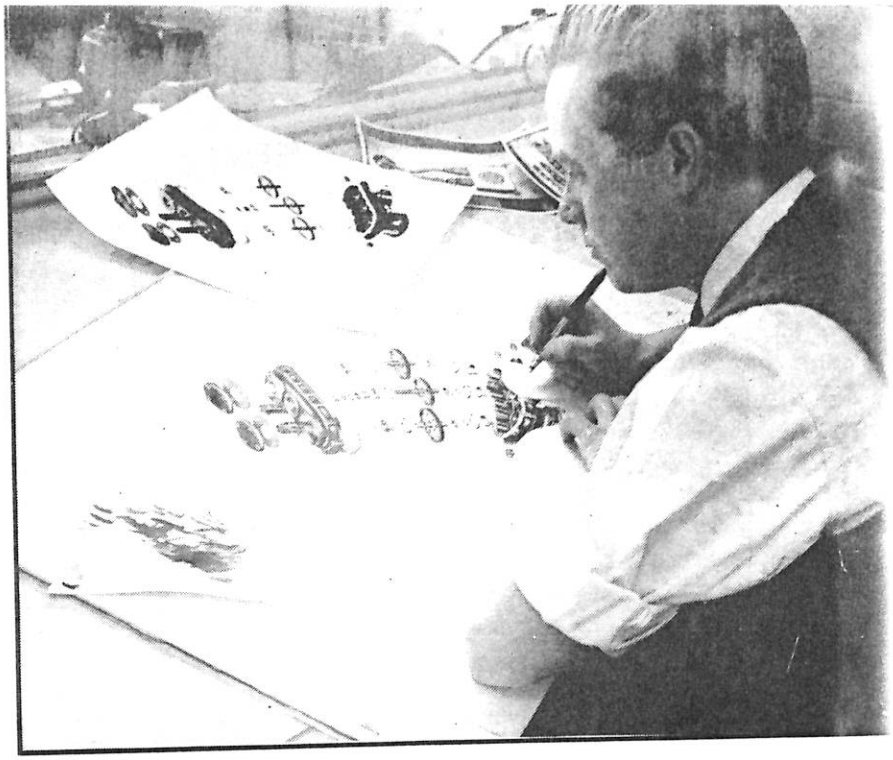
Technical Publications IN THE AIRCRAFT INDUSTRY Part I



Where photographs are available, they can usually be brought to required standard for technical manuals by the airbrush artist.

By HARRY McDOUGALL

IN THE DAYS of the strut and wire biplane, a maintenance manual was a handy little book one carried around in one's pocket. A rigging diagram, tire pressures and a few other details were all the data necessary to keep an aircraft serviced. Nowadays, a set of manuals for an aircraft may run into several thousand pages and cost a quarter million dollars. A survey taken throughout the British Aircraft Industry revealed that more people are employed in the production of technical literature than in the not inconsiderable field of aerodynamics.

During World War II, the manuals produced to facilitate the servicing of Canadian-built aircraft were mostly rewrites of existing U.S. and U.K. publications. In 1955, with native Canadian aircraft, powered by Canadian-designed and built engines reaching RCAF squadrons in increasing numbers, and with American and British aircraft undergoing elaborate Canadianization redesign before being put into production, the preparation of technical publications has become an important phase of the aviation industry.

AMC Function: The procurement of publications for the RCAF is a function of Air Materiel Command. The funds are provided by the Department of Defence Production either as part of the prime contract for the aircraft or by separate contracts.

