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STANDARDIZATION OF AIR MATERIEL 1939-1944

CONTROLS, POLICIES, AND PROCEDURES

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Prepared by the USAF
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STANDARDIZATION OF AIR MATERIEL, 1939-1944:

CONTROLS, POLICIES, AND PROCEDURES

The original of this monograph and the documents from which it was written are in the USAF Historical Division, Archives Branch, Bldg. 914, Maxwell Air Force Base, Alabama.

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FOREWORD

This monograph recounts the efforts made by the United States and her allies to standardize their airplanes and airplane equipment during World War II. After briefly reviewing governmental and industrial efforts toward standardization from 1919 to 1939, the problems of mass production for war are treated in detail. The present study was written by Dr. M. P. Claussen.

Like other Historical Division studies, this history is subject to revision, and additional information or suggested corrections will be welcomed.

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Chapter I

AERONAUTICAL STANDARDIZATION BEFORE WORLD WAR II

Concept of Standardization

Standards and standardization have many connotations and applications in the development and production of materiel, and even more meanings in the industrial and commercial world generally. Standardized grades of commodities and services have long been an objective of both manufacturers and consumers. In order to expand the opportunities for mass production, reduce the costs of production, and enlarge the potential market, producers sought by commodity standards to reduce the centrifugal effect of individualistic manufacturers producing individualized products. Standards and standardization were a common policy in the industrial world before the war, and went forward under the slogan of "mass production and higher standards of living."[1] Industrial interest in standards was recognized in a nation-wide organization, the American Standards Association, which attempted to coordinate a vast network of some 600 trade associations interested in the preparation of standards and common specifications. These associations ranged from the Abrasive Grain Association down the alphabet to the Wire Cloth Manufacturers Association,[2] and on them there was superimposed, in addition to the national association, an International Standards Association organized in 1926 in order to expand the foreign market by the use of internationally acceptable commodity and service standards.[3]

While these standardizing agencies represented the producer in his search for improved methods of mass production and mass distribution, standards were also being sought by consumers. Consumer organizations were attempting, through "grade labelling" and other types of standards, to simplify purchasing and make the consumer a more intelligent and critical buyer. Occasionally such efforts encountered, paradoxically, the opposition of a standards-conscious business world that predicted ominously that such consumer standards would lead to "regimentation" whereby "everyone /would/ wear identical hats, live in identical houses, eat identical food, and think identical thoughts."[4]

Among the consumers working for standardization, the federal government was the most active "consumer," if only because it was "the largest single purchaser of goods and services in the country."[5] Since about 1920 standardized specifications for equipment and material common to the various federal agencies had been published and disseminated to industry by the Treasury Procurement Division, which was the purchasing agent for all common items needed by various departments. Its "General Schedule of Supplies," containing about 1,600 specifications, was the "Bible" of the purchasing agents throughout the federal offices, as well as a guide for use by industry and business. Included in the schedule was the large group of "U.S. Army Specifications" governing the numerous items of war materiel procured by the various supply arms, among them the Air Corps, which controlled the preparation of specifications for classes 93 (air armament), 94 (air equipment), 95 (power plants), 98 (airplanes), 99 (balloons), as well as scattered items under other

classes, such as aviation gasoline, certain enamels, aircraft dope, aircraft fabrics, and aircraft hardware.[6]

In Army procurement, a weapon was standardized when, in the course of experimental development, it had been tested and found operationally suitable and sufficiently advanced in its characteristics to be ordered safely in quantity. Standardization was thus the link between the experiment and production through which every item of materiel passed. This was standardization in the sense that the item, e.g., an airplane, was standard for operational use. The airplane, however, was made up of components that were also to be produced according to standard specifications by various subcontractors, so that, if standardized, the components would be interchangeable regardless of their origin. The components themselves were in turn made up of materials and parts that were manufactured according to either Air Corps standards or joint Army-Navy aeronautical (ANA) standards; and some of the aircraft industrial processes--design criteria, manufacturing methods, and testing processes--were likewise subjected to standardization. Standardization of material for the Air Corps--and for the Naval air arm and the British air forces--had its counterpart in all the procurement arms and services, in each of which the "standardization" of a given item of ordnance, clothing, vehicle, food, or other weapon of war was a formal step that marked a pause in the experimental development of that item and the placing of a production order with the contractor. Standardization, in fact, underlay the entire war machine in most of its aspects.[7]

Origin of Standards in World War I

During World War I problems of aeronautical standardization were few, if only because aircraft production was small in comparison with the overwhelmingly larger munitions programs called for in connection with the ground and naval operations of that war.[8] A very few airplane models, American and British, were standardized for manufacture in the United States, and the number of contractors was so small that there was no appreciable problem of interchangeable components and accessories.

There were some attempts to extend the standardization of equipment and components to include the Navy air arm. A Joint Board on Aeronautic Cognizance was organized by the Army and the Navy in January 1917 to stimulate air cooperation, but it was interested more in jurisdictional agreements than procurement economy, and standardization did not actually appear on its agenda. About the same time, another joint board—the special board reporting in March 1917 on the development of a joint aeronautical service—merely recommended (along with a dozen or more other recommendations on Army-Navy cooperation) that airplane types adopted by the Army and Navy be "as nearly alike" as consistent with their particular missions; that "aircraft motors, machinery, radio sets, bombs, and other accessories" should be standardized "to the greatest extent compatible" with such missions; and that "there should be had the mutual interchange of ideas and joint cooperation that now [since October 1916] obtain in the design and construction of the first Zeppelin [airship]."[9] But, on the side of the Army, the standardization work was not specifically

assigned anywhere in the Air Service, and it was not until after the war that the Aeronautical Board (successor to the Board on Aeronautic Cognizance)[10] was expanded to cover standards for parts and materials, and an AN Specifications Unit was set up as part of the Engineering Division at McCook Field, Dayton, Ohio.

Aeronautical Standardization Between Wars, 1919-1936

The demobilization after the World War left the Engineering Division of the Air Service in charge of a limited program for the development and procurement of airplanes and accessories. The aircraft industry was in its infancy, and the unorganized air transport industry was limited to an airmail route which was established the year before under the Army and which was not to reach any size until after the next decade. In this situation the chief potential customer for aircraft was the Army, so that specifications and standards were largely controllable by the Army; but aircraft development was so uncertain and the trends so unpredictable that standardization was difficult if not impossible. Perhaps it was undesirable..

Administratively, some attention was given to the Army-Navy cooperation. The Aeronautical Board was directed the next month "to prevent competition in the procurement of material"; to ascertain, "before arranging to purchase aircraft, . . . whether aircraft of the type desired can be obtained /by one Service/ from the other"; and to "coordinate" in cases where aeronautical purchases were being made abroad by the two services.[11] This precept was little more than a statement of promise and hope. The

same directive outlined the differences in tactical missions to be performed by Army aircraft and by Navy aircraft, thus limiting at once the opportunity for standardized aircraft; and the competitive struggle between the Army and Navy air arms during the next two decades was to result in a trend away from, rather than toward, standardized combat planes. Not until the outbreak of the European war and the urgency of industrial mobilization in 1939 and 1940 was there any appreciable rapprochement between the two air arms.

With respect to materials and parts, standardization between the Army and Navy met with more success. The Aeronautical Board's directive in 1920 did not specifically mention standardization; but the Board in 1921 did make a beginning on certain related problems by preparing a standard procedure for the drawing up of experimental contracts and a uniform procedure for the testing of aeronautical materiel.[12] In 1922 the National Advisory Committee for Aeronautics urged the importance of materials standards, and agreed with the Board that the latter should monitor the work.[13] But the Board was not given responsibility until fifteen years later; instead, still another Board was set up--the Joint Army-Navy Standards Board of 1923, based on a suggestion by the Engineering Division and incorporated in an agreement between the Director of the Air Service and the Navy.[14] One officer was assigned from each service, including Maj. D. C. Emmons for the Army, and they were directed to "harmonize" those differences, many of them "minute and unimportant" by themselves, that burdened the manufacturer with the stocking of materials and parts of odd sizes, dimensions, and specifications.[15] Annual conferences were

begun in 1924,[16] alternating between Dayton (McCook Field) and Philadelphia (Naval Aircraft Factory).[17] The board of officers served in addition to their other duties,[18] and they were not assisted by any permanent working committee; but the annual conferences, opened also to representatives of the aircraft industry, did result in the preparation of some specifications for parts that could be used in common. Compromise was almost always necessary, resulting in slight modifications of the specifications of the Army or of the Navy, respectively. According to an Air Corps report in 1927, the Bureau of Aeronautics was deferring to the Air Corps in about 75 per cent of the cases, either because AC specifications were "superior" or because the Navy was "more willing to compromise."[19] Exactly what percentage of specifications were standardized in these years is not known, but by about 1930 "all the bolts, nuts, cotter-pins, washers, rivets, tie-rod terminals, clevis pins, turnbuckles . . . and /some/ larger items of equipment . . . /had been/ made 'AN' standard"; AN standard drawings for such parts became familiar to aeronautical draftsmen; and parts manufacturers began to feature the symbol "AN" in their catalogs.[20]

Though the two services could forget rivalry to some extent, there were still weaknesses in the Army-Navy standardization procedure.[21] The "master agreements" negotiated between the two services were not published as actual procurement documents for use by industry, but were merely filed with each service as documents to be "incorporated" in the published specifications of that service.[22] In effect, the "master agreement" was not a common standard but merely a guide to the two specification sections. Deviations and divergences crept into the published specifications, many of them obscure and indiscernible, especially to higher authority

within each service, but quite noticeable and "exasperating" to the manufacturers who had to stock both sets of materials.[23] In some cases, such as that involving the altimeter, the joint agreement was merely "a confession of inability to get together."[24] There were other difficulties as well. In one case four years were spent in agreeing on basic structural design values for steel and magnesium alloys. Joint conferences became more and more spasmodic, with no annual meetings between 1934 and 1936. In 1936 a Navy suggestion for an annual meeting was held up in the Air Corps for three months. The confusing explanations for this delay, first that the Materiel Division had not been able to decide on an agenda and a date, and a few weeks later, that the Navy letter had been misplaced, indicated perhaps a lack of positive policy and action on the problem of common specifications.

Chapter II

STANDARDIZED MATERIALS AND PARTS, 1937 - 1944

The Aeronautical Board's Permanent Working Committee, 1937

The year 1936 was a low point in Army-Navy agreement on standardization. The lack of achievement was not unnoticed in the Air Corps, however. Brig. Gen. H. H. Arnold, acting Chief of the Air Corps, complained of the "very intangible results" over the previous 18 years,[1] and endorsed a plan for the establishment of standardization as a full time function in the Air Corps and in the Aeronautical Board. A Permanent Working Committee (WCAB) was established within that Board in February 1937 by agreement between the Secretaries of War and Navy, based on a plan worked out by Maj. A. J. Lyon of the Materiel Division, in cooperation with Lt. C. F. Cotton of the Navy Bureau of Aeronautics, and approved by the Army and Navy members of the Board, Lt. Col. W. E. Lynd and Lt. Comdr. W. D. Sample, respectively.[2] Lyon's plan called for several specific changes: a permanent coordinating body to serve as recorder, editor, and publisher of specifications; and the elevation of this agency to the Aeronautical Board, in order to insure greater support by reason of its being in a higher echelon.[3] At the same time, existing agencies and technical experts within the Air Corps and Bureau of Aeronautics were to be used for the actual preparation of specifications, except that "more personal contact" between the two services was hoped for.[4] For the working committee, a modest staff of only two officers and two aeronautical engineers was proposed, to be supplied,

one of each, by the two services; but funds even for them were not available from the current Army appropriations, according to the legal interpretation of the Army's budget,[5] and no appointments were made until 1938. Ultimately a staff of about 50 officers, civilian engineers, and clerical assistants was assigned to this committee, divided about equally between the AAF and the Bureau of Aeronautics.[6]

In addition to this coordinating and editing staff in Washington, an AN Specifications Unit was established by the Materiel Division at Wright Field, under the latter's "administrative control" but under the "executive control" of the working committee of the Aeronautical Board in Washington,[7] while a comparable unit was organized by the Navy at the Naval Aircraft Factory at Philadelphia. This dual control made the Wright Field unit an "orphan," in the Materiel Command and necessitated occasional reminders from AAF Headquarters that "all possible assistance" should be rendered by the operating units of the Command in preventing "bottlenecking in the AN Specification Unit at Dayton."[8] The actual preparation of specifications and drawings was accomplished and the comments of the respective services on proposed standards were assembled, at these two air materiel centers at Wright Field and Philadelphia. The Wright Field unit, like the working committee of the Aeronautical Board, underwent an expansion, from two engineers in 1938 to 10 in 1942.[9] The personnel of this unit (renamed the AN Standards Branch in 1943) consisted of the officer in charge, a civilian with long Wright Field experience assisting him, and a substantial group of young aeronautical engineers. The Wright Field unit was charged with obtaining the "coordinated opinion

and comments on all standards from all interested sections of the Materiel Command,"[10] and its original directive invoked the "full cooperation" especially of the long-established Specifications and Standards Unit,[11] which had been concerned for many years with intra-Army standards and which now seemed threatened by a competitor, so to speak, interested in the extension of Army standards to joint Army-Navy use.

