An Airplane is Not a Rabbit

By STANLEY E. SOHLER

THE RATHER OBVIOUS biological fact that airplanes will not reproduce themselves is one of the major headaches of the men who are charged with the responsibility of maintaining the country’s military potential in a state of preparedness. At the present time, the Navy and the Air Forces are working with the Army-Navy Munitions Board to make sure that the manufacturers of airplanes and their components shall not lack facilities, materials, machine tools, and manpower in case of an emergency. Already, reserves of machine tools are being established, materials are being stockpiled, and war plants are being placed in stand-by reserve. Also it is expected that the manpower mobilization plans now being developed will insure an equitable distribution of skilled labor between industry and the armed services.

However, all of these things must be done regardless of the nature of the specific air weapons which would have to be produced in volume in case of war. It is the purpose of this article to indicate the manner in which the individual engineer, whether chief designer or draftsman, can make a positive contribution to the military security of the United States.

In 1946, the Navy and the Air Forces authorized study contracts with aircraft and component manufacturers to obtain the industry’s own recommendations concerning the feasible peacetime preparedness measures which would substantially accelerate the production of air weapons in case of emergency. As was expected, all the companies pointed out the need for a supply of resources such as the facility, machine tool, and material programs already under way. However, when it came to the “internal preparedness” measures, nearly all of the aircraft companies stated that the first step would have to be redesign for volume production, even on the models currently in peacetime production (not including carry-over World War II models).

In view of the probable nature of the start and prosecution of any future war, it is courting national suicide to plan to devote vital time and skill, after we are attacked, to the redesigning and retooling of air weapons currently in peacetime production. This situation poses the obvious question: “If we spend millions to develop air weapons which are of value to the country only in case of war, why do we authorize the peacetime production of models whose design is not ready for immediate use in case of war?”

Actually, the apparently short-sighted design policy of most aircraft companies can be traced directly to the development and procurement policies of the Air Forces. This “policy” is really not a positive policy at all, but rather the costly lack of a clearly defined internal responsibility. In simplified terms, the Air Forces engineering divisions interpret their own responsibility to end when they have awarded and administered the basic research and construction contracts for two or three experimental models having the maximum possible performance. The procurement divisions interpret their responsibility to be the securing of the maximum number of airplanes within limited budgets.

As a natural result, a minimum of re-engineering expense is allowed under the production contract to correct the basic lack of “producibility” in the experimental model. Neither division is given, or accepts, the responsibility for the “producibility” of the design.

The real key to the whole design problem lies in the policy and practice of these military engineering divisions. In most cases, an airplane model has its inception with the Air Staff’s strategic planners, who visualize a certain kind of probable mission and the corresponding performance characteristics which will be needed. It is the job of the engineering divisions to notify manufacturers of what is desired and to evaluate the resultant design proposals submitted by the manufacturers. This first step is the one which really creates and fixes most of the problems encountered at later stages of the design development.
Only a very limited number of men can work efficiently on one such jig at a given time, and the total elapsed time required to complete a cycle through the jig is very long. This problem becomes even more acute after the structural work is completed and the thousands of equipment items and controls must be installed in the cramped quarters of the fuselage.

At low production rates, of one or two per week, such a situation is not critical, but a rate of 100 per week with semi-skilled labor has been shown to be impossible under such conditions. In other words, there just wouldn't be enough tool and die makers to make the elaborate jigs, nor enough floor space to house them, nor enough skilled labor to use them if it became necessary to increase production 100 times while still using the "unit" design and the corresponding production methods necessitated thereby.

What, then, does producibility really involve? On our fuselage example, if producibility were to be introduced into an existing "unit" design inherited from the "performance only" experimental stage, the following major design changes would be necessary before high production rates would be possible.

1. The splitting off of a tail cone which could be bolted to the main fuselage after separate horizontal and vertical stabilizers had been bolted to the cone and after all of the internal rigging and wiring had been easily installed in this empennage "sub-unit".

2. The splitting of the fuselage into at least two sides, panels (and possibly a top and bottom), each of which could be easily assembled by itself in a sub-assembly jig, and most of the wiring and equipment easily installed while completely accessible.