The principal publications required for a new aircraft are:

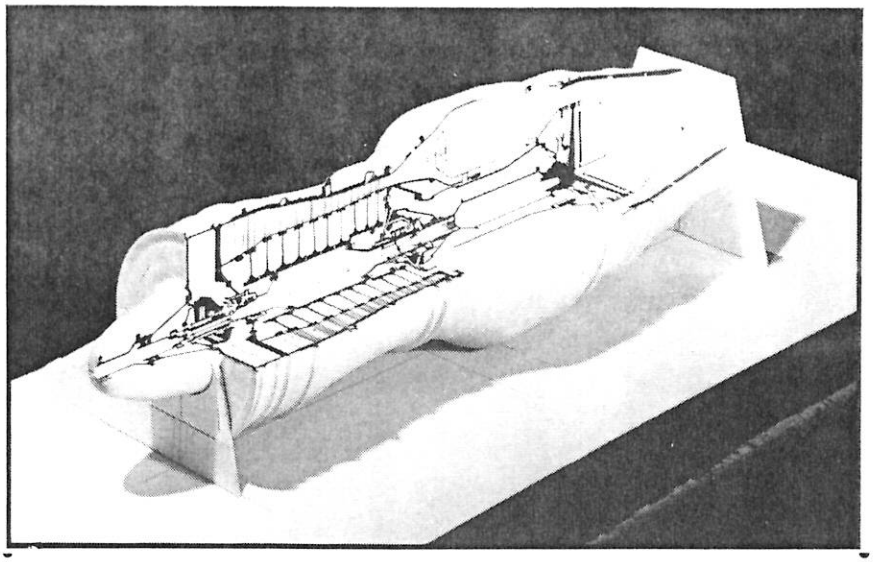
- Pilots Operating Instructions
- Description and Maintenance Instructions
- Illustrated Part List
- Weight and Balance Data
- Equipment Manuals on proprietary products

This set of publications is supplemented by many subsidiary publications, leaflets, etc., which together cover every phase of aircraft servicing. A typical Maintenance Manual contains over 500 pages of text, illustrations and wiring diagrams. The accompanying Illustrated Part List may be almost twice as large.

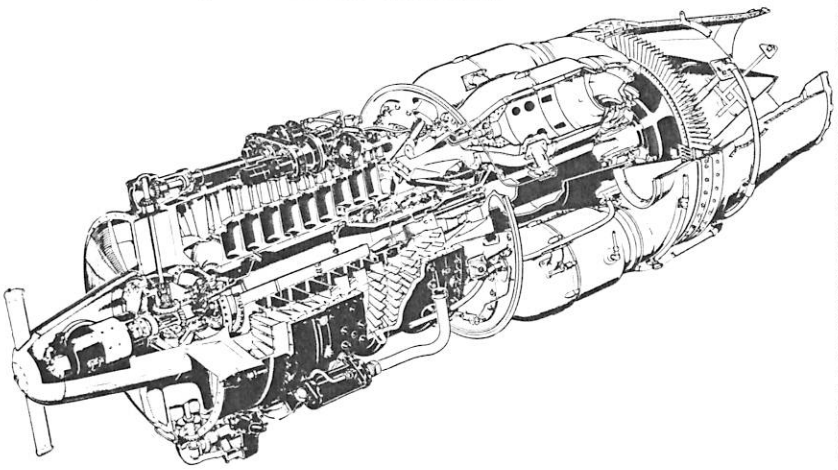
Publication Organizations: Obviously the preparation of such a large volume of technical literature is a major task and this is reflected in the sizes of the staffs required. In the U.S. several companies maintain staffs of upwards of 500 people—technical writers, illustrators and production personnel.

In some companies, the technical publication departments are part of engineering. However, since the majority of technical publications are used primarily for servicing purposes after the aircraft have been delivered, the publications department is normally a part of the Sales & Service organization and acts in support of the Service Department. The Technical Editor is usually responsible for all publications issued to the Air Force but is not normally concerned with technical literature for use within the company. In some small organizations, dealing with conventional aircraft, the text is produced by members of the Engineering Division, each of whom writes up the servicing details for the particular components or systems which he designed. With more complex aircraft this becomes impractical and the text must be prepared by trained technical writers.

