

RESEARCH & DEVELOPMENT IN AERONAUTICAL INDUSTRY.

By Dr. V. M. Ghatage, Chief Designer, Hindustan Aircraft Ltd., Bangalore.

A good deal of research and development work is essential for the proper working of an aeronautical industry. Very little work has been done in these directions in our country although we do have a fairly well equipped aircraft factory capable of manufacturing airplanes but the lack of research and development work on many of the essential items that are required for the successful design and manufacture of aircraft has hampered the progress of this factory. If one looks at the general conditions in this country, it could be seen that almost everything in the way of material and equipment needed for the successful design and manufacture of airplanes is not available from indigenous sources. The light alloys and alloy steels required for building airplanes have to be bought from outside sources, and so also all the instruments and proprietary parts such as engines and propellers. In addition to these, a number of items like radio, radar, armaments including such other small things like pulleys, cables, bearings, etc., are not manufactured in this country. It may be possible for us to obtain these things from foreign firms in normal times but in case of an emergency it would be very difficult to get these items, which in turn would mean the progress of the aeronautical industry would be adversely affected. Development work, therefore, consists of not only finding ways and means of designing airframe and manufacturing them but also the manufacture of such other proprietary items as engines, propellers, light and steel alloys, cables, plumbing lines, radios, instruments, etc. It is assumed that adequate measures would be taken by the Government to develop and manufacture these specialised articles in this country as early as possible. It is intended to give a picture of what is necessary by way of research and development for building airplanes when the materials are made available to the aeronautical industry.

The research in this field can be divided into two main groups:—

- (a) The pure academic research in aerodynamics, the theory of elasticity and the strength of materials.
- (b) Industrial research where the application of this theoretical knowledge is specifically worked out for current and new problems occurring in the design and development of airplanes.

It is expected that the pure academic research would be taken up by Universities and Scientific Institutions who are far better suited for conducting this type of work while the other part should be taken up by special research establishments equipped and established by the Government for rendering assistance to the aeronautical industry in this country. About the latter type of development, a little more could be said at this stage.

The work involved in providing the scientific and technical information needed for the purpose of developing new aircraft is really of a tremendous magnitude. The equipment required for this purpose is very expensive and it is not possible to get the specific information needed if the equipment is not adequate. The running expense of such an establishment is also a very expensive item and no University or Institution would be in a position to find the finance for such an undertaking. The expenditure that would be incurred on such an organization could only be considered as a premium paid against the future development policy of the country and the necessary funds for this purpose must come from the government of the country. It is true that it is not possible to establish and equip an institution to meet the varying needs connected with the development work and bring it to the standards of similar institutions existing in U.K. and U.S.A. in a short time, but a modest beginning must be made at an early date in this direction so that in the course of about 5 years the institution will be in a position to render some assistance to the aeronautical industry. A brief list of the various departments that such an establishment should have and the details of the preliminary development work on which such an establishment should engage itself are given in Appendix "A".

It must be pointed out that organizations established by the Government to cater for the industrial needs of the country alone would not solve the problems connected with the development work which a company would be undertaking. A number of problems would crop up during the design of an aircraft and which would require solution in a comparatively short time in order to keep the design work progressing satisfactorily. In order to overcome this latter problem, the company itself must have a comparatively small research and development department of its own consisting of a fair sized wind tunnel and a good set-up for structural testing, material testing laboratory and a few other facilities for vibration and allied work. The work of this department will be mainly to carry out experiments on specific problems which would crop up during the design of any particular airplane and supply necessary information required urgently for this purpose. A department like this is an important adjunct for a company engaged in the design and manufacture of airplanes and could be of immense use to the industry. Almost all big companies possess a good set-up in this direction.

In addition to this, there are certain problems which require continuous research work in order to keep the progress of the entire industry in line with the development in other parts of the world. It is also necessary to have a long range programme of development and research work on problems which cannot be solved in a short time. Such problems where completely new and revolutionary ideas are involved, may be presented by the industry, they can be tackled either by Universities or special establishments, depending upon the type of work involved. The tremendous amount of research work carried out for the last ten to fifteen years—and which is being carried out even now with the same intensity—on the design and development of gas turbines is an example of this nature.

