established for fixed and mobile supply facilities in order to determine the necessity for revisions to reflect changes in usage was only applied during the last months of the war. These allowance lists are an important factor of requirements as well as

a means for controlling the distribution of materials. A continuing review of inventoried stock on hand, needed dispersal and pipeline factors, replenishment time, and procurement lead-time factors may have improved procurement.

We have considered some of the causes of the unbalance of supply and demand of spare parts as well as problems of requirements. Let us now consider the situation relative to procurement.

The policy of procuring large quantities of spare parts on the basis of initial spare parts lists concurrently with the end item raised serious problems. While it was necessary to follow this policy in establishing initial stocks of spare parts, it inevitably resulted in some perpetuation of errors which were understandable in original estimates. The practice of procuring replenishment spare parts on a basis not in accordance with actual usage data accentuated the problem.

It is believed that the practice of procuring spare parts on the basis of initial allowance lists concurrently with the end item should be limited to the initial procurement of spare parts and should not be permitted for replenishment procurement when there has been sufficient time to accumulate usage experience. Moreover, when additional major end items are being procured for replacement purposes, spare parts for such end items should not be procured ordinarily on the basis of concurrent spare parts lists. Stocks of spare parts should be established, for the end items being replaced and all spare parts procurement thereafter should be on a basis reflecting actual usage.

There may be a few exceptions, but in general, more satisfactory balance in supply and demand can be had when procurement for replenishment purposes is made by individual items based upon a review of current inventories, outstanding contracts, and the trend of actual replacement demand for such items as determined from stock control records modified by projected operational plans, as well as any planned demobilization of equipment.

Procurement of spare parts generally had been along vertical lines on an equipment model basis. This resulted in wasteful and unidentifiable duplication in procurement caused in part by the lack of knowledge of "parts interchangeability." The development of interchangeable parts data should be continued and kept current by the technical services and bureaus in order that requirements be computed and procurement directed along functional lines. Furthermore, when interchangeability is established within a technical service or bureau, the next step should be the correlation of such interchangeability data among the various technical services and bureaus.

Although the rapid expansion of programs during the war prevented in many cases the procurement and use of standardized equipment, it is

mandatory that more attention be devoted in the future to the formulation of standardization and simplification programs. A previous lecture and seminar have discussed these subjects.

In view of the past methods used for stating requirements and the resulting serious procurement problems, effort should be directed to develop procedures which will insure uniformity and flexibility in adjusting or cancelling outstanding contracts for spare parts in order (1) to reflect changes in accumulated usage experience, (2) to permit early change-over to procurement on an individual item basis, (3) to reflect the changes brought about by development of interchangeable parts data, and (4) to compensate for unbalanced or excess stocks. Moreover, in view of the dangers of the creation of excess and obsolete stocks, consideration should be given to limiting deliveries of materials under outstanding contracts (by amendment to the contracts, if necessary) to rates not to exceed maximum authorized delivery schedules.

To effect more efficient procurement of spare parts, it is desirable that action be continued to centralize the procurement of all common items within a technical service or bureau, then, as the next step, the centralization of procurement of all common items in the technical service or bureau having the major interest, and eventually the centralization within one technical service or bureau of the procurement of items common to two or more of the technical services and bureaus.

We have briefly considered a few of the problems of requirements and procurement. Let us now turn to the distribution of spare parts. One of the most difficult problems concerning spare parts was in achieving selective and efficient distribution. The long period of time which was consumed by the many functions which had to be carried out between requisition and delivery in advanced areas accentuated the problem. Distribution problems are believed to have been more important factors during the war than actual scarcities of spare parts. Maldistribution will adversely affect the most complete and accurate computation of requirements. It will unnecessarily use up our critical raw materials and overburden the best scheduled production capacity.

The key to the effective solution of the distribution problems is scientific selectivity according to known needs. In many instances it was indicated that approximately 85 percent of all spare parts requirements could have been filled out of 10 percent of the total number of parts carried in stock. This indicates that if proper distribution is to be had, continuing studies must be made of actual usage data in order to distinguish between the "fast-moving, high-mortality" parts, and the "slow-moving" parts.

Wartime experience showed that the lack of (1) knowledge of interchangeable parts, (2) proper identification of parts, (3) proper definitions and classification of spare parts, (4) proper screening and technical editing of spare parts requisitions, and (5) disposal of obsolete and

excess stocks, made the wartime distribution system less efficient. Surveys in the field also indicated that at several of the Advanced Supply Bases, spare parts received had not been unboxed or binned. Much of the problem of spare parts is attributable to improper and uncoordinated packaging and packing methods as well as marking of containers. There were reports of inefficient handling and lack of technical supply "know-how." These conditions were under process of correction as more experience was gained in Supply Base operations.

Studies should be continued to determine the best means of insuring that usable materials are placed back into the supply system and that excess or obsolete stocks are made available for disposal when bases in the advanced areas become inactivated or are rolled-up. It is necessary that equipment and spare parts be salvaged or reconditioned as soon as the bases in the rear areas become inactive because of the high rate of deterioration. In addition, knowledge of the facilities and equipment located or to be located in advanced areas would provide more detailed information as to equipment populations and the spare parts necessary for their maintenance.

We have considered some of the policies and procedures which may be set up for accurate computations of requirements to result in more timely procurement as well as providing for efficient and selective distribution of spare parts. To implement these procedures we must devise the proper administration and controls.

The key to the effective solution of the spare parts problem is the establishment of controls which would permit the development of complete, accurate usage data and stock and inventory records as well as preventive maintenance and supply discipline to prevent either insufficient or excessive procurement.

In the final analysis, the controls which are established are only as effective as prescribed regulations relative to these activities are complied with.