The AN unit at Wright Field was expanded in December 1943 to coordinate standards within the adjoining Air Service Command (ASC) as well,[12] the latter being also a procurement command for certain categories of air materiel. Since June 1943, however, a unit of the ASC Maintenance Data Section had been handling some of this work, and shortly after a WCAB recommendation in January 1944, the jurisdiction was clarified and this activity was restored completely to the Air Service Command and assigned to a higher echelon--the Control Office, where sufficient authority existed for canvassing the entire Command on proposed standards.[13] After the ASC was consolidated with the Materiel Command in August 1944, a single standards section was established for the entire Air Technical Service Command, with appropriate branches for AN and AAF standards under the same higher authority, the Engineering Division.[14]

The reorganization of 1937 meant not only a new committee and additional personnel, but a reappraisal of the objective of aeronautical standardization and a gradual shift from peacetime to wartime procurement. Originally, the purpose of standardization since World War I had been to reduce procurement costs and increase production efficiency, within the limited budgets of the Air Corps (and of the Navy). Now after 1937, the

new objective was to "clear the decks" for national defense, to make standardization an integral step in the imminent mobilization of the aircraft industry for national defense and wartime production of aircraft. Mere economy was less important than standardizing materials and parts for speedy assembly-line production, for simplified supply and maintenance within the combat air forces, and ultimately for more effective combined operations with the Navy air arm and the Allied air forces.

Relations with the Aircraft Industry

While the Air Corps and the Bureau of Aeronautics were reappraising their specifications and drawings in terms of a common standard, the aircraft industry and the aeronautical engineers of the country were likewise interested in the problem, in order to increase their productive capacity to meet expanding orders.

The most articulate spokesman for the industry on problems of standards was T. P. Wright, vice-president of Curtiss-Wright Corporation, executive of other aircraft firms, and, after June 1940, a top executive in the aircraft sections of the National Defense Advisory Commission, the Office of Production Management, and the War Production Board. Addressing the industry in December 1940, Wright said that standardized materials was one of the three essentials for success in mass production of aircraft for national defense, and the other two being machine tools and a trained labor supply.[15] Although he predicted that the hope of mass production of a small number of models was likely to be "rudely shattered" by the fact that modern air warfare called for a variety of types, and that the design of each of them was likely to change as new

combat performance data were received, he nevertheless thought that standardization could be achieved at least for aircraft hardware, fittings, parts, and materials. Furthermore, there were industrial methods and processes that could be standardized, chiefly such matters as the selection and training of personnel, engineering and drafting methods, tooling equipment, and shop methods.[16]

It was necessary to include industry representation in the determination of AN standard specifications, in order to tailor the needs of the Air Corps to meet the actual abilities of the industry to fill those needs. It was necessary to balance "what is wanted against what can be furnished,"[17] to weigh tactical requirements against production ability, customer against producer. Ideally, the Air Corps might have insisted on the ultimate in quality and performance for a given part contained in an airplane, while the manufacturer might have resisted a new specification in the interest of using existing parts. Compromise was necessary in order to achieve immediate production and quantity procurement, and this compromise was most easily achieved by advance consultation with the industry rather than by a later laborious revision of a fait accompli presented to the industry.

Administratively, two groups of engineers throughout the industry were involved in material standards, the Society of Automotive Engineers (SAE) and the National Aircraft Standards Committee (NASC). The SAE Standards Division and its numerous technical committees on engine and propeller parts, accessories, materials, and processes were made up of aeronautical engineers serving voluntarily as professional men, with the professional prestige of the SAE behind them. The NASC, on the

other hand, was an industrial committee fostered by the Aeronautical Chamber of Commerce in 1940 as a sort of trade association, representing the official views of the aircraft industry itself and authorized to commit the industry to a given technical standard.[18] These professional and industrial committees, frequently with the same technical personnel serving on both,[19] were the channels through which the Services dealt in proposing standards to the industry, in receiving its comments and counterproposals, and in disseminating the published AN standards.

Of the two groups of committees, the SAE was the older, an inheritance from before the war, when the SAE had addressed itself to the peacetime needs and objectives of the aircraft and automotive industries, that is, the commercial demands for "mass production, reduced costs, and increased sales." With the beginning of defense mobilization in 1940, the SAE "cleared the decks" for war work; expanded its prewar aircraft standards division and placed it under the direction of Carleton E. Stryker (of Bendix Aviation) as part of a larger defense committee headed by Dr. George L. Lewis (of the National Advisory Committee for Aeronautics); and disseminated a brochure among Army procurement officers "offering its further cooperation."[20] These changes did not, however, basically alter the pattern of Air Corps-industry relations. The Materiel Division already had its established channels with the SAE, first through the Aeronautical Board and its working committee established three years earlier (1937) and next through the various Wright Field laboratories that had officers actually sitting on SAE technical subcommittees.[21] Furthermore, the SAE organization

was in the final analysis unofficial and its SAE Handbook of specifications was binding neither on industry nor on the Air Corps. Not until SAE specifications were officially accepted by the Air Corps, a practice beginning in 1941, was a given standard acceptable in actual effect, as far as Army procurement was concerned.[22]

Besides the SAE and the NASC, there were numerous other industrial and Federal committees concerned with phases of aircraft standards with whom the Materiel Division and Aeronautical Board dealt, such as the trade associations dealing with iron and steel welding, paint and varnish, rubber, cable, and tires and rims.[23] Not the least in importance was the Interdepartmental Screw Thread Committee, reestablished in April 1939 by the National Bureau of Standards to represent the Commerce Department, the Services, and industry for the standardization of "tremendous trifles" like gages, dies, nut and bolt head dimensions, and the microscopic distance between threads of a screw.[24] In this activity the Air Corps objective was "to introduce a requirement in all our airplane specifications that one type of screw thread would be used throughout the airplane."[25] By 1942 the Committee had published two basic specification handbooks on screw threads, which were incorporated into and "formed a part of" the ANA specification on the subject.[26]

Some of these standards organizations had grown up with the industries that they represented; others were wartime agencies that mushroomed during the "defense period" after 1939, as "national defense" became the slogan of industry, business, and government. Superimposed on all of them was a "Standards Group," set up in February 1941 in the Aircraft Section of the Office of Production Management (OPM) to "coordinate" all

these standards agencies in order to "avoid duplication of time and effort" on aeronautical standards.[27] The Air Corps called attention to the fact that the Aeronautical Board and the Joint Aircraft Committee were already the going concerns for "all" standards activities of the Army and the Navy, as well as the British missions in the United States.[28] In a subsequent clarification of its activities, the OPM unit became concerned chiefly with allocating the work on a national scale among the numerous trade associations and technical committees throughout the industry,[29] leaving the Aeronautical Board and the Joint Aircraft Committee to do the coordinating for the military services.

Symptomatic of the trend away from industry control toward Air Corps and Navy control of standards was the fact that ANA standards were being more and more accepted commercially in civil aviation. The demand for AN specifications for civil aviation became so great that the Chief of the Air Corps found it necessary in July 1938 to formulate an official policy whereby Air Corps and AN specifications "should be confined /in/ their application to U.S. Government contracts."[30] However, their use for civilian aircraft was not to be discouraged, except that no reference to their service origin was to be made.[31] Likewise, aircraft design standards came to be dominated by the services as aircraft production shifted to a war basis; the Army-Navy-Civil committee, established by the Commerce Department in 1935, was in September 1941 established as a satellite of the Aeronautical Board, with Army and Navy chairmen, alternately, rather than with a CAA chairman.[32]

Autonomy for aeronautical standardization, was achieved, furthermore, with respect to various "overall" standards-monitoring agencies

throughout the military establishment. For example, there existed a Plans, Programs, and Requirements Committee established in the Army and Navy Munitions Board about 1936 (after March 1942, the Standards Division of ANMB);[33] and a Standards Division in the office of the Assistant Secretary of War[34] (shifted in March 1942 to the Services of Supply). The ANMB unit was merely a recording office for "final authentication and record" for aeronautical standards, and in 1943 withdrew entirely after it appeared that this final step had added nothing except several weeks of delay in publishing a given standard.[35] The Services of Supply unit was concerned primarily with non-aeronautical items of ground materiel and items common to all the arms, not of policy interests to the AAF because (as the Materiel Division pointed out in December 1941) "the Air Corps is already carrying on Army and Navy /aeronautical/ specification coordination."[36]

Progress and Problems

At the outbreak of the European war in September 1936, 24 standard specifications on materials had already been published, covering paints, dopes, chemicals, and a few items of cotton, rubber, and metals;[37] 220 AN standard drawings had been completed, chiefly for hardware items such as bolts, nuts, couplings, etc.; and 151 "AN Master Agreements" had been put into effect on flight instruments, engine instruments, vacuum pumps, fuel pumps, wheels, and brakes.[38] By the end of 1940, as the planning of industrial mobilization was giving way to the actual expansion of production, a Materiel Division review of the aircraft situation acknowledged that the Aeronautical Board "has effected complete standardization to a level that is consistent with the tactical uses of the equipment."[39] If standards were still far from "complete," at least the

standards achieved during the "defense period" before the Pearl Harbor attack were vital to mobilization. The Aeronautical Board thus described the situation, in a retrospective review published to the industry in November 1942:[40]

> The fact that AN standardization had been in effect for years preceding our sudden entrance into this war is now a factor of definite assistance which we could ill afford to do without. The establishment of such a standardization policy, the development of the standard parts themselves, their production, their use in airplane manufacture, and their distribution to repair bases, is a task which cannot be accomplished in a matter of months. Had this basic policy and its implementing procedures not been already functioning it would be almost too late to begin. Or, stated in other terms, if the non-standard parts practices of our domestic hardware or appliance industries, and others, prevailed in aircraft manufacture, it is likely that a sizable percentage of our planes now flying would be on the ground for want of some small part with an odd-size thread.

By the end of 1943 the accomplishment in terms of quantity of standards published had expanded to 181 specifications and 333 drawings. Comparatively, about 85.7 per cent of "AAF parts" were "AN standards," as of the end of 1943.[41]

This simple statistical record of progress represented more than a publishing achievement of Army-Navy aeronautical specifications, drawings, bulletins, and indexes.[42] The standards represented detailed analyses by engineers at Wright Field, at the Naval Aircraft Factory, and in the industry committees. They represented, also, a group of acceptable compromises between the Army and the Navy, and between them and industry--compromises arrived at by committee members who at their best were "skilled diplomats, /some with/ the combined talents of a lawyer and inventor to put /them/ across."[43] A basic principle of procedure, followed since 1938, was to work out a standard that would

actually be agreed upon, and not to publish a so-called "standard" consisting of two slightly different items--one for the Army and one for the Navy. In other words, "to agree to disagree" was ruled out as a method of procedure. Instead of such a "double standard," the "hard way" of publishing a single standard was established and "adhered to in all ANA standards without exception, in spite of the many cases in which it would have been expedient to permit statement of non-common requirements."[44] Of the differences that were not ironed out, some represented different tactical needs of Army aviation and Navy aviation. Other differences were probably fanciful, representing conflicts of customs and usages between one service and the other. Other controversies represented differences in fundamental nomenclature and usage, such as the airspeed indicator, which in the Army showed miles per hour, and in the Navy, knots. The AAF's m.p.h. measurement was based on the statute mile used in cross-country maps, while the Navy's knot was based on the nautical mile, corresponding to one minute on a great circle on the earth's surface, cartographically more accurate for global warfare. This particular problem, which also affected existing maps, handbooks, and operating procedures, was still unresolved during the war.[45]

Another problem, administrative rather than technical, was the actual enforcement of a joint standard within the AAF after it had been officially accepted and published by the Aeronautical Board. Whenever standards were approved by the Board,[46] "their use becomes mandatory on the AAF," as it was stated in the directive; and while the directive was not actually published in the AAF until December 1943,[47] it had been the general rule

since 1937. Complete enforcement was never achieved, however. The Chief of Air Staff in October 1942 complained that "full advantage" of the Board's work was not being taken, and directed the Materiel Command to permit the procurement of non-standard items "only" in specific cases where the Commanding General of the Command reviewed the pertinent details and rendered a specific decision.[48] Some exceptions were found to be obviously necessary: (1) items that were procured for experimental or service testing were by their very definition not standard; (2) non-standard items that were in some cases found more suitable for the maintenance of existing standard equipment; and (3) non-standard items that appeared in combat theater requirements submitted to OC&R, items which were approved unless the theater commander could be persuaded by AAF Headquarters that the standard item was just as good.[49] These exceptions, which had been made even under "mandatory" standardization, were eventually written into the formal directive in December 1943, and were authorized as a means for insuring "flexibility" and "practical procurement."[50] At the same time, other "temporary deviations" from AN standards were permitted, "only . . . as a last resort" and only if granted by the Commanding General of the Materiel Command or the Air Service Command, whichever had cognizance of the particular procurement involved.[51]

This AAF policy for enforcing standards was reiterated and expanded in a M&D directive to the Materiel Command in February 1944.[52] Endorsing in general the plan for executing standards, the Command replied that it "stands firmly in favor of standardization as a principle, but feels equally strongly that standardization should not be taken at the expense of production."[53] The M&D directive was subsequently revised so that,

effective 1 April 1944, AN standard parts and materials were to be incorporated in "current production" airplanes as well as in the "new production" models such as the B-29, B-32, B-35, and F-11, and even in new experimental airplanes, unless the particular experimental nature of such future models made the use of the standard undesirable. Always it was "understood," however, that standards were "not to be incorporated in production models [of aircraft] where deliveries would be jeopardized."[54] Finally, the Materiel Command stated still another category of exceptions to standards, those arising out of industrial demobilization, requiring deviations that should be "granted for obvious reasons to manufacturers of aircraft and equipment going out or soon to go out of production."[55]

Meanwhile, there was criticism of unilateral action being taken by the AAF without the Navy. The growing "eagerness" of the Materiel Command to grant deviations from AN standards, while it was a common complaint within the WCAB[56] was also criticized by industry. Thus, the Douglas Aircraft Corporation in December 1943 complained that the AAF was permitting deviations from certain AN standards governing threads of turnbuckle barrels and steels for fluid fittings, without a similar waiver by the Navy, making it[57]

> difficult to segregate and earmark AN parts or materials purchased to AN specifications for use on airplanes produced for one of the services only. Furthermore, such segregation unduly hampers the flexibility accruing from being able to transfer AN parts from one plant to another . . . or to other airframe manufacturers, . . . to relieve shortages and level off inventories. On the other hand, it is generally desirable to take advantage of the latitude allowed by deviations authorized for the primary purpose of eliminating shortages.