A technical writer is usually a technician with a flair for writing, rather than a writer who has entered the aircraft industry. It is relatively easy for a man who knows the technicalities of his subject and can write reasonably intelligently to set down the information in the required form, but it is almost impossible for even the most skilled writer to comprehend an involved hydraulic or fuel system without extensive shop experience. With technical illustrators, who in most publication departments outnumber the writers, the situation is reversed. It is far easier to teach a good artist to produce adequate technical illustrations of aircraft components than it would be to teach even a skilled draftsman the principles of perspective. Good illustrators must usually possess the natural "gift," even if only to a limited extent, of being able to



Many short cuts may be taken to simplify preparation of illustrations. To prepare jet engine cutaway drawing below, a wooden model was first made to outline shape of engine, then split along its length. One segment was removed and sections of plan and elevation pasted in place as shown above. A photo was then taken and blown up to required size. Tracing paper was placed over photo and other details added. By this means, much layout work was eliminated.



visualize a piece of mechanism as an illustration even though they may not understand its purpose.

The technical responsibility for both the text and the illustration in the manuals is usually borne by the writer, the illustrator being responsible only for the artistic quality of the work he produces. The production phases after text and illustration have been completed are usually carried out by a separate section employing people with a specialized knowledge of page layout, plate-making, printing, etc. They also handle the distribution of completed publications.

Method of Preparation: The format of all RCAF publications is governed by an RCAF Specification—EO 00-5-2, Preparation and Printing of Engineering Orders. This gives the required layout. Additional specifications detail the required breakdown for individual publications.

The preparation of technical publications commences long before the flight of the first prototype. As soon as the blueprints are issued to the shops for construction of the first aircraft to begin, a duplicate set of prints is delivered to the publications department which begins work on the initial issue of the Pilots Operating Instructions and the Maintenance Manual. The first issues of these publications are fairly simple since the available information is usually very limited. Also since all prototype aircraft are modified rapidly, the design does not stabilize sufficiently in the early stages to justify the expenditure of large sums of money on publications which will become obsolete very quickly.

The first step in the production of any publication, e.g. a maintenance manual, is the preparation of a layout showing the "Scope and Arrangement" of the proposed manual. This specifies the format of the manual and shows its breakdown into parts and sections. It is submitted to the RCAF who determine whether it provides the coverage required. After approval, the "Scope and Arrangement" is mimeographed and the various sections allotted to individual technical writers. Work is allocated according to the particular abilities of the writer. It is usually found that individual writers have a much greater interest in certain phases of the work than in others. One writer may show a keen interest in hydraulics, another in flying controls. Invariably the best way to produce the most work with a given number of writers is to allot the individual sections of the manual according to the writer's particular interests. Radio, radar and electrics are, however, invariably allotted to a separate group.

Specialization Trend: As in engineering there is an increasing tendency towards specialization. In dealing with a modern aircraft under continuous development one writer cannot normally write and keep up to date the sections of a publication covering more than three complex systems. Although the interchangeability of writers is generally aimed for, this is never fully achieved since it is obviously more difficult for a new writer to learn, say, the complete hydraulic system, before revising it to cover the latest modifications, than it would be for the person who wrote the original section to do so. For the same reason continuity of service gives the technical publications group a vested interest in the services of individual writers. To be efficient, a technical writing group must be reasonably stable.

The information for a maintenance manual is gathered from all sources and the writer may have to consult a dozen different people, from the Project Engineer down to the airframe assemblers in order to write up a complete system. Thus it frequently happens that the technical writer knows more about an individual system than any other single person

in the whole organization, not excluding the designer. In designing a flying control system, provided he allows for adjustment at a sufficient number of places, the designer may leave it to Production to devise the best rigging procedure. Similarly the production people who rig the controls initially may have no direct connection with the field personnel who make day to day adjustments.