This problem involves questions of organization and division of responsibility between the various technical services and area commanders and it is not the purpose of this presentation to be specific in discussing this aspect of the problem. It is believed, however, that a greater exchange of information among the various technical services and bureaus and the area commanders as to means and procedures for developing more adequate controls would result in considerable improvement over methods used in the past war.

There still were weaknesses in the inventory and stock control systems as of V-J Day. So far as spare parts are concerned, a basic necessity is control of inventory at each point within the supply system to as near the operating level as is practicable under war conditions in order

to key procurement to issue for use. As pointed out previously, it is essential that accurate and prompt information on experience be secured for correction of estimated usage factors previously set up to determine both procurement and distribution. If study indicates that it is practicable under war conditions to extend inventory and issue records beyond the continental United States, it appears to be extremely desirable that this be done. It should be noted that some of the technical services and bureaus were making progress in this direction.

Much needs to be done in standardizing spares and spare parts nomenclature and bringing about a clearer understanding of terminology generally. The lack of standardization and proper understanding of nomenclature becomes obvious in any study of spare parts problems.

Studies of interchangeable parts were underway before the end of the war, but in general the effort expended had not had time to show substantial results.

Various production problems still existed. There is a question as to whether proper consideration had been given to securing balance between the production of complete end items and spare parts. The lack of balance in some instances had been caused by administrative policy, which placed emphasis on the production of urgently needed major end items and the preference of manufacturers to produce end items rather than spare parts. While this policy was understandable in the past, it is believed that increasing emphasis must be placed on maintenance problems in the future.

There also appears to have been a lack of sufficient personnel, particularly qualified personnel, to handle spare parts efficiently through the various stages of requirements, procurement, distribution, storage, preservation, handling, issue and stock control. The efficient supply of spare parts is a highly technical and complicated job. Experience is required to analyze and adjust procedures under effective control, which must be sufficiently flexible and subject to frequent revision to meet the unpredictable and unforeseen demands of war.

I submit that the importance of the spare parts problem should be recognized by the setting up of a separate Spare Parts Control Unit in the War Department General Staff, as well as in the Navy, functioning in close coordination. I believe the importance of proper balance in procurement of spare parts should be further recognized by having a general and a flag officer assigned to serve as directors of such Units.

The spare parts problem is one of many ramifications. In a general supply control division of the Army or Navy each of the branches or sections, whatever they are called, are concerned primarily with their particular mission. It may be requirements, distribution, stock control, or maintenance. However, the solution to the problem of spare parts has to cover and

has to be considered from all of these phases. It is believed the several problems relative to spare parts can be considered for simultaneous, coordinated action, to arrive at solutions which can be resolved into policies. Therefore, my opinion is that we should have one Unit of the Army and one Unit of the Navy, reporting directly to the Director of the Service, Supply and Procurement Division, and his opposite in the Navy.

These Units would serve as directing, coordinating and policy making agencies on the following, as well as other facets, relative to the spare parts problem of the respective technical services and bureaus.

1. Establishment of maintenance and repair policies as to:

   a. Practical standards of acceptance after repair to assure combat serviceability and safety in use of equipment.

   b. Efficient and operative shop and field repair procedure and methods using latest technological features.

2. Basic concurrent and replenishment requirement factors, permitting flexibility and revision, to reflect usage in maintenance and repair, to include stock needed for dispersal of supply points and intransit or pipeline absorption, loss through capture or abandonment as well as other recognized losses under varied global conditions of peace and war.

3. Preparation of and periodic distribution to all using agencies of accurate and complete parts catalogues to provide;

   a. Listing of spare parts identified by nomenclature, stock number and illustration.

   b. Complete interchangeable data together with functional and emergency dimensional interchange.

   c. Allowance lists or their equivalent for all echelons of supply together with approved authority to sanction emergency revision.

4. Identification and inventory of spare parts on hand, disposal of surplus and proper preservation and storage of balance.

5. Controls of field issue and practical conservation of spare parts.

6. Enforcement of practical preventive as well as preservative maintenance of major items.

7. Simple and sufficiently complete stock control records as well as achievable Zone of Interior and Theater of Operation inventory procedure and controls.

8. Priorities for handling and shipment of requisitions for spare parts according to relative urgency of need.

9. Improved communication and transportation of spare parts based on priority of need.

10. Proper and coordinated packaging and packing for varied global climatic conditions as well as indelible and legible markings on exterior shipping and interior storage containers.

11. Mandatory concurrent procurement of spare parts in appropriate relation to contracted quantities of major end items.

12. Training and assignment of sufficient and qualified personnel to the highly specialized and technical work relative to requirement procurement, distribution and supply of spare parts coordinate with approved maintenance and repair programs.

The War Department has recognized the importance of these problems, as indicated by a General Staff Supply Group memo of 2 December 1946, " Study of Spare Parts Problem." May I quote one sentence from that memo.

"It is necessary that the wartime experience of the War Department agencies in all aspects of this supply problem be analyzed, the policies governing the problem be evaluated, and that a continuing study be instituted in order that the most effective solution of the various phases of the spare parts problem might be reached."

Similar action by the Navy to centrally direct and coordinate the activities of the respective bureaus relative to spare parts will be an important factor in the resolution of many unsolved problems.

At such time as a civilian super coordination agency is established, the directors of the Army and Navy Spare Parts Control Units should be under the direction of a high level official of such civilian agency to assure that activities are coordinated and controlled to the over-all advantage of the military as well as civilian economy.

As I mentioned before, we are having a seminar this afternoon at which representatives of the Army, Navy, and Air Forces will be present. It may be that you gentlemen would prefer to hold your questions until the seminar rather than continuing at the present time. But if there are any questions at this time, I will attempt to answer them.

No questions? Thank you very much, gentlemen.

(29 January -----350)E