This incident was seized upon by the WCAB to initiate a directive to be issued through the Aeronautical Board itself, a procedure rarely invoked

in standardization matters. The board stated that the promiscuous granting of deviations by a single service without joint coordination was resulting in "abuses" that were "confusing" the production program and nullifying joint standardization; and directed that each "temporary" deviation be specifically explained and defined as to its scope and duration, and that "permanent" deviations be acted on through the regular channels of the WCAB.[58]

In order to speed up the joint approval of deviations, Douglas had recommended that the Joint WPB organization, the Aircraft Resources Control Office (ARCO), be given authority to grant "on the spot" deviations. This proposal was vigorously opposed by the existing joint body--the WCAB, with the Army member observing that the head of the ARCO conservation unit seemed to have an interest and was "actively engaged" in seeking such authority.[59] The substitution of one joint body in Washington for another was probably not the ideal solution. A more basic solution was to decentralize deviation problems to the procurement districts, where industry and the services could make their views immediately known on a proposed deviation. A suggestion in June 1944 from the Western Procurement District proposed that the district supervisor and the Navy representative at that district (the Bureau of Aeronautics General Representative) act as a subcommittee of the WCAB to review requests for deviations before sending them to Wright Field, the Navy, and the WCAB for action;[60], the WCAB approved the procedure, as long as it was limited to screening proposals and making recommendations rather than to actual granting of approval.[61] This procedure seemed likely to be extended to other procurement districts.

Chapter III

STANDARDIZED AIRPLANES AND EQUIPMENT

Whatever factors were behind the need for standardized materials and parts were equally patent for standardized equipment and airplanes: to increase the opportunities for mass production, to improve the flow of supplies to the theaters, to ease the maintenance problem, and to facilitate joint operations by the Army and the Navy and by combined American and Allied forces. Whether the scope was to standardize within the AAF, to standardize with the Navy, or to standardize with the British, the goal was to speed up the mobilization of the aircraft industry and to facilitate combat operations.

Standardization of Materiel Within the AAF

Even without a Navy air arm, with its separate procurement of items similar to the Army's, standardization of materiel within the AAF was a sine qua non for the effective mobilization of the aircraft industry during the war. While not the sole factor in the achievement of quantity production of airplanes and accessories, certainly interchangeable components and standardized parts were absolutely necessary for final assembly of aircraft, for the production of components, and for the subcontracted manufacture of "bits and pieces" that made up the major components and accessories.

Even in the peacetime procurement of limited quantities of aircraft, standardization had been recognized in Army Regulations as the basic step between development and quantity production.[1] In one of prewar years, 1936, the Air Corps reaped the cost benefits of some of

the standardized types by exercising contract options which permitted a single year's requirements in a given type to be increased to include a second year's quantity.[2] But mass production in any real sense did not exist, and standardization as a current operating procedure was merely a formality. As a problem in industrial planning for future war mobilization, however, standardization could "hardly be overreemphasized" in importance, according to the Bryden Board in 1936 [3]

> Drawings and specifications /for wartime procurement/ cannot be prepared until the /aircraft/ type has been standardized. Industry cannot be acquainted with the task to be imposed upon it in war until the government's needs are made known in the form of drawings and specifications. Since thousands of airplanes will be required early in the next war, resort must be had to mass production methods. The most important step that can be accomplished in preparation for mass production of aircraft in war is the standardization of types and the preparation of drawings and specifications around such standards.

Standardization of a limited number of combat aircraft types was the simple formula for mass production. While development would continue during the war and combat experience would lead to improvements, the planners nevertheless urged that "to depend upon research and development after the war starts for advanced types of aircraft would be fatal."[4]

The question of when to freeze designs of existing aircraft models in order to begin quantity production constantly crept into production planning during the subsequent defense period, and periodically warnings were issued on the virtues of production over perfectionism, based on the general policy in AR 850-25.[5] Thus, a committee on the reorganization of the Materiel Division spoke in January 1939 of the freezing of designs and specifications as "the foundation of all mass or large quantity

production"; anticipated the objections to such a policy, that in wartime, combat performance data would require production changes; but urged that the number of the "change orders" in production contracts must be "drastically curtailed," unless the change actually facilitated manufacture or was imperative for combat needs.[6] A similar anxiety was expressed in August 1940 by the Assistant Secretary of War, who cited the "desperate" situation of the British because of their failure to freeze designs, and discussed the lessons that should be learned by the American Army:[7]

> The technical services are never satisfied with anything less than a perfection which is always unobtainable. The best is the enemy of the good. If we are to avoid the catastrophe of "too late and too little" there must be a decision as to production types. Germany has demonstrated that thousands of imperfect tanks on the battlefield are better than scores of perfect tanks on the testing ground. . . . Failure to freeze designs . . . must be constantly guarded against. Not only do changes in design lead to increased costs but to the much more vital factor at this critical time, delay in delivery. Changes, no matter how sound technically, will disrupt manufacturing schedules with resulting delays. No changes in design should be made except for reasons of safety or tactical necessity. Even in these situations the decision to make the change should be carefully weighed against the delay that will ensue.

Actually, this policy of "freezing designs" was "already in effect," but the Assistant Secretary's views were sent on to Wright Field by the Chief of the Materiel Division as a reinforcement of its existing policy.[8]

The perennial problem--when to pause in development and standardize for quantity production--was further aggravated, from the production viewpoint, by demands for non-standard items arising out of combat experience. During 1940 and 1941 the United Kingdom was the combat "proving ground" for Air Corps airplanes and weapons sold or lend-leased to Great Britain, as well as for Britain's own weapons. With American

entry into the war after 7 December 1941, this proving ground was extended to the areas outside the European theaters. The performance reports on airplanes, engines, propellers, bombardment accessories, armament, and radio and radar by Air Corps and British observers, together with parallel experimental activities going on meanwhile at the Wright Field laboratories and in the British developmental establishments--all had to be translated in terms of improved equipment and installations into the standardized production types coming off the assembly lines. The Materiel Command's answer to this problem was to abandon the peacetime formula of rewriting the standard specification for the airplane and writing a change order into the contract. Instead, last-minute modifications of production models were to be made not in the final assembly plants but at establishments called "modification centers," usually located in the vicinity of assembly plants. The idea of modification centers, which was developed late in 1941 and put into effect in March 1942, provided a compromise solution to permit both development and production to proceed unhampered. Of all the airplanes manufactured during a typical nine-month period in 1943, for example, 36 per cent were "hand tailored" at those centers, with final changes dictated by particular theater commanders, by changing combat conditions, and by advances resulting from research and development.[9]

Along with standardizing a particular airplane, it was also necessary to standardize components and accessories among the various contractors producing the same item. The policy for achieving this was known as GFE--Government-Furnished Equipment--and covered items produced by prime and subcontractors under AAF standard specifications (or under

joint Army-Navy specifications). As a phase of war mobilization policy, standardized GFE originated in May 1936, when the Chief of the Air Corps and the Assistant Secretary of War agreed that "all future Circular Proposals /for aircraft procurement/ should make these requirements /for standardized GFE/ mandatory and permit deviation therefrom only in exceptional circumstances." The manufacturers favored the policy, it was said, in order to reduce the changes on production orders, while the Air Corps favored it because "undoubtedly it will materially simplify procurement, supply, and maintenance problems."[10] In actual practice during wartime, this GFE policy was basic to mass production; but it was occasionally threatened by production delays. Thus in May 1942, when shortages of GFE equipment were menacing the aircraft production program, Lt. Gen. W. S. Knudsen, then in the Under Secretary's office, and General Arnold were inclined to be sympathetic to "cut /ting/ down materially on the GFE list /of items/" and permitting the aircraft manufacturer to seek his own sources for accessories--CFE (Contractor-Furnished Equipment); but the Chief of the Materiel Command expressed anxiety over "problems of replacement and interchangeability which /would/ upset the service maintenance very badly if we permit /the contractors/ . . . to furnish non-standard items of equipment, whose parts cannot be readily replaced,"[11] and the GFE policy prevailed as a general rule.

Closely related to standardization was the problem of simplification. In contrast to the infancy period of military aviation in World War I, when only two or three models of military airplanes were produced in quantity in the United States, there were almost 70 models in existence in the Air Corps in September 1939, and 140 in December 1941.[12] Even ignoring those restricted models that were not tactically available,

there were 74 standard and limited standard tactical and training types at the time of the Pearl Harbor attack,[13] and 36 of them were described by General Arnold as "suitable for combat." To reduce this number to minimum was the production engineer's dream, as well as the hope of the Air Service Commands in the combat areas; and even from the point of view of training and combat operations, there were obvious advantages to standardization. By October 1944 the number of "first line" combat airplanes was reduced to 29,[14] while the number of serviceable transports and trainer airplanes was as high as 91,[15] undifferentiated as to first and second line because most of them were in use even though no longer in production.

On the related problem of complex equipment, boards were from time to time appointed in the AAF to survey the variety of air weapons and accessories. For example, a Special Board on simplification was organized at the Materiel Center on 11 August 1942, headed by Col. O. R. Cook. His report was an attack chiefly on superfluous equipment and "gadgets" that affected the flight performances of the airplane itself, such as formation lights (forbidden on combat missions), altimeter correction cards ("seldom used"), complicated landing gear indicators (instead of a single simple device), pyrotechnic signalling devices (a "combat hazard"), various items of interior "trim" (which could be "limited"), and radio and radar equipment generally, which was particularly criticized as consisting of "too many kinds" rather than "bare necessities" and of items installed merely "because /they/ may be handy to have along sometime." Bombers were over-equipped, the Board found, with items such as permanent septic tanks, fittings for 100-pound bombs (in heavy bombers),

and fittings for tow targets. Fighters should also be simplified, it was recommended, by removing most of the lights, the airplane data case, the emergency brakes, the walks along the wings, and even the IFF radar; and by reducing the number of fittings or "provisions," which were "always an invitation for someone to add something to the airplane which may not be absolutely necessary for its highest efficiency as a Fighter and may, in fact, reduce its efficiency as a Fighter."[16]

Shortly thereafter a policy on simplification was issued by the Director of Military Requirements,[17] and a Bomber Weight Reduction Board was appointed in AAF Headquarters, with a directive to recommend eliminations of all non-essential equipment and furnishings from the B-26, the B-25, the B-17, and the B-24.[18] Eventually the B-29 was also included, to be analyzed for speed, range, and ceiling after being stripped of everything, including all turrets and fire control except the tail turret.[19]

The variety of accessories and the variety of tactical types of aircraft represented not the production engineer's ideal but military requirements, usually a result of ideas gained from experimental engineering, service testing, and combat proving, all of which dictated deviations from standard. Within the AAF the standardization of a new or improved item of air equipment was the function in AAF Headquarters of AC/AS, OC&R,[20] which reiterated in June 1943 that no item of air materiel "will be accepted for standardization or purchase in production quantities" merely on the recommendation of some other AAF organization or command, such as the AAF Equipment Board, the Air Service Command, or the Equipment Laboratory at Wright Field.[21]

In the final analysis, the absence of lag in standardization was due to the fact that the tactical, strategic, and logistical missions of the air force and its air weapons were not completely standardized, because of the flexible nature of air operations in warfare and the variety of tactical applications of aviation that were "sported" during the war. Furthermore, the theaters and areas of operations were anything but "standardized." Finally, the enemy required anything but "standard" treatment. Even without the existence of other air arms in the Allied war effort, such as the Navy, the RAF, and the Fleet Air Arm, each with its own standards, there were a variety of air missions, variety of terrain and climate, and variety of enemy weapons and tactics in global warfare that were delimiting factors in the standardization of air weapons.[22] The problem was larger than materiel development, aeronautical specifications, and industrial cooperation. To achieve maximum standardization required a combined synthesis of training, tactical doctrine, and war planning.

Joint Army - Navy Aircraft Types

If the varying tactical, strategic, and logistical missions of the combat Air Forces were not and could not be entirely standardized within the AAF, the problem was further aggravated by the existence of a Naval air arm, with its own missions, some of which (e.g., carrier-based aviation) occasionally were quite different from the Army's but others of which (such as patrol bombardment) overlapped or duplicated the AAF mission. Ever since 1917 the Army and Navy had been discussing--and disputing--the differences in their air missions: the Army-Navy agree-

ment in October 1916 had attempted to dispose of the controversy by defining Navy aviation as aircraft operating with the fleet, aircraft operating from land bases for "overseas scouting," and aircraft for defense of naval stations and naval facilities located on land; and Army aviation as aircraft operating with the "mobile Army" (air-ground support), aircraft for the "fire control of coast defenses" and for the "spotting of coast defense guns" (observation and liaison), and aircraft for "anti-aircraft defense of /Army/ fortifications."[23] Bomber airplanes were not even included, and in the 1920's and early 1930's the Navy first attempted to deny bombers to the Army as a useless weapon and later, even after the Pratt-MacArthur agreement of 1934, to appropriate land-based "patrol bombers" as part of its own aviation mission.[24] The controversy was relatively dormant by the time of the outbreak of the European war in 1939, when airplane development and procurement was firmly fixed in two independent materiel centers--Wright Field for the Air Corps and the Naval Aircraft Factory (Philadelphia) for the Navy Bureau of Aeronautics.