The technical writer must cover the whole subject for he is required to give not only a description of the system but also complete details of its operation and all other information required to rig the flying controls and keep them serviced throughout the life of the aircraft. On a new aircraft, opinions on almost every operation varies. The writer must frequently act as a mediator relying on his own background of experience to decide which particular servicing technique should be put in the manual.

high integrity

SINCE IT is almost impossible to formulate any system of accurately gauging the volume of work put out by a writer, a high standard of integrity is required. It is almost literally true that the better the writer, the less he produces. This is because as the writer gains more experience he is able to take on more difficult work. It may require only a few hours to write ten pages on the operation of a component which is well known and understood—but a week's persistent investigation into, say, an emergency procedure for inclusion into the Pilots Operating Instructions may result in the addition of only a single paragraph.

It is important that the writer should understand at the outset to whom his words are addressed. Technical publications are used by a variety of people with widely different interests. An officer investigating an accident may be interested in the peculiarities of a complete system but the mechanic in the field wants to know only how to service the particular component that has been giving him trouble. The storekeeper is interested only in part numbers. The writer must try to cater for everybody but obviously should aim primarily at the type of personnel who will make the greatest use of the particular publication.

Cost vs. Value: The cost of production must also be weighed against the value of the completed publication. In the early stages of World War II, before experience formulated more practical standards, some of the publications produced in the U.S. were fantastically elaborate: in one manual an instruction to "inspect the tires for wear" was accompanied by an illustration of a man gazing at a tire! Unnecessary elaboration can delay completion of a publication until the aircraft with which it deals is obsolescent.

This controversy on the required quality of technical publications is still largely unresolved. It continues to be a question of individual discretion just how much money should be spent on publications for an aircraft which it is known will be undergoing extensive development and modification. This particularly affects illustration work which usually absorbs more manhours than the text. The writer, having completed his text, asks only for simple but accurate illustrations and requires them as quickly as possible. The illustrator, knowing that the ultimate user rarely understands the pressure under which the publication was produced, tends to try to produce high quality work which will stand scrutiny at a later date. A reasonable compromise can come only from each member of the partnership understanding the other's viewpoint.

It is also controversial whether "sales appeal" should be built into technical publications. Since self-praise is no recommendation, such phrases as "The system is so well designed that very little servicing is necessary . . ." are always edited out before publication—nevertheless, the provision of a good set of publications, particularly if they are well-illustrated, can undoubtedly influence a team evaluating a particular aircraft. Again the publication department must exercise a great deal of discretion.

It is not possible to check text for technical accuracy without duplicating the writer's work, therefore the responsibility for the manual must be borne wholly within the publications department. Design and Production personnel will usually read through a draft of the manual and make constructive criticisms but will hesitate to approve it officially. Nor should they be required to do so.

illustrations

HAVING drafted his sections of the manual the writer next issues dockets for the required illustrations. The most effective illustration is a properly retouched photograph. However, the commonest type used is the line drawing, the reason being that good photographs are difficult to obtain. The illustration is usually required before the aircraft is built and even when a prototype is available, the area to be photographed is frequently inaccessible. The writer delivers to the illustrator a docket defining the illustration he requires, together with the necessary blueprints, suitably marked. From these, the illustrator prepares a sketch which the writer approves. A pencil drawing is prepared from the sketch and this is again approved by the writer before being finally inked and annotated.

One of the main problems in preparing illustrations is to establish uniformity of style. Artists tend to be individualists, sometimes to the detriment of the finished book. A Standard Procedures Manual, defining line thicknesses, type faces, etc., is a great help, although the provision of a few "ideal" drawings as samples define the requirements more adequately than words. The principal problem, having established the style, is to ensure that the illustrators adhere to it —sometimes a formidable task and one which, if not handled diplomatically, can result in an astonishingly rapid turnover of staff. Most illustrators are individualists whose main desire is to be considered as "creative." Working to a standardized format is the antithesis of their normal desires.