3. The breakdown of wiring and plumbing design drawings into units which correspond to the structural sub-assemblies mentioned above.

4. The inclusion of bolt angles or other suitable means for quickly and accurately joining the sub-assemblies together in a "mating" or master jig.

The volume of engineering work and elapsed time involved in such a redesign for producibility is only part of the story. Tooling must be redesigned and rebuilt to the new drawings and the manufacturing process almost completely replanned. This takes time, a priceless commodity during a war.

Without producibility, the desired quantities of fighting air power simply cannot be produced. Do it then, make sense to wait for the astronomical production demands of war before starting after one of the major prerequisites of such production?

It is apparent that a basic change of military engineering division policy will have to take place before the bulk of the airplane companies will voluntarily do away with the "Iron Curtain" which now exists between their advance design and production staffs. Specifically, the military engineering divisions will have to be given the direct responsibility of seeing to it that producibility actually receives equal weight with performance in design proposal evaluation, and making sure that any experimental airplanes incorporate as much of the producibility concept as possible. After all, an experimental airplane (not a basic research project) is supposed to be a prototype of a usable air weapon. To the extent that producibility is sacrificed in an experimental model to gain performance, the
further their sale. Actually, the chip or thread removed during the engraving of lacquer-coated records is highly inflammable. Abnormal temperatures and humid atmospheres may affect record materials to some extent. If one lives where abnormal conditions exist, these factors should be checked.

Naturally, one might wonder which of the three systems of recording is the best; that is, whether the mechanical, the optical, or the magnetic system inherently is best. Or perhaps, whether lateral is better than vertical. It is the writer’s judgment that the capabilities of all systems are "about equal", but that the skills acquired by the proponents of each of the systems vary somewhat from time to time. This phase of the matter leads to conflicting opinions. At the moment the highest quality seems to have been obtained under carefully controlled conditions while the record was being played back at the outside edge from an original, lateral-cut, lacquer-coated disc. This effect does not eliminate the possibility that the future may produce a different system with striking results, or that the performance may be readily duplicated on a commercial basis. It is interesting to note that in 1929 the ambitious California Institute of Technology glee club produced a recording of its alma mater song. That of us who bought a copy of that record were sadly startled to learn that all record concerns had stopped production of records for the advance design engineers. Several models now in the experimental stage have actually been designed from the beginning with the basic structural needs of producibility given full consideration.

How is it possible to incorporate producibility without adding so much weight that all design competitions are lost? Although a strong, farsighted management is essential for their successful combination, the understanding and broadmindedness of individual engineers can go a long way toward achieving the same effect. It was found that when the production men were fighting with the engineers to get the experimental design revised to incorporate some producibility in the production version, most of the changes resulted in a weight increase. The production men had their hands full trying to protect their own interests, and "never mind what it does to the weight". However, when the production men worked with the designers at the time the original design was created, the production men came up with as many weight-saving ideas as weight-increasing ideas. The result was a high-performance airplane that could be produced in quantity in case of an emergency, with no major redesign or retooling problems.

The best solution is a change of military engineering and procurement policy which will encourage the top management of all companies to follow through in this manner. In the meantime it is suggested that the designer let this one thought come to mind each time he sets pencil to paper: "You have to draw it only once, or maybe twice. Somebody else may have to duplicate it in metal a thousand times in a hell of a hurry, and your life and his may well depend on how fast it can be done."

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Air Staff and the entire nation are actually being misled, as they can never get such an airplane in large quantities. The many individual experimental super-weapons found in Germany gave added proof to an often quoted but all too seldom recognized truism: "No nation has ever won a war with a handful of laboratory samples, even though the samples individually surpass any other weapon in the world."

It would appear that nothing can be done until the military engineering divisions are properly set up to handle their full responsibilities. However, at least a start has been made within the aircraft industry toward breaking down the "Iron Curtain" which excludes production men from the inner sanctum usually reserved for the advance design engineers. Several models now in the experimental stage have actually been designed from the beginning with the basic structural needs of producibility given full consideration.

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