Some efforts were made to standardize aircraft types that were more or less common to both air arms. The War Plans Division of the General Staff in 1932, in a memorandum on industrial planning based on Air Corps information, recognized that if standard aircraft types suitable both to the Army and Navy could be adopted, "the problem of allocation of war-time production would be much simpler than it is t present." The following analagous types in Army and Navy were apparent:[25]

Army	Navy
Pursuit	VF Fighter
Bombardment	VT Torpedo
	VB Bombing
Attack	None
Observation	VO Observation
	VS Scouting

Army	Navy
Observation	VR Amphibian
Amphibians	VP Patrol
Transport	VJ Utility
Primary Training	VN Training
Basic Training	VO Observation

No agreement resulted, however, before the European war. Shortly after September 1939 the Air Corps, The General Staff, and the Navy undertook by means of a new Joint Air Advisory Committee to "study and advise" the Chief of Staff and the Chief of Naval Operations on various mutual problems--aircraft types, interchangeable equipment, research, training, installations, and employment and operations--where duplication existed or cooperation would be beneficial.[26] Standardization of combat types, while it was on the agenda, was never taken up as a special topic by the committee. In May 1940, however, the Air Corps independently made an overture towards standardization by accepting the Navy's dive bomber as satisfactory to the Army and by halting its own development work on that type.[27] Subsequently, in September 1940, another committee, the Army-Navy-British Joint Committee, took up specifically the problem of both aircraft and equipment standardization between the services and included as well the British Purchasing Commission as the third dominant customer for U.S.-produced military airplanes. In the joint schedules of production set up by this new committee (soon renamed the Joint Aircraft Committee), the Navy eventually accepted and used a number of AAF models, chiefly the PT-13, AT-6, and AT-7 trainers, the C-47 and C-54 transports, and the B-25 and B-26 medium bombers.[28] The Navy, furthermore, reversed its pre-war attitude toward heavy bombers, and requested

(in February 1942) that a quantity of B-24 Liberators be allocated for use at icebound North Atlantic and North Pacific bases on naval missions of convoy escort, observation, scouting, and patrolling; and promised that existing joint agreements on employment would be followed.[29] Special modifications of these bomber, transport, and trainer types required by the Navy were incorporated after the planes left the assembly plant, thus preserving at least the basic production advantages of standardization.[30]

Aside from these few examples of joint use, Army-Navy standardization of aircraft models was far short of any ultimate goal. As a maintenance problem, for example, it was said by the Director of Base Services that[31]

> While it might be said that airplanes and aircraft engines etc. are common to the Army Air Forces, Naval Aviation, Marine Aviation, and and Coast Guard Aviation, this is true for the most part only in that all these activities fly and maintain airplanes. Except for the most common maintenance parts, very few of the many thousands of items of spare parts, or even accessories, are common or interchangeable between the services.

Inter-Allied Aircraft Types Procured by the AAF

Even before the outbreak of the European war, Britain had been the dominant foreign customer of the American aircraft industry. Her purchases had been generally encouraged by the Air Corps as a device for keeping the aircraft industry alive and for encouraging its expansion. As part of that same objective, the Air Corps, through the Aeronautical Board and the State Department, released more and more of its restricted models of airplanes and equipment for sale by its contractors directly to the British, as well as to other friendly neutrals and potential allies.

The British, however, were looking not only for American commercial and military types, but also for facilities for the production of their own combat models--non-standard types of airplanes as far as the Air Corps

was concerned. When in June 1938, for example, it was learned that an American firm (Stone and Webster, Inc.) was proposing to organize a production engineering agency for handling the production in the United States[32] of components of Blenheim bombers and possible other British and French combat types, the Aeronautical Board opposed the plan because it would lead to the "building [of aircraft] to foreign standards of weights and measures (metric), of no help to U.S.," as well as result in monopoly, endanger military secrecy, and adversely affect the industry's deliveries to the Air Corps.[33]

The threat of foreign types to Air Corps standards was based on more than an objection to the metric system, which was a system of standards based on wider international usage than American measures and which in any future global war might be more workable. By mid-1940, the production of non-standard types in the United States was becoming a threat to an integrated mobilization of industry. France had fallen, and her contracts in the United States had been taken over by the British. The British in turn let additional contracts, based largely on the introduction of several of their own types into American production, chiefly the four-engine Sterling bomber, the two-engine Beaufighter, and the single-engine Typhoon pursuit airplane.[34] While the expanded production facilities were welcomed by the Air Corps, the production of non-standard types was vigorously opposed. At an Anglo-American conference at Wright Field on 5 and 6 August 1940, the Air Corps, as well as the other American representatives from the Navy and the National Defense Advisory Commission, argued that the introduction of British types into American industry would lead to "such program confusion, . . . dilution of engineering and managerial effort, and . . . increased general burden on the industry" that

both the American and British aircraft programs would be delayed.[35] As a result of the conference, the British agreed to abandon any further idea of manufacturing their own airplanes in this country,[36] and the Air Corps submitted a list of American types that would "either equal or exceed [British military] requirements," including the B-24, which "approximates the Sterling in performance"; the long-range, higher-speed P-38, in place of the Beaufighter; and the P-47B, P-40D, or P-51, instead of the Typhoon.[37]

The withdrawal of British types from American production and the offer of Army types as a substitute led directly to the setting up of administrative machinery for carrying out the details of the agreement--decisions as to exactly which types would be mutually acceptable and exactly what modifications on American planes were necessary for making them operationally suitable to the RAF, so that all the services could "realize the . . . potential deliveries" expected in their production agreement of 23 July 1940.[38] The combined "Army-Navy-British Purchasing Commission Joint Committee" was proposed by the Air Corps on 13 August 1940 and organized on 13 September by the three parties concerned. Standardization work was assigned to a main subcommittee, which met for the first time on 9 October 1940, under the chairmanship of T. P. Wright of the National Defense Advisory Commission, with an Air Corps officer--Maj. D. G. Lingle of the Aeronautical Board--as Recorder.[39]

The Air Corps and the General Staff regarded Anglo-American standardization as a policy for insuring that the War Department would benefit by the expanded production resulting from British orders. Standardization would result not only in greater economy and efficiency throughout the industry, but would also permit British contracts and British-committed

production facilities to be taken over promptly "in case of British defeat."[40] This was the realistic policy of the War Department during the perilous days of the Battle of Britain in August and September 1940. A few months later, in the confidential and public discussions on the pending Lend-Lease bill to give more direct aid to Britain and other potential Allies, Congress was assured that by emphasizing U.S.-British uniformity in the production of weapons, "they could in an emergency be used by our own forces,"[41] as well as "combine the best results of the experience of both ourselves and the other nations."[42] Pursuant to this policy, the Defense Aid appropriations for implementing the Lend-Lease policy contained clauses whereby the War Department retained production control and title to aircraft (or other weapons) produced with Defense Aid money, and the President was authorized to withhold such weapons from foreign governments and retain them for American military use "whenever in [his] judgment . . . the defense of the United States will be best served thereby."[43] Thus it was possible to "freeze" all aircraft and equipment allocations on the day of the Pearl Harbor attack. After American entry into the war, it was largely because of the previous standardization agreements with the British that American-produced aircraft could feasibly be placed in a common pool for allocation by the Combined Chiefs of Staff and the Munitions Assignments Board.

In addition to existing production models satisfactory to both American and British air forces, experimental models and future development of air weapons were also involved in the agreements of August and September 1940. The Anglo-American conference at Wright Field in August acknowledged the

urgency of combining the lessons being learned from British combat experience with the technical advances being made by American experimental engineering, and of ironing out in advance any Anglo-American differences of opinion on characteristics of new weapons, in order that "more mutually satisfactory airplanes [could be] made available to both countries in the future."[44] T. P. Wright urged, in the interest of orderly production expansion, that the standardization of such future models be expedited by giving to the British "blanket approval" to visit the experimental engineering departments in any American plant (except with respect to those planes or accessories that might be specifically excepted) and to fly or be flown in such service-developed aircraft for inspecting their characteristics.[45] The Chief of the Materiel Division promised, in connection with a proposed inspection trip by the British to various West Coast plants, to make technical data available at least on all production models, and offered to send along an Air Corps representative in order "to make certain that there was no reticence on the part of the manufacturers in discussing [standardization] issues."[46] The inspection trip was made and the British found it of "some value," especially in confirming among them the need for using American rather than British types; but they complained at the omission of experimental developments, "which are indispensable to deciding whether the improved model will be acceptable."[47] The Air Corps, on its side, was ready to give the British permission to inspect planes, mock-ups, specifications, drawings, reports, and other information on such development projects as pressure cabins, self-sealing fuel tanks, turbo-superchargers, bomb-rack installations, and power turrets. But especially with respect to turrets, the Air Corps asked for the release

by the British of corresponding data on their own Frazer-Nash turrets;[48] and with respect to bombsights, the Navy was not ready to release the Norden sight, the procurement of which it controlled. On 4 September 1940 a general information-release policy was transmitted to the British by the War Department, covering these exceptions but otherwise including "all data and access to all mock-ups and physical articles . . . required for the British-American mutual airplane production program."[49] Among the developmental projects soon to be inspected was the XB-29 long-range bomber, the mock-up of which the British were invited to witness in November 1940.[50]

Eventually mock-up inspection was the stage in the development of an advanced model or article of equipment at which the British mission was generally called in for the purpose of "advance standardization." In March 1941 General Arnold, by then Deputy Chief of Staff for Air, stated as War Department policy that British advice and recommendations should be obtained "as early" in the developmental stage "as this information can be obtained from them," and that the "actual standardization" should occur "during the mock-up stage when the mock-up of a particular type is available."[51] In August 1942 this procedure was formalized by being added to the revised precept of the JAC Subcommittee on Standardization.[52]

The exchange of technical information between the Air Corps and the British, whether on production or on experimental models, was beset by other difficulties. Insufficient British personnel was one of these problems. The British Purchasing Commission started out in October 1940 with only two men assigned to standards cases, and the Materiel Division, criticizing the "tremendous delay" resulting from the meager size of the British staff, asked first for 14 technical men,[53] and later (after the Lend-Lease Act

was passed in March 1941) for a total of 22 British engineers to be assigned in Washington and at Wright Field.[54]

Another problem was the channels for the flow of technical information, not at all clear at the beginning. There was, for example, "a great deal of delay" due to transmittals going through the State Department, a procedure that the Treasury representative on the JAC promised to remedy by a "short-cut";[55] and after the State Department withdrew, the intelligence divisions of both the Air Corps and the General Staff did likewise, after establishing proper accountability in the Materiel Division and the Joint Aircraft Committee.[56]

On the side of the British representatives, there was also some initial confusion. Besides the British Purchasing Commission's air technical staff, which provided the authoritative representatives on the JAC standardization subcommittee, there appeared another mission in Washington--a general technical mission headed by Sir Henry Tizard, which had "no love" for and "little cooperation" with the other mission and which was working independently among American scientists and industrialists, including the aircraft industry on the West Coast.[57] The Materiel Division's concern was not only to preserve the channels set up through the Joint Aircraft Committee, but also to insure that a "centralized record" of requests for information was being kept either by the British Publishing Commission or the British Embassy in Washington, "so that the United States will be in a position to demand like information from the British."[58] This problem was finally settled in favor of the Purchasing Commission, but even as late as August 1941 the Materiel Division complained to the British that their responsibility for the making of detailed standardization decisions

was not clear. At Wright Field, it was asserted, the British had three separate sections--one each for the RAF, the Ministry of Aircraft Production, and the Air Ministry--instead of a single responsible liaison office.[59] In January 1942 AAF-RAF technical liaison in the United States was finally established under a single jurisdiction, the British Air Commission.[60]

Another problem affecting the channels for standardization was the occassional tendency for decisions to be made in England rather than in the United States; this practice arose from visits to England by War Department policy-making officers and American factory representatives with whom the British wanted to deal directly. Thus, a decision on turrets was made in London in May 1941 by General Arnold and Assistant Secretary Robert A. Lovett, based on technical assistance of certain Emerson Electric engineers who were also in England at the time; and the Chief of the Materiel Division commented on the incident as an example of difficulties that had become more and more chronic since August 1940:[61]

> The British keep calling for all sorts of technicians to go to England but I yet don't understand why they don't send their technicians to the United States, go over the equipment which we are manufacturing and make their changes here or refer the matter to the Joint /aircraft/Committee for complete standardization.
>
> During the past ten months /since August 1940/ there have been numerous times when it has been practicably impossible to get a decision out of the English in connection with standardization. I believe this condition is going to become much worse if we endeavor to have somebody in England /such as Emerson Electric engineers/ trying to standardize equipment we are manufacturing in the United States.
>
> May I again emphasize the fact that we must not get out of channels on the standardization phase. The English are extremely difficult to deal with and we have managed to keep them in line for the Joint Aircraft Committee. If other people begin to talk standardization and the Materiel Division /represented on the JAC/ is neglected, we are going to be in a complete spin and get thoroughly

in trouble within the next ten months.