Isometrical: One method of ensuring uniformity is by making all drawings isometric so that they can be scaled out. This system works well with certain types of illustrations, particularly drawings of small objects. When the subject to be illustrated is large, the distorted appearance of the isometric projection becomes objection-

able. There are a number of mechanical devices for producing perspective or pseudo-perspective drawings, probably the most effective being the perspective drawing board. This is a drawing board incorporating curved cutouts on its edges which, in conjunction with a special tee-square facilitates accurate layout work. It also has the effect of standardizing on styles and viewpoints. By its use an illustrator can, without difficulty, modify an illustration produced previously by a different person yet without showing any distinction in style. Similarly it is possible for several illustrators to prepare the insets for a single illustration so that the finished result appears to be the work of one man.

It is common to standardize on reduction sizes, most illustrations being prepared to a scale of twice up. The use of LeRoy or similar pens to standardize on line thicknesses is almost universal. Adhesive arrows are used for callouts. The use of adhesive art has also been extended into the illustration itself. It is now possible to purchase adhesive drawings of many standard parts, e.g., hydraulic and fuel pipe unions and elbows which, when pasted down, require the manual drawing of only the remaining components and the pipes to produce the completed illustration.

Printing is invariably by offset lithography. Text is prepared on electromatic typewriters and later pasted down or is typed directly on standardized layouts. The type is normally reduced slightly in the plate-making stages and this has the effect of "cleaning up" the type. On small manuals, the completed illustrations can be reduced photographically to the page size and the negatives for text and illustrations "stripped" together. However, for large publications this is a cumbersome method requiring a rigid accounting system for all the copy. The preferred method is to reduce the illustrations to the standard oversize used for the text, paste them down with the text and then rephotograph down to the plate size. This results in a slightly lower quality of work but greatly simplifies the production phases.

Small Numbers: Since the quantity of each publication required is not

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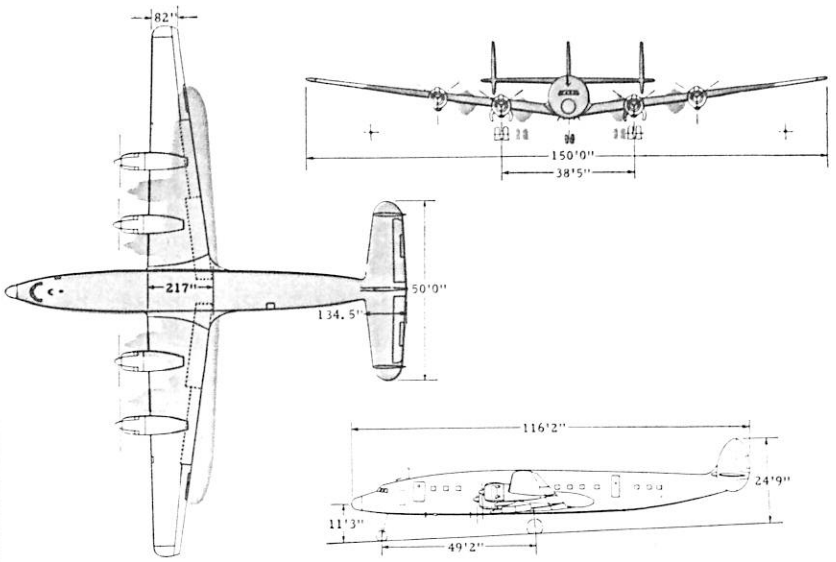


The "Super" Super Connie

With the announcement during June of Lockheed's new Model 1649A Super Constellation, one of aviation history's most durable designs has been given a new lease on life that seems to ensure its continued presence on the air transport scene for many more years. The 1649A, an extended-range version which brings any European capital within easy non-stop range of New York, is already the subject of substantial orders from Air France (12 worth about $35,000,000) and TWA (24 costing some $75,000,000).

The basic design differences between the current 1049G Super Constellation (shown in color above) and the new 1649A (black line drawing), are to be found in the wing, the engines, and the propellers. The fuselages are practically identical, as are the empennages. The nose has been moderately elongated to accommodate weather surveillance radar.