A good deal of thought has to be given in prescribing design requirements and standards of workmanship in manufacturing aircraft.

This can only be derived from long experience and as such for preparing complete data on these items, resort will have to be made to other countries where similar information is already in existence. It is easy to get normal design requirements laid down for civil airplanes from other countries but special design requirements for service airplanes of different categories are generally a closely guarded secret and information, if any, available on these matters, even from friendly countries, will be generally considered as out of date by those who provide such data. In this connection it is a good idea to set up a committee comprising of technical men from the various branches of the industry, Government organizations and the Indian Air Force to pool their experience in their usual work and try to set up some sort of a standard requirement with the help of available data on these matters from U.K. and U.S.A. The work involved is of a very great magnitude and will take at least 3 to 4 years for an exhaustive compilation of the required information for the benefit of those who may require such data in the industry. This also brings forward the issue of the establishment of a Directorate of Technical Development (Air). It is necessary to have an organization which would coordinate the work of various industries and would give the necessary government support to the different firms to develop all the necessary items to the required standard for the building of an airplane. A possible set-up of a Directorate of Technical Development based on the one existing in U.K. is given in Appendix "B". It is neither possible for this country to have an elaborate set-up nor advisable at this stage due to lack of enough technically trained personnel and also due to lack of necessary funds that would be required for the maintenance of such a set-up. However it is advisable to make a beginning now and set up a nucleus organization in this direction. It is suggested that a small group of men comprising of aerodynamicists, and structural engineers who would be able to examine the type records of new airplanes presented to them and give decisions as to the suitability of the designs from the point of view of airworthiness regulations would be necessary as one part of such an organization. It should also consist of another branch which will look to the possibility of design, development and manufacture of suitable aero-engines under licence from other firms in the beginning and build to the original design at a later stage. One such group of men should accelerate the work of getting the power plant of an aircraft designed and built in this country. It may be that another group would also be required to function in this organization which will look purely to the needs and requirements of military aircraft. The men in this group would also simultaneously try to coordinate the work of manufacturers and give them the necessary encouragement by placing orders of such items as could be made in this country and see that all technical information and help is provided to them so as to bring these products to the standards required in the aircraft industry. In view of this, the set-up of a temporary organization which will form the nucleus for a DTD is given in Appendix "C".

So far in this paper only the things and organizations that are necessary for the development work have been dealt with. But it would not be out of place to give a tentative idea of what types of special airplanes would be required for the defence of this country. The development work on such airplanes would take 5 to 7 years.

This suggestion is purely based on information collected from various people who have a large experience in other countries about the types of aircraft required for given conditions. Considering the vast expanse of the country and assuming the defence is mainly in view, it is necessary to have a very large number of airplanes of certain type than a smaller numbers of greater variety. It must also be pointed out that the financial implication for building a large number of airplanes of different categories is not of a small magnitude. In order to avoid these difficulties, it would be necessary to develop a utility fighter and a fighter-bomber capable of carrying a comparatively small bomb load but can go unprotected on its own and do a greater number of sorties in a given time because of its higher speed. To this should be added a transport airplane which will be used both by the civil air lines in the country and with a little modification could be used as a troop transport and freighter for the air force. The design and development of these 3 types, if undertaken now, would come to the prototype stage within a period of 5 to 7 years. Within this period we could build the prototypes of these 3 types of airplanes and the tooling as well as the jigs and fixtures could be manufactured and kept in abeyance until such time when a mass production is required. This would assure the country of at least getting these 3 types of airplanes in large numbers provided the development and manufacture of suitable power plants and other items required for these aircraft is undertaken and carried out simultaneously.

In conclusion, I would like to point out that an attempt has been made in this paper to point out the bare necessities in the way of research and development considered from the point of view of the aeronautical industry. I know that some of the points mentioned are of a controversial nature and there would be many who have other plans in their minds. However the fact remains that the industry, to say frankly, is practically non-existent in this country and a very strenuous effort must be made on all sides to put it on its footing. If this paper has given a stimulus to the thinking of responsible people in this country for finding out ways and means for the purpose of establishing the aeronautical industry, I believe the object of the paper is more than achieved.