In addition to special visits and ad hoc missions, there were also permanent missions in England, including the military attaché's office at the American Embassy and the air section of the Special Army Observers Group.[62] The latter, which was reorganized after Pearl Harbor as the Air Technical Section of the Eighth Air Force, was concerned primarily with inspection and observation of British production, development, and combat performance, and thus also figured in the problem of standardization, chiefly with respect to encouraging the British to undertake "parallel standardization" of British-manufactured air materiel that might be used in the same theaters with the American Air Forces.[63] In August 1942, after the Directorate of Military Requirements had challenged the policy of British participation in American standardization without reciprocal privileges for the AAF in the United Kingdom,[64] the JAC directed its Subcommittee on Standardization to include in each standardization case a recommendation that similar items produced in the United Kingdom be made "operationally and dimensionally interchangeable" with U.S.-standard items.[65] The Recorder (Col. D. G. Lingle) arranged with the Ministry of Aircraft Production and the Eighth Air Force a procedure JAC standardization cases would be taken up for consideration by the former's standardization offices, and mock-up inspection of all British-developed aircraft would be attended by the Air Technical Section.[66]

Another problem, concerned also with channels on the side of the Army Air Forces, was the coordination of AAF military requirements with inter-Allied standardization policies. The Materiel Division of the Air Corps[67] and the War Plans Division of the General Staff originally represented the

Army on the Joint Aircraft Committee, and the Chief of the AAF presided over the plenary committee, thus insuring broad consideration of AAF needs and interests. After the reorganization of March 1942 AAF military requirements for aircraft were made the special responsibility of the Director of Military Requirements (after 29 March 1943, the Requirements Division of OC&R), and that office was also given membership on the JAC Subcommittee on Standardization,[68] chiefly in order to insure that aircraft standards within the AAF (controlled by Requirements) coincided with standardization between the AAF, the Navy, and the British (controlled by the JAC).[69] Mere membership did not always insure a coordinated policy, however, and the directives sent to Wright Field incorporating Requirements policies, on the one hand, and JAC policies, on the other, led to complaints by the Materiel Command that "frequent" conflicts were occurring and that Wright Field was "trying to serve two masters," especially in cases where Requirements ordered special modifications dictated by tactical situations and by requirements of the various theater commanders.[70] A solution, arrived at in January 1943 by the JAC, was to direct that Requirements clear all AAF-inspired changes through the JAC, as the ultimate authority on standardization, headed by the AAF Commanding General himself.[71]

Within the framework of such difficulties as clearing the release of technical information and working with insufficient British personnel, the Materiel Division arranged with the Navy, the British, and the National Defense Advisory Commission in October 1940 to consider airplane types acceptable to the British and equipment and accessories usable with them.

Bombs, bombing accessories, engines, armament, and radio equipment were the big problems, high on the priority list; but there were about 20 other items on the standardization subcommittee's agenda and priority list, as approved by the JAC on 9 October 1940.[72] Eventually technical committees and subcommittees were organized by the main subcommittee for handling the following problems:[73]

Aircraft Ordnance and Armament
- Bombs, Torpedoes, Mines, and Chemicals
- Bomb Suspension
- Pyrotechnics
- Bombsights
- Gun Sights and Gun Cameras
- Turrets and Gun Mounts
- Aircraft Guns, Ammunition, and Armor Plate
- Rockets

Photographic Equipment
Electrical Equipment
Compartment Heaters
Instruments and Navigation Equipment
Instrument Panels
Oxygen
Helmets
Fighter Strength Requirements
Parachutes
Petroleum Products
Power Plants
Sea Rescue Equipment
Seats and Belts
Self-Sealing Tanks and Hose
Windshields
Radio-Radar Installations
Training Aircraft
Camouflage
First Aid Kits
Fire Extinguisher Systems
Air Cargo and Transport Airplanes
Airport Lighting Equipment
Recognition Devices
Naming of Aircraft
Aircraft Test Procedure
- Armament Test Procedure
- Carbon Monoxide Detection and Control
- Manual-Emergency Operation of CO_2 System
- Structural Vibration Survey
- Vacuum, Hydraulic, and Pneumatic Systems
- Water Tightness of Cockpit and Inclosures
- Methods of Reducing Performance Data

Many of the cases handled by these Army-Navy-British subcommittees were primarily Army-Navy problems, in which the British frequently had less a fixed technical notion of their own than a desire for unanimity between the Army and the Navy. In fact, in retrospect, it might be said that, if the Army and Navy had been able to agree more comprehensively before October 1940, either through the Aeronautical Board or through other channels, there might have been no need for an combined Army-Navy-British standardization committee, such as that set up under the JAC.[74] In recognition of the Army-Navy phases of these inter-Allied problems, the Aeronautical Board's Working Committee was usually represented on the JAC technical subcommittees, especially where a case involved an item of equipment that required a published specification.[75] In other words, specifications growing out of Army-Navy-British cases were issued simply as joint ANA specifications, through the regular WCAB procedures. Conversely, no "ANB" specifications were ever issued. This situation was recognized in April 1944, when the JAC standardization chairman, T. P. Wright, in an appraisal of the work of his subcomm ttee, recommended that standardization of AAF- and BuAer-procured equipment be returned to the Aeronautical Board, with the British sitting in as consultants when their interests were involved; he further proposed that the JAC concern itself chiefly with standardizing "expendable" air items, that is, ordnance munitions primarily procured outside the AAF (and the BuAer) by the Army and Navy Ordnance Departments and by the Chemical Warfare Service, agencies over which the joint Aeronautical Board had no control.[76] These proposals were more than a recommendation. They stated a trend

already evident in 1944 in the fact that the Aircraft Ordnance and Armament Technical Committee was the most prominent activity in JAC standardization.

The extent of Army-British and Army-Navy-British standardization achieved during the years 1940-1944, if measured in numbers of entire airplanes, was very limited. Before Pearl Harbor "only in a few cases /had/ the standardization of complete aircraft reached the point where one production line for any particular model could be established"; the lack of standardization was due (according to the Air Corps) to different operational requirements, different methods of employment, British "unwillingness to compromise," and especially "the bombsight question," on which the Navy remained firm in opposing release to the British.[77] Of the airplanes standardized, the B-24D and the P-40D were promptly accepted by the British in lieu of their comparable types, the LB-30 Liberator and the Hawk 87A; but even in these cases there were details that remained unstandardized. Between the two Liberators, there were originally 55 differences; about two-thirds of these differences were removed by November 1940.[78] Of the agreements, some of them represented Air Corps preferences, such as the Hamilton-Standard propeller, a .50-caliber nose gun (instead of the British .303 gun), six crew positions (instead of seven), batteries, pilot compass, and location of navigator's station; others represented British preferences, such as high-pressure oxygen systems and some of the radio and radar equipment. Other differences remained unresolved, such as bombsights, turrets, and automatic pilots; not until after Pearl Harbor were these variations removed. In the case

of the two Hawks, the Air Corps reported them as "completely standard" as far as the production line was concerned;[79] but the engines in them differed (the American V-1710F and the British Rolls Royce, respectively) so that the standard airplane contained duplicate fittings for interchangeable installations of the engine.[80] There were about 22 additional models (bombers, fighters, transports, and trainers) on which standardization agreements were reached,[81] and while each of them could then be produced on a single assembly line, all of them contained some alternative or duplicate fittings and other "provisions" for the later installation of non-standard equipment that differed between the services. Although simplifying production, such duplicate fittings also tended to result in an "airplane /that/ is heavier, more expensive, and /with/ its performance somewhat reduced."[82]

In actual practice not all standardized types were used by all services--Army, Navy, and British. In September 1942, 27 AAF airplane models were listed by the JAC as those "in which more than one Service has a substantial interest,"[83] and in the revised 1943 production program of February 1943 the list was reduced to 21 (for the British, Navy, and AAF), of which the follow ng 12 were planned for the British:[84]

AAF	British
B-24	RAF Liberator
B-25	RAF Mitchell
B-34	RAF Venture
A-20	RAF Boston
A-30	RAF Baltimore
A-35	RAF Vengeance
P-40	RAF Kittyhawk
P-51	RAF Mustang
C-61	RAF F-24
AT-6	RAF Harvard
AT-19	RAF Reliant
PT-26	RAF Cornell

Most of the agreements were consummated during 1940 and 1941, before Pearl Harbor.[85]

In actual practice, not all variations from standard came before the Joint Aircraft Committee. First of all, among the various modifications, there were "minor variations" between Air Corps models and Defense Aid models that were based on requests made by the British. Such lesser changes did not clear through the JAC, whose interest was gradually concentrated on changes that might cause "significant delay in deliveries or significant variation in the contractor's engineering or shop work load";[86] but the JAC did insist that proposed changes, however minor, be agreed on informally by Army, Navy, and British representatives at Wright Field before being discussed with the particular manufacturer involved.[87] As to changes proposed by the Air Corps resulting from experimental development (or, after Pearl Harbor, from requirements of theater commanders), the British found themselves unable to attend "all and every conference," particularly because of their small technical staff in the United States. They were to be informed, however, by the AAF of "any mock-up or other relevant inspection on aircraft types in which . . . the British may at some time become interested."[88] Whatever changes were to be incorporated in the production line, whether of British or Air Corps origin, two copies of each change order or engineering order[89] were to be supplied via the JAC to the British and to the Navy. Specifications were not to be rewritten to include every such change, not only because the Wright Field specification-writing section would be "overtaxed" by such frequent changes, but especially because "by the time such a revised specification is written incorporating the standardization

changes, new changes and addenda would have to be added which would complicate the use of the specification as much as before."[90]

The AAF, the Navy, and the British dominated standardization, just as they dominated the allocations of U.S.-produced aircraft. But both before and after the Lend-Lease Act of March 1941, there were other foreign air forces besides the British who were customers for American production and who had an interest in Army-Navy-British standards. The British Dominions, China, the various American Republics, and (after July 1941) the Union of Soviet Socialist Republics all received substantial numbers of American planes and equipment. By an early ruling of the Joint Aircraft Committee in February 1941 none of these countries was to be represented in the Committee's deliberations. At the same time the JAC agreed that such "other foreign nations /besides the British/ should be encouraged to procure standardized articles."[91] Pursuant to this policy, most of the planes allocated to the other Allies were Army-Navy-British types. But, like the British, each country occasionally required special changes subsequent to the final assembly of the plane. These alterations were handled at the AAF modification centers. Thus, B-25H's and C-47A's for China were modified at Omaha and Long Beach; P-36G's for Peru, at Memphis; and B-25D's, A-20G's, P-39's, and C-47A's for the U.S.S.R. at Kansas City, Daggett (Calif.), Niagara Falls, and Oklahoma City.[92]

Early in 1944 aeronautical standardization between the AAF and Latin American air forces was beginning to assume a greater importance, as post-war plans for the air defense of the Western Hemisphere began to take shape. In a Plans study (in April 1944) for building up air power in Latin America, "interchangeability" was the theme: tactical units inter-

changeable throughout the western hemisphere; uniformity in training standards, operational control, and tactical and strategic doctrine; and interchangeable materiel.[93] AAF-standard airplanes and equipment were to be the basic factor in this postwar system of hemisphere defense.

Chapter IV

SUMMARY AND CONCLUSIONS

Standard materials and parts were a prerequisite for the speedy mobilization of the aircraft and automotive industries after 1939, as well as for efficient maintenance in the field. AAF specifications governed many materials, and were prepared at Wright Field and published by its Specifications Unit. Others were joint Army-Navy standards, prepared either at Wright Field or the Naval Aircraft Factory at Philadelphia and coordinated and published by the Aeronautical Board's Working Committee. A few were Army-wide or Federal-wide standards applicable to non-aeronautical uses as well. Still others were standards prepared by industry committees such as those under the Aeronautical Chamber of Commerce of America, or by a particular company's "standards department"; some of these were accepted by the AAF if no government issued specifications existed. This system of standard specifications had a long history, first involving agreement within the AAF on materials suitable for the construction of military aircraft and equipment; next, requiring agreement with the Navy air arm on items suitable for use in common procurement; further, achieving enforcement and compliance by both services and industry when a joint standard was involved; and finally, revising them to incorporate new developmental progress or to meet new requirements submitted by the combat air forces and other tactical air organizations. Government specifications already existed, of course, for many aeronautical materials when the European war began in 1939. Of the total of 636 pertinent specifications in force in

September 1939, 136 (21 per cent) were AAF and 24 (4 per cent) were ANA, with the other 75 per cent being general Army and general federal specifications. After five years of war production, by November 1944, AAF specifications had increased by 60, and ANA specifications by 220, both representing a shift away from general Army and federal standards to those more particularly adapted to aeronautical production.

By 1943 aeronautical equipment, including finished components for aircraft installation, included almost 350 types jointly acceptable to the Army and Navy air arms, including especially 109 items of armament, 88 instruments and instrument components, and 66 items of landing gear.[1] While impressive, these 350 AN items were outweighed by perhaps 750 other items,[2] governed by the AAF's own specifications, representing materiel peculiar to the AAF or items on which agreement with the Navy was not achieved. As far as complete airplanes was concerned, the AAF's own standardized airplanes included 36 models "suitable for combat" at the time of the Pearl Harbor attack in December 1941. This number was reduced to 29 models by October 1944. Only a few of these AAF models were accepted by the Navy for joint procurement; among these were the B-24 and (for a time) the B-25 and the B-26. However, with respect to non-combat types, a few AAF trainers and several transports and utility airplanes were jointly standardized.[3] Even in these limited cases, however, modifications for the Navy were necessary after the airplane left the final assembly line.