But these changes are enough, according to Lockheed, to give the 1649A the greatest range (6,500 miles) of any airliner ever built and a point-to-point speed of up to 70 mph faster, at ranges beyond 4,200 miles, than any other transport powered by reciprocating engines. Actual maximum cruising speed is said to be "around 350 mph". The high point-to-point speed claimed is, of course, due to the fact that the great range of this aircraft makes it possible to eliminate refueling stops.

The first class version of the 1649A will normally carry 58-64 passengers.

The new wing spans 150 feet, an increase of 27 feet over that of the 1049 model, and has been extensively redesigned. It is also somewhat thinner. Extensive use is made of large milled sections of integrally stiffened wing skins throughout the wingspan, top and bottom. This is said to be the most widespread application to date of the Lockheed-developed technique of weight-saving and strength-increasing.

Fuel capacity will be 9,600 U.S. gallons, up from 6,500 for most Super Constellation models, and 7,750 on tiptank-carrying versions. This is sufficient to give an endurance of 24 hours, plus normal reserves.

Wing area has been increased by 200 sq. ft. to a total of 1,850 sq. ft. The engines are located five feet farther out the wing from the fuselage, a feature that is expected to reduce the cabin noise level and vibration. The larger propellers are also expected to contribute in a similar manner as a result of their lower rpm (engine reduction gearing has a ratio of .355:1 compared to .4375:1 in current models).

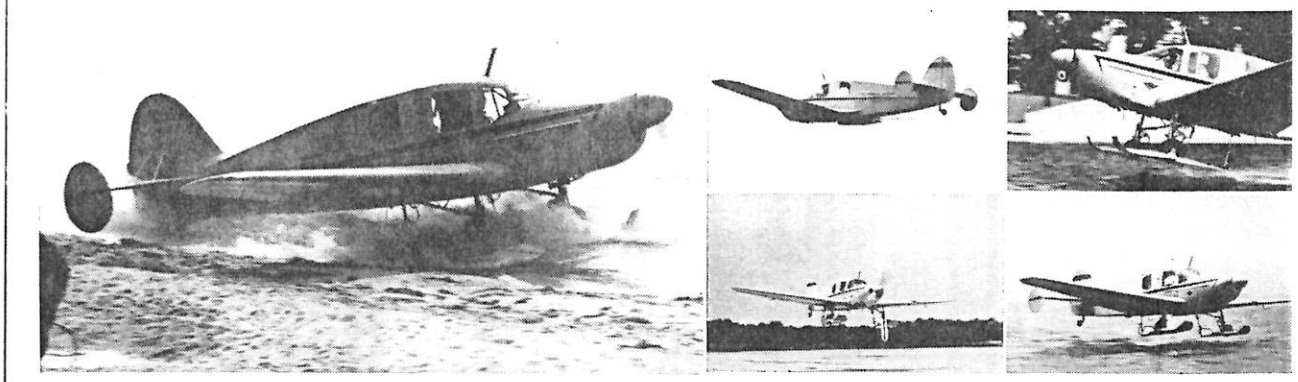
The engines are an improved model of the Wright Turbo-Compound 18, the R-3350EA-2, which develops 3,400 hp for take-off, compared with 3,250 hp for the civil versions now in use.

The three-bladed propellers measure 16 ft. 10 in., as against 15 ft. 2 in. on the 1049G.

Maximum take-off weight will be 156,000 lbs., an increase of 18 500 lbs., while maximum landing weight will be 123,000 lbs., up 10,000 lbs.

Space-limit payload will be 17,000 lbs. for ranges up to 4,700 miles, and 16,000 lbs. for more than 5,000 miles.

Other Lockheed announced data about the 1649A include: one additional 2-by-4 foot emergency door, rear cabin; wing incorporates 16.7% lower root thickness-to-chord ratio, 18 versus 15, with aspect ratio of 12, versus 9.17 now; fuel system improvements, fuel lines placed inside tanks; new 3,000 psi hydraulic system, with completely independent dual pressure source, and each system operated by different pairs of engines; new, simplified twin-cylinder boosters for each control surface; improved flap system.