Standardization with the British, on the other hand, was perhaps more successful, first in connection with their early purchases of American military aircraft and (after the Lend-Lease Act of March 1941) in the AAF-controlled production of Defense Aid aircraft destined for

allocation to them. Early Air Corps-British Purchasing Commission agreements, negotiated through the Joint Aircraft Committee, covered the B-24 and the LB-30 Liberator and the P-40D and the Hawk 87A; and eventually most of the dozen or more AAF models produced for the RAF came from common assembly lines, while modification centers handled the peculiar installations, fittings, and other changes required by the British to adapt the planes to tactical operations with British-produced and designed aircraft. Concurrently, many items of equipment were individually standardized by the AAF and the British, or by the AAF, the Navy, and the British, including especially about 200 separate items of bombs, fuses, bomb-carrying gear, pyrotechnics, aircraft guns and ammunition, armor plate, and other aircraft ordnance and armament.[4] Furthermore, the British representatives on the Joint Aircraft Committee's technical subcommittees were invited to witness mock-up inspections of developmental items of air materiel in order to assist in the "advance standardization" of items likely to be ultimately allocated to the British from American production.[5] This privilege led increasingly to AAF demands for reciprocal standardization within the United Kingdom, including reciprocal privileges for American air observers to attend mock-up inspections of British developmental items. As the end of the European phase of the war became predictable in 1944 and developmental interests tended to shift to the Asiatic and Pacific theaters and as reciprocal standardization by the British lagged, the AAF in the summer of 1944 revived its earlier proposals to abolish the Army-Navy-British standardization functions of the Joint Aircraft Committee and to restore standards work to the joint Army-Navy level, under the Aeronautical Board.

While the standardization of air materiel between the AAF and the RAF did not reach an optimum, it at least compared favorably--or equally unfavorably--with the record of standardization between the AAF and the Navy Bureau of Aeronautics. What differences remained were, more often than not, based on well-considered variations in development and design, in commerical preferences (and vested interests), in training methods, in operational doctrines, and in provincial customs and usages. Sometimes "customs and usages" became annoyingly fanciful. Thus, in one JAC meeting, an AAF officer proposed that "nomenclature" of air equipment also be made uniform; "That's fine," an RAF officer replied, "I'm sure we're all in favor of simplifying nomenclature." If this was the ultimate in non-standardization, certainly there was in the record a more hopeful side as well--the fact that the AAF and the RAF had been consulting ever since 1940 and had agreed on a score or more of airplane types and several hundred types of equipment and accessories that could be procured for common use.

G L O S S A R Y

AAG	Air Adjutant General, AAF, custodian of AAF central files
AB	Aeronautical Board
AC/AC	Assistant Chief of the Air Corps
AN	Army-Navy
ANA	Army-Navy Aeronautical (standards)
ANB	Army-Navy-British
ANC	Army-Navy-Civil
AR	Army Regulations
AS/W	Assistant Secretary of War
ATSC	Air Technical Service Command
BAC	British Air Commission
BPC	British Purchasing Commission
BuAer	Navy Bureau of Aeronautics
C/AC	Chief of the Air Corps
C/AS	Chief of the Air Staff
CFE	Contractor-Furnished Equipment
CTI	Classified Technical Instructions
DC/AS	Deputy Chief of the Air Staff
GFE	Government-Furnished Equipment
JAC	Joint Aircraft Committee
MC	Materiel Command
MD	Materiel Division, OCAC
M&D	AC/AS Materiel, Maintenance, and Distribution
M&S	AC/AS Materiel and Services
NACA	National Advisory Committee for Aeronautics
NAF	Naval Aircraft Factory
NASC	National Aircraft Standards Committee
NDAC	Advisory Commission to the Council of National Defense
OCAC	Office of the Chief of the Air Corps
OC&R	AC/AS Operations, Commitments, and Requirements
OPM	Office of Production Management
PWC	Permanent Working Committee, Aeronautical Board
SAE	Society of Automotive Engineers
SCS	Subcommittee on Standardization, Joint Aircraft Committee
S/W	Secretary of War
T/BA	Table of Basic Allowances
T/O	Table of Organization

US/W	Under Secretary of War
WCAB	Working Committee, Aeronautical Board
WF	Wright Field
WPB	War Production Board

F O O T N O T E S

Chapter I

1. American Standards Association, Industrial Standardization and Commercial Standards Monthly, VIII-X (1937-1939), passim.

2. These agencies are all described, as of 1941, by Robert A. Martino, Standardization Activities of National Technical and Trade Organizations (Washington, 1941) and by C. J. Judkins, Trade and Professional Associations of the United States (Washington, 1941).

3. Industrial Standardization, X (June, 1939), 151.

4. Industrial Standardization, XII (Oct., 1941), 260.

5. Stat ment by C.E. Mack, Director of Procurement, Tre sury Dept., ibid., XIV (Dec. 1943) 341-345.

6. ACO, Index . . . of Specifications, Jan. 1942 ed., especially pp. 247-268, 271-272.

7. The Index to the Army Regulations (AR 1-5, 1 Jan. 1943 ed., pp. 471-474, 527-528) lists some of the varieties of standards, but in a sense the entire body of ARs constitute military standardization.

8. Aircraft production was controlled in 1917 by the Aeronautical Division (after 1 Oct. 1917, the Air Division) of the Signal Corps, and after the reorganization of 24 April 1918 by the Bureau of Aircraft Production of the Air Service. National Archives, Handbook of Federal World War Agencies and Their Records, 1917-1921, pp. 12, 14.

9. Memo for S/N by Board of Army and Navy officers relative developments aeronautical service, 12 March 1917, in AAG 334.7.

10. Renamed the Aeronautical Board, 29 Dec. 1919. See memo for Maj. F. P. Lahm from Capt. A. J. Clayton, Sec., AB, 21 Jan. 1920, on history of the Board, in AAG 334.7.

11. WD GO 4, 22 Jan. 1920, sec. VII; reissued 17 June 1924; both in AG 580.1.

12. Annual report of the AB, in ltr. Capt. D. S. Seaton, Sec., to the Manufacturers Aircraft Association, 19 Oct. 1921, in AAG 334.7.

13. Memo for Maj. T. H. Bane from Maj. Henry W. Harms, 22 May 1922, in AAG 334.8.

14. Memo for Rear Adm. W. A. Moffett, Chief, BuAer, from Mason M. Patrick, C/AS, 22 May 1923; and reply by Moffett, 26 May 1923; both in A. J. Lyon file on "Standardization /1932-1936/," in WCAB files (Hereinafter cited as "Lyon file").

15. Lyon file.

16. Memo for Chief, BuAer, from C/AC, 11 Feb. 1936 (Lyon file).

17. Memo for Maj. Jones from Capt. L. T. Miller, 19 Dec. 1934, in AAG 334.7.

18. Memo for Sec. Aero. Board from WCAB, 27 Jan. 1937, in AAG 334.7. Among the Army members of the board were Maj. Leslie MacDill (about 1928), Maj. Clinton W. Howard (1929-33), Capt. A. J. Lyon (1934), and Maj. O. P. Echols (1934). See memo, 4 Jan. 1929, in AAG 210.69; memo for BuAer from C/AC, 4 Jan. 1934, in AAG 201; and memo for Maj. Jones from Capt. L. T. Miller, 19 Dec. 1934, in AAG 334.7.

19. Memos for Brig. Gen. W. E. Gillmore, Chief, Materiel Div. from Maj. L. W. McIntosh, 27 Jan. 1927, in AAG 400.1.

20. Lingle and Seitz, "Standardization: The Record So Far," SAE Journal, XXXVI (Nov. 1942), 2.

21. "Army and Navy Aeronautical Standardization Agreement," AN-9140, ca. 1923; AN 9140-A, 5 May 1930; AN 9140-B, 24 May 1932. Copy of 1932 agreement, incorporating procedures, is in Lyon file.

22. Lyon file.

23. Memo by BuAer, no author, ca. 18 Dec. 1936 (in Lyon file).

24. Memo for Chief, BuAer, from W. W. Webster, Manager, Naval Aircraft Factory, 27 Oct. 1936 (in Lyon file). This memo mentions 47 items of Air Corps-Navy correspondance, 1932-36, leading to the "current crisis" in AN standards.

Chapter II

1. Memo for Plans Section by Arnold, 17 Dec. 1936, in AAG 400.1142.

2. Lyon file contains copies of various drafts of plans, Oct.-Dec. 1936; see also BuAer to C/AC, 7 Nov. 1936, in AAG 334.7; AB ltr. 501 (case 75), 1 Feb. 1937, in WCAB files. Army members of the Working Committee of the AB were Lt. Col. H. W. Flickinger; Maj. D. G. Lingle, appointed about July 1939, and Maj. G. R. Gaillard, appointed 7 Apr. 1943, WCAB files.

3. Elevating standardization up to the AB gave the problem sufficient additional prestige. At the same time, however, two other joint boards were also given certain nominal control over standards. Standards affecting "plans relative to the national defense" were to be referred by the AB to the Joint Board for final approval, while all standards had to have the "final authentication" of the ANMB. Neither of them in actual practice exercised any real review or policy function as to standards, and in 1943 the ANMB withdrew entirely. Meanwhile, the AB in July 1939 was raised in rank directly under the Commander in Chief, and while the WCAB has never invoked White House support for standardization, the President's military order of 5 July 1939 is occasionally mentioned in its publicity to the services and to industry. (Lyon's plan, "Standardization of Aeronautical Equipment," 2d draft, ca. Dec. 1936, in Lyon file).

5. Memos for AG from AC/AC, 17 Aug. 1937, and for C/S from G-1, 1 Sept. 1937, in AG 334.3; and memo for C/AC from Lt. Col. H. W. Flickinger, PWCAB, 23 Nov. 1937, in AAG 334.7.

6. Memo for C/AS from Brig. Gen. William E. Hall, DC/AS, 26 May 1944, in AAG 334.

7. MD O.M. 254, 23 Apr. 1938, "Organization and Functions of A-N Aeronautical Specification Unit," in WF file 334.8. This dual control was confirmed in AAF Memo 20-19, 9 Dec. 1943.

8. Memo for CG MC, from Brig. Gen. B. W. Chidlaw, Chief, MM&D, MD, 15 Apr. 1943 in WF file 334.8.

9. D. G. Lingle and G. A. Seitz, ". . . The Record So Far," p. 4.

10. MD O.M. 254, 23 Apr. 1938, and related R&Rs, in WF file 334.8.

11. Ibid.

12. AAF memo 20-19, ". . . Aeronautical Board," 9 Dec. 1943, and related R&Rs, in AAG 300.6.

13. R&R, WCAB to Chief, MM&D Air Services Div., 29 Jan. 1944, in AAG 322; statement by Maj. J. M. Miller, WCAB, 3 Nov. 1944.

14. R&R, WCAB to Chief, M &D Air Service Div., 29 Jan. 1944, in AAG 322 AAF Units.

15. Increased production, furthermore, was only one benefit that could be anticipated from standardization. Wright predicted that standards would also facilitate engineering and testing, improve maintenance, and increase reliability and ease of operation. (Aviation, XXV /Dec. 1940/ 67.)

16. Ibid., pp. 66-67, 146.

17. Lingle and Seitz, " . . . The Record so Far," p. 11.

18. Ibid., pp. 11-12.

19. Min. of SAE mtg., 17 Apr. 1940, in A. J. Lyon project book No. 21, "SAE Standardization."

20. SAE bulletin (press release), 21 July 1940; T. P. Wright, NDAC, to Brig. Gen. George H. Brett, Chief, MD, 7 Aug. 1940; reply by Brett, 13 Aug. 1940; and SAE brochure on ". . . Cooperation," 27 May 1940; all in AAG 080.

21. For example, Dr. George L. Lewis of the NACA, in effect part of the Air Corps organization; J. B. Johnson, Chief of the Materials Laboratory; and Opie Chenoweth, Power Plant Laboratory, (inter-office memo for Chief, MD, from Chief, Experimental Eng. Sect., WF, 12 July 1940, in AAG 080).

22. Air Corps Bulletin no. 40-A, 10 Sept. 1941, listing all Aeronautical Material Specifications of non-Government origin; revised as Bulletin no. 40-B, 28 Sept. 1942; superseded by ANA Bulletin no. 147, 17 Sept. 1943 (copy of latter in AFIHI). Commerical AMS standards, while they were recognized by the Army and Navy as indicated above, were definitely relegated near the bottom of the list of preferred standards. The categories of preferred standards were established in the following "order of precedence" for the AAF: ANA; Federal; AAF; US. Army; Navy; Navy Aeronautical; Naval Aircraft Factory; AMS; individual company specifications and standards ANA Bulletin no. 143, 18 Mar. 1943 (copy in AFIHI).

23. Lingle and Seitz, " . . . The Record So Far," p. 12. These associations are described in greater detail in Martino, Standardization Activities of National Technical and Trade Organizations (1941).

24. Memo for S/W from S/Commerce, 31 May 1939, and memo for WF from Maj. M. E. Gross, MD, 19 Nov. 1940, in AAG 334.8; Industrial Standardization, XIV (Dec. 1943), 345. The Air Corps had one of the two Army representatives on the Screw Thread Committee.

25. Memo for WF from Maj. M. E. Gross, MD, 24 Apr. 1941, in AAG 334.8.

26. Handbooks H-25 and H-28 on "Screw-Thread Standards for Federal Service," issued thru the National Bur. Standards, and referred to and excerpted in Army-Navy Specification AN-GGG-S-126 on "Screw Threads: Standard, Aircraft," 30 Jan. 1943 (copy of latter in AFIHI).

27. Headed by Carleton E. Stryker, who had headed SAE aircraft standards work. Industrial Standardization, XII (Apr. 1941), 85-87; memo for Brig. Gen. O. P. Echols, Chief, MD, from Stryker, 21 Feb. 1941, in AAG 334.7.

28. Memo for Stryker from Echols, 26 Feb. 1941, in AAG 334.7.

29. The jurisdictions of the various industrial committees for aircraft standards allocated by the WPB (successor to OPM), are listed by Lingle and Seitz, pp. 11-12, as of Nov. 1942.

30. OCAC Digest of Policy No. 186, 2 July 1938, and related correspondence, in AAG 400.1141.

31. On its face, this policy of discouraging civil use of military standards seems in retrospect to have been overly cautious and unnecessary if not undesirable, from the viewpoint of promoting wider use of Army standards. The reason for it, as stated by the C/AC when the policy was being formulated, was to "eliminate the constant demand by manufacturers for additional copies of Government-owned specifications, at the same time not placing restrictions on the industry in the use of the technical requirements of Specifications upon which no restricted measures have been placed." (Memo for all Divisions by C/AC /sgd. Lt. Col. M. F. Davis, Exec./, 29 June 1938 in AAG 400.1141.)

32. Precept of the committee, approved Sept. 1941, and related correspondence, in AG 334.8; and AF News Letter (Feb. 1942), p. 36. Design criteria are also discussed in another AAF historical study, "Materiel Research and Development Programs and Policies."

33. Memo for Lt. Col. O. P. Echols from Maj. A. J. Lyon, 1 Oct. 1936, in Lyon File; ANMB Orgn. Order nos. 2 and 6, 3 Mar. 1942, in AG 334.

34. Described in Industrial Standardization, X, (Aug. 1939), 211-214.

35. Statement by Maj. J. M. Miller, 3 Nov. 1944.

36. Memo for Specifications Branch, WF, from MD, 8 Dec. 1941, in AAG 334.7. See also AR 850-25, Chap. 2, par. 31 1/2, 10 Oct. 1939, and AR 850-25, par. 32, 30 June 1943. The ASF-Navy "Joint Army-Navy Committee on Specifications," handling so-called "JAN" specifications, was not established until Dec. 1942, five years after the WCAB and two years after the JAC were established for joint aeronautical specifications. Some of the JANs on certain common basic materials were being considered for adoption by the AAF and Navy in Oct. 1944, but were to be issued to the industry as "ANA" rather than as "JAN" documents, in order not to confuse the manufacturer with cross references to still another category of specifications. See Joint SOS-Navy directive, 22 Dec. 1942, in AGO file SP 400.114; memo for AAF IC and SOS procurement branches from SOS Standards and Specifications Sect., 9 Feb. 1943, in WF file 334.8; M&S MD, diary, 5 Oct. 1944.

37. Air Corps Bulletin No. 23, 10 Sept. 1939 (copy in M&S Standards and Specifications Sect.). About 25 additional ANA specifications were published or near publication governing engine parts, fuels and oils, hydromatic propellers. (Memo for S/W from C/AC, 23 Feb. 1940, in AAG 334.7.)

38. Air Corps Bulletin No. 23, 10 Sept. 1939.

39. MD, "Notes on the aircraft situtation for the calendar year 1940," p. 9, in AAG 452.1.

40. Lingle and Seitz, " . . . The Record So Far," p. 9.

41. Memo for CG AAF from Lt. Col. C. M. Gaillard, Army member, WCAB, 15 Dec. 1943, in AAG 334.

42. These publications, consisting of AN Aero. Specifications, AN "part" Drawings, ANA "design" drawings, ANA Bulletins, and ANA Indexes, are described in Lingle and Seitz, " . . . The Record So Far," pp. 6-11, and in AAF Memo 20-19, 9 Dec. 1943. The procedure and editorial policy governing the preparation of these documents is described in the WCAB manual, "Aeronautical Board Outline of Procedure for Preparation and Issue of Army-Navy Aeronautical Specifications," first issued in Sept. 1939, prepared by Lt. A. M. Blamphin; a revised manual by Lt. Felix Smith is now (Nov. 1944) in preparation.

43. Lingle and Seitz, " . . . The Record So Far," p. 4.

44. Ibid., p. 5.

45. Ibid., p. 8.

46. That is, the Army and Navy members of the Board, including General Arnold; Gen. Oliver P. Echols (AC/AS M&S), and a member of the Opns. Div. of the General Staff--as distinct from the member of the Working Committee.

47. AAF Memo 20-11, 9 Dec. 1943, and related correspondence, in AAG 300.6.

48. Memo for CG, MC, from C/AS, 28 Oct. 1942, in AAG 400.1142; copy also in AAG 400.114.

49. OC&R Requirements Div. which was charged with receiving and evaluating theater needs, was concerned primarily with standardization of finished articles of materiel rather than materials and parts, but if parts were involved, that Div. did not necessarily refrain from acting on proposed deviations. Thus, in June 1943 it ordered a deviation from a parachute standard (requested by the 8th AF) involving changes in pack-opening elastic and harness fasteners and snaps. It subsequently defended its action, denied any "violation" of an Army-Navy agreement, and invoked the "obligations of the AAF Headquarters to the combat units in Theaters of Operations." (R&Rs, OC&R to MM&D, 9 June and 24 Sept. 1943, and R&R, WCAB to OC&R, 22 Sept. 1943, all in WCAB file " . . . Procurement and Use.")

50. AAF Memo 20-11, 9 Dec. 1943, and related correspondence, in AAG 300.6. Earlier, by MC O.M. 43-25, 1 Sept. 1943, a similar policy had been issued at Wright Field (WCAB file, "Deviations").

51. AAF Memo 20-11, 9 Dec. 1943. In August 1944, the merged MC and ASC were renamed the Air Technical Service Command.

52. Direc. of 10 Feb. 1944, mentioned in memo for CG MC from Chief, M&D Production Branch, 15 Mar. 1944, in AAG 400.114. See also MC FO Memo 6-1, 2 Feb. 1944, governing execution of AB standards.

53. TWX, CG MC to AC/AS, M&D, 1 Mar. 1944, in AAG 400.114.

54. In addition, the MC was directed to organize a unit or project in its Production Div. for "policing the use" of ANA standards and reporting progress to M&D quarterly. See direc., 10 Feb. 1944, described in memo for CG MC from Chief, M&D Production Branch, 15 Mar. 1944, in AAG 400.114.

55. TWX, CG MC to AC/AS M&D, 1 Mar. 1944, in AAG 400.114.

56. See comment by Lt. D. L. Drum, WCAB, on routing slip. 24 Nov. 1943, in WCAB file "Deviations."

57. Douglas Aircraft Corp. to CG MC, 10 Dec. 1943 in WCAB file. See also comments on same, in memo for AN Standards Branch, Engr. Div., by Production Engr. Sect., 21 Jan. 1944 in same file.

58. A.B. No. 528 (Case No. 188), 11 Feb. 1944; sent to MC for compliance by M&D, 29 Feb. 1944. For background, see R&R, Army member, WCAB, to AC/AS M&D, 27 Jan. 1944, in WCAB file "Deviations."

59. Memo for AN Standards Branch, MC from Army member, WCAB, 28 Dec. 1943, in WCAB file " . . . Procurement and Use."

60. Memo for Chief BuAer from BAGR, Western Procurement District, 19 June 1944; memo for Engr. Standards Sect., ATSC, by Army member, WCAB, 3 Oct. 1944. Both are in WCAB file "Deviations."

61. See note above.

62. Statistical summaries given here were calculated from the monthly list of "Material and Process Specifications" (AAF Bulletin No. 23), editions of 10 Sept. 1939, 10 Dec. 1941, and 10 Nov. 1944, all filed in M&S Standards and Specifications Section. Excluded from these calculations are items listed in the above bulletins that were "finished" items of materiel such as fuel and lubricants, as well as procedural and process specifications.

1. AR 850-25, 23 July 1936, par. 5. See also later version, 30 June 1943. This regulation also made the AAF responsible for standardization of its own materiel.

2. Bryden rpt., 22 July 1936, in AG 400.

3. Ibid.

4. Ibid.

5. AR-850-25, 23 July 1936 and 30 June 1943.

6. Rpt. of committee, 10 Jan. 1939, in A. J. Lyon project record book no. 18.

7. Memo for C/AC from AS/W, 26 Aug. 1940, in A. J. Lyon project record book no. 38.

8. CTI-96, 7 Sept. 1940, in A. J. Lyon project record book no. 38.

9. Memo for Brig. Gen. Frank E. Lowe, Special Senate Committee to Investigate the National Defense Program (Truman Committee), from Julius H. Amberg, Special Assistant to S/W, 11 Dec. 1943, in AAG 333.5.

10. Statement by Lt. Col. J. H. Burns, office of AS/W 17 Aug. 1936, in AG 400.

11. R&F, Lt. Gen. H. H. Arnold to Maj. Gen. Oliver P. Echols, 2 Apr. 1942, and Echols to Arnold, 9 May 1942, in AAG 452.1.

12. MD, "Model Designation of Army Aircraft," editions for 1939-1944, inclusive.

13. War Department Special Quarterly Report of Airplanes, 30 Sept. 1939 (copy in AFIHI); and MD Consolidated Stat. Rpt., 30 Nov. 1941, in AAG 452.1. In addition to standard and limited standard types, there were 29 developmental models in 1939 and 21 in 1941.

14. SC-AI-26, "Delivered Airplanes on Hand . . .," 31 Oct. 1944 (copy in AFIHI).

15. In addition to first line models, there were 89 second line combat models of airplanes, including some that were developmental, service-test, obsolete, or condemned planes.

16. Rpt. of Special Board (dated 22 Sept. 1942) established by Materiel Center by SO 208, 11 Aug. 1942, and subsequent comments, in AAG 452.1.

17. Policy No. 32 of the Directorate of Military Requirements, 21 Nov. 1942, on "Simplification of Aircraft," discussed in memo for Recorder, Working Subcommittee on Standardization, JAC, from Brig. Gen. B. W. Chidlaw, AC/S, MC, 19 Dec. 1942, in JAC file on "Subcommittee on Standardization." Chidlaw warned that each aircraft would have to be analyzed separately and all components and accessories considered together, so that only one change in the production line would be necessary. Thus, "a decision to eliminate the co-pilot's position, seat, controls, etc. in a bombardment airplane would undoubtedly affect the distribution of the armor plate at the pilot's position, which in turn might well affect that type of seat used, the type of safety harness, possibly the compass location, etc."

18. Memo for Director of Communications and others by Director of Bomb. 15 Oct. 1942, in AAG 334.7. The Board was appointed 15 Oct. 1942.

19. Daily activity report, AC/AS OC&R, 23 June, 3 July 1944.

20. Before the reorganization of 29 Mar. 1943 this function was handled by the Director of Military Requirements.

21. Memo for Chief, Engr. Div., MC, from Chief, MM&D MD, 24 June 1943, in AAG 400.1.

22. Rpt. by T. P. Wright, Chairman, Working Subcommittee on Standardization, JAC, 12 Aug. 1942, in JAC file on "Subcommittee on Standardization."

23. Rpts. of 27 Oct. 1916 and 12 Mar. 1917 by Army-Navy boards, in AAG 334.7.

24. USAF Historical Study No. 6, Development of the Heavy Bomber, 1918-1944, p. 134; and memo for C/S from Brig. Gen. Oscar Westover, 1 May 1934, in AAG 400.12.

25. Memo for C/S by WPD, 4 Apr. 1932, in AAG 334.7.

26. Memo for Adm. Stark from C/S (drafts dated 19, 20 Feb. 1940, and another undated), in AAG 334.8; memo for Joint Air Advisory Committee from C/S and Chief of Naval Opns., 16 May 1940, in AG 334.3; sum. of mtgs., May, June 1940, in AG 560.

27. Memo "for all concerned" from Maj. Gen. H. H. Arnold, 19 June 1940, in AAG (U).

28. Stat. Control tabulation, "U.S. Airplane Factory Deliveries, by Destination and Allocation" (SC-AP-12), 1943 and 1944, passim.

29. Navy request was made early in Feb. 1942 and reply by AAF on 10 Feb. asked what use was to be made of the bombers; Rear Adm. J. H. Towers replied to C/AAF, 14 Feb. See memo for C/AS by Chief, MD, 16 Feb. 1942, in AAG 452.1

30. Memo for WF from M&D Modificati n Div., 2 May 1944, in AAG 452.01.

31. Memo for DC/AS from Brig. Gen. L. P. Whitten, Director of Base Services, 2 Feb. 1943, in AAG 045 Navy.

32. Ltr., Stone and Webster, Inc., to Sec. of State, 16 June 1938, in AAG 334.7

33. AB memo no. 510-1 (case 95), 8 July 1938, in AAG 334.7.

34. Min. A-N.B-NDAC conference, 5-6 Aug. 1940, and memo for Chief, MD, from Executive, MD, both in A. J. Lyon project record book no. 38.

35. Memo by T. P. Wright, 7 Aug. 1940, summarizing conference of 5-6 Aug. 1940, in A. J. Lyon project record book no. 38.

36. Apparently the British tried at a later date to have the Halifax produced in the United States. See R&R, CG LC, to A-3, 2 Jan. 1943, in AAG 092.2.

37. Min. of conference of 5-6 Aug. 1940 in memo for Chief, MD, from Executive, MD, in A. J. Lyon project record book no. 38.

38. S/W to S/Treasury (draft written 13 Aug. 1940), 21 Aug. 1940, in A. J. Lyon project record book no. 38. See also Air Historical Study No. 6, Distribution of Air Materiel to the Allies, 1939-1944, p. 16.

39. Min. JAC, 20 Sept., 9 Oct., 1940.

40. Memo for C/S from G-4, 15 Aug. 1940, in AG 452.

41. Statement by S/W Henry L. Stimson, 14 Oct. 1941, in Hearings . . . Senate . . . H.R. 5788 . . ., 77 Cong., 1 sess., p. 29.

42. Memo for Lt. Col. E. M. Powers from Col. A. J. Lyon, Engr. Sec., MD, 29 Mar. 1941, in AAG 032. See also "Distribution of Air Materiel to the Allies," pp. 15, 22, 27.

43. Defense Aid Supplemental Appropriation Act of 21 Mar. 1941, quoted in JAC, "Organization and Functioning of the Working Sub-Committee on Standardization of the Joint Aircraft Committee," 1 Jan. 1942.

44. Min. of Army-Navy-British-NDAC conference, 27 Aug. 1940, in A. J. Lyon project record book no. 38.

45. Memo by T. P. Wright, 7 Aug. 1940, exhibit "F" in A. J. Lyon project book no. 38.

46. Rpt. by T. P. Wright on conference of 13 Aug. 1940 in A. J. Lyon proj ct record book no. 38.

47. Memo (to MD) from BPC ca. 30 Aug. 1940 in A. J. Lyon project record book no. 38.

48. R&R, Intel. Div. to MD, 20 Aug. 1940, in A. J. Lyon project record book no. 38.

49. Memo for S/W from Chief, MD, 10 Sept. 1940, in A. J. Lyon project record book no. 38.

50. Min., JAC, 16 Nov. 1940. As of Sept. 1944, however, No B-29's were allocated to the British by the Munitions Assignments Board.

51. Memo for Working Subcommittee on Standardization from Recorder, Army-Navy-British Purchasing Commission Joint Committee, 17 Mar. 1941, in JAC file.

52. Revised "Precept of the Subcommittee on Standardization of the Joint Aircraft Committee," ca. 20 Aug. 1942 in AAG 334.7. Mock-up inspection privileges were granted to the British by the AAF partly on the premise of reciprocal privileges for AAF representatives in the United Kingdom. Although this was nominally granted by the British in Sept. 1942, AAF offices gradually became convinced that full reciprocity did not exist. In Aug. 1944 M&S proposed that mock-up inspection procedure be "eliminated" and that at the end of the European war the Army-Navy-British standardization procedures of the JAC be rescinded. (Memo for SCS from AC/AS M&S, 29 Aug. 1944, in SCS files). While the British were not specifically mentioned in the above memo, oblique reference was made to them by pointing out that new designs of airplanes being developed in 1944 would not be available "during this war" because of the two or three year lag between experimental design and quantity production; and by complaining that too many people were present at developmental mock-ups, making the transaction of business "difficult."

53. Memo for Philip Young, Assistant to the S/Treasury, from Chief, MD, 10 Oct. 1940, in AAG 334.7. See also min., 9 Oct., 16 Nov. 1940.

54. Min., JAC, 11 Mar. 1941.

55. Ibid., 4 Nov. 1940.

56. Min. JAC, 16 Nov., 18 Dec. 1940.

57. Memo for Maj. A. J. Lyon from Maj. M. E. Gross, 10 Sept. 1940, in A. J. Lyon project record book no. 38.

58. Ibid.

59. Ltr., C/AC to C. R. Fairey, BPC, 12 Aug. 1941, in AAG 330.

60. Ltr., C/AAF to Sir Charles Portal, 12 Jan 1942, in AAG 336.4.

61. Memo for Maj. Gen. H. H. Arnold from Brig. Gen. G. H. Brett, 7 May 1941, in AAG 400.1142.

62. The members of this Group, also called the Chaney mission, are listed (as of 15 July 1941) in AG 211.99. The air members included Maj. Gen. James E. Chaney, Brig. Gen. Joseph T. McNarney, Col. A. J. Lyon, Col. Harold M. McClelland, Maj. Townsend Griffiss, and Maj. Ralph A. Snavely.

63. Min. of standardization mtg. in London, 28 Sept. 1942, in JAC file on "Subcommittee on Standardization."

64. Col. M. E. Gross, representing the Director of Military Requirements on the SCS, proposed that in June 1942 the SCS be abolished and that its functions be taken over by the existing joint Aeronautical Board, because the "British will, in the future, receive only a limited number of aircraft from this country." He withdrew his motion at the meeting of 7 July 1942 after "repercussions" (obviously resulting from British appeals to higher authority), but reasserted his view that "unless three-way standardization is possible, the need for such a Committee /as the SCS/ does not exist and . . . the motion will be re-presented." (SCS min., 23 June, 7 July 1942, in SCS files.)

65. Revised "Precept of the Subcommittee on Standardization of the Joint Aircraft Committee, and JAC to Carnegie Endowment for International Peace, 12 June 1944, on "Historical Background" of JAC, p. 6.

66. Memo for JAC from Recorder, JAC Subcommittee on Standardization, "Application of standardization in the United Kingdom," ca. 25 Sept. 1942, in JAC file on "Subcommittee on Standardization"; SCS min., 27 Oct. 1942, mentioning MAP agreement that AAF and USN representatives would be invited to future British mock-up conferences (in SCS file on case 3,000).

67. After the reorganization of 9 Mar. 1942, it was named the Materiel Command in Washington and the Materiel Center at Wright Field; after Mar. 1943, the AC/AS Materiel, Maintenance, and Distribution and the Materiel Command, respectively; after about July 1944, the AC/AS Materiel and Services and the Air Technical Service Command, respectively.

68. Min., JAC, 3 Apr. 1942.

69. Memo for Director of Military Requirements from C/AS, 10 Feb. 1943, in JAC file on "Subcommittee on Standardization."

70. 1st Ind. (Memo fro CG MC by Col. D. G. Lingle, SCS), Brig. Gen. B. E. Meyers, MC, to C/AS, 18 Jan. 1943, (ibid.). While the Materiel Command complained of deviations by Requirements, Requirements also questioned deviations being made by Materiel. For example, OC&R stated in October 1944 that the Air Technical Service Command had "failed in many instances to comply strictly with agreements of the /JAC/ Subcommittee on Standardization . . . notably . . . /in/ the case of aircraft instruments." OC&R also charged that M&S frequently was "not represented" at SCS meetings, and that ATSC sent junior officers instead of "personnel of higher responsibility." (R&R, OC&R Requirements Div. to AC/AS M&S, 2 Oct. 1944, in SCS files.)

71. Memo for CG MC and for Director of Military Requirements from Col. D. G. Lingle, Recorder, JAC Subcommittee on Standardization, 12 Jan. 1943, and for OC&R Requirements Div. from JAC, 30 Apr. 1943 in JAC file on "Subcommittee on Standardization."

72. Min., JAC, 9 Oct. 1940, "tentatively" approving priority list of 2 Oct. 1940. The list is also included in the "Directive for Working Subcommittee on Standardization," 2 Oct. 1940, in JAC file on "Subcommittee on Standardization," and in JAC, "Organization and Functioning of the Working Sub-Committee on Standardization . . ./" 1 Jan. 1942.

73. Lists of members of JAC Subcommittee on Standardization and its various technical and technical subcommittees, 20 July 1943; and organization chart of JAC, 1 May 1944; both in AFIHI files.

74. Statement by Capt. Harry Rockwell, AC, and Lt. G. M. Ethridge, USNR, both of the SCS Recorder's office, 5 Nov. 1944.

75. Memo for MC from Maj. G. R. Gaillard, Asst. Recorder, SCS, 27 Jan. 1943, in AF file 334.8.

76. Memo by T. P. Wright, 7 Apr. 1944, approved and summarized in SCS min., 25 Apr. 1944, in SCS file.

77. Memo for US/W from C/AC, 23 Aug. 1941, in AAG 452.1-17.

78. Brig. Gen. Carl Spaatz, AC/AC, to Philip Young, Asst. to S/Treasury, 22 Nov. 1940, in A. J. Lyon project record book no. 38, JAC case no. 9 on B-24 standardization.

79. Spaatz to Young, 22 Nov. 1940, as cited above.

80. JAC case no. 36, on standardization of Curtiss P-40D and Hawk 87-A.

81. JAC "Register of Casses," passim.

82. Ltr., Lt. Col. E. M. Powers, Chief, Engr. Unit, Aircraft Sect., OPM, to Chairman, JAC, 29 Apr. 1941, (and later ltr., 27 May 1941), in JAC file on "Minutes . . . 5/2/41."

83. CTI-923, add. 1, 26 Sept. 1942, in AAG 400.1142.

84. Memo for Director of Military Requirements by C/AS, 10 Feb. 1943, in JAC file on "Subcommittee on Standardization."

85. JAC to Carnegie Endowment for International Peace, 12 June 1944, on "Historical Background" of JAC, pp. 6-7.

86. Memo for Recorder, JAC, from Maj. D. G. Lingle, Recorder, JAC Working Subcommittee on Standardization, 5 June 1941, in JAC file on "Minutes . . . 8/14/42"; JAC case no. 233, "Standardization of Modification Procedure"; BAC, min., on AC-BAC discussion at WF, 14 May 1941, in SCS file.

87. JAC case no. 233; JAC, "Organization and Functioning of the Working Subcommitte on Standardization . . .," 1 Jan. 1942; JAC, rpt. no. 1, case no. 3,000, "Administrative Procedure for Standardization," 15 Sept. 1942 (in HD files); and CTI-923, add. 1, 26 Sept. 1942, in AAG 400.1142.

88. Memo for Recorder, JAC, from Lt. Col. D. G. Lingle, Recorder, JAC Working Subcommittee on Standardization, 2 Mar. 1942, in JAC file on "Subcommittee on Standardization." This recommendation was approved by the JAC about 7 Mar. 1942 and forwarded to Wright Field as CTI-536, 18 Mar. 1942. (In AAG 400.1142)

89. Engineering Orders were discontinued by the MC in favor of Contract Change Notifications in Oct. 1943. (JAC, Rpt. no. 3, Case no. 3,000, 16 Oct. 1943, in JAC file.)

90. JAC Working Subcommittee on Standardization to JAC Chairman, "Specifications for Standardized Aircraft," ca. 7 Aug. 1941, in JAC file on "Minutes . . . 8/11/41." Recommendations were approved by the JAC on 11 Aug. 1941. In Aug. 1941 a Special Projects Branch was established in the Production Engineering Section at Wright Field, to follow up the JAC cases being sent out, "to achieve some measure of uniformity, control, and record of the incorporation of these standardization cases in production aircraft." In 1943 this unit became the ANB Standards Branch, and in 1944 it was shifted from Production to the Engr. Div. Brig. Gen. George C. Kenney, Asst. Chief, MD, to Chief, MD, 17 Sept. 1941, in WF file 334.8.

91. Min., JAC, 13 Feb. 1941.

92. Air Historical Studies, No. 11, Distribution of Air Materiel to the Allies, 1939-1944, p. 78.

93. Memo for C/AS from AC/AS Plans, 13 Apr. 1944, in AAG 381.

Chapter IV

1. Statistical summary calculated from MC, "Index of Army /and Navy/ Aeronautical Equipment," vols. 1-6, published in 1943, filed in M&S Standards and Specifications Section.

2. AFSC, "Index /of/ Army Air Forces Specifications," Oct. 1944. Back issues of this monthly list and index are filed in M&S Standards and Specifications Section.

3. These included, as of 20 June 1944, the AT-6D, the L-5, the L-5B, the C-46A, the C-47A, the C-54A, the UC-45B, and the UC-45F. At the same time, a few Navy models were accepted as standard by the AAF, especially the Consolidated PBY-5A (Army OA-10), the Curtiss SB2C-1 (Army A-25A), and the Douglas SBD-5 (Army A-24B). See SCS "List of Aircraft on Which Change Orders and Engineering Order/s/ are Requested, In Accordance with /JAC/ Case no. 300," approved by SCS 20 June 1944, superseding prior lists. (Copy in AFIHI).

4. SCS list of "Army-Navy-British Standard items of Aircraft Ordnance and /Armament/Equipment Approved by the Joint Aircraft Committee as of 31 May 1944," with supplement "as of 1 September 1944" (copy in AFIHI).

5. SCS "List of Aircraft on Which Change Orders and Engineering Orders/s/ are Requested, In Accordance with /JAC/Case No. 3,000," approved by SCS 20 June 1944, superseding prior lists. (Copy in AFIHI.) This list was issued periodically beginning 13 Oct. 1942. See SCS minutes, 13 Oct. 1942, in SCS files.

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400.345 Allowances of Supplies (Feb. 1935-Feb. 1942)

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452.1 Classification of Aircraft (1935-Oct. 1942)

452.1 Foreign Planes (1935-1943)

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