UNIVERSAL LANDING GEAR: This Bellanca Cruisemaster is described as being the first airplane to be equipped with retractable "hydro-lift". All American Engineering Co., Wilmington, Del., which designed and developed this type of landing gear, says that it is not to be confused with hydro-skis such as are used on the Convair Dart, as these are for use on water only. Hydro-lift enables a landplane to operate from any surface, including water, snow, mud, ice, and runways, according to AAE. A number of landings and take-offs have already been made from water, sod, and hard-surfaced runways.

PARACHUTES

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during the initial inflation or opening period of the parachute, reducing the sudden flaring out of the skirt and thus preventing "explosive opening" of the canopy.

As the canopy expands, the extensions act as aerodynamic brakes against the sudden radial outward motion of the canopy skirt and provide a smooth, uniform opening with minimum opening shock. In descent, a considerable amount of air turbulence is created between the closely-spaced flow separation edges of the extensions, which increase the drag of the parachute. The guide surfaces are tilted inward 45° to the direction of descent. Any deviation of the parachute from the vertical position deflects the air flow along the guide surfaces in such a way that the canopy is directed back to the vertical position. The airman approaches the ground with the parachute in this position, enabling him to land straight down on his feet.

Other Types: There are several models of this type parachute, adapting the guide surface principle to a wide range of modern flying conditions. Stabilization, or guidance of bombs, mines, torpedoes and streamlined objects is accomplished with other special types of guide surface parachutes, making possible a new degree of precision in mine-laying and bombing — maximum accuracy with minimum oscillation. Aerial-launched torpedoes are stabilized in their flight paths by these parachutes, replacing conventional fins.

The high approach and landing speeds of jet aircraft demand a method of deceleration and braking which will insure safe landings even on short runways. For bombers, large ribbon-type brake parachutes provide the drag which allows the approach to be made at a steeper angle. They effectively shorten the roll and are particularly effective when slippery runway conditions make wheel brakes inadequate. Smaller, ring-slot type parachutes are similarly used for jet fighters. In both of these heavy-duty applications the parachutes reduce landing hazards and cut down wear on tires and braking systems.

TECHNICAL PUBLICATIONS

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large by publishers' standards, a small multilith press can often cope with the printing requirements. The system of printing one page at a time is slow, but confers several advantages. It allows last minute changes to be made without the scrapping of large plates. It also permits individual sections of the book to be re-run as revisions at a later date without the preparation of large plates. The small plates are also easier to handle and store. However, for particularly large jobs, the services of sub-contracting printers who can print large numbers of pages at a single run are frequently employed.

Collation of a large book is a problem usually solved by the crude, tedious, but nevertheless effective method of having a large number of people walk around a large table, picking up one sheet at a time.

DOLLAR DECISION

(Continued from page 18)

example, plant averages in the Maritimes will total about $1.09 per man-hour, while those in Montreal $1.40 and Toronto $1.70."

"Man-hours are really the best basis for assessing one proposal against another," Stephenson says. And since we are truly interested in the amount of national effort we are calling upon our aircraft industry to put out, our dollar evaluations should, if we could work it, show man-hours instead of the more familiar price tag of dollars and cents.

It is clear then, that this is just another case where dollars alone may be misleading, and it serves to stress the fact that we must "look beneath the surface" with every dollar decision to ensure that all the factors behind the price tag are carefully tabulated. When it comes to defence spending, with the taxpayers' money, this is even more important. However, with the RCAF, the Defence Research Board, the Department of Defence Production, and finally the Department of Finance's "Treasury Board," all dabbling in defending the dollar, there are few factors that escape scrutiny.

The results of this process are apparent. As Thor Stephenson sums it up, "We in Canada get as much as any country in the world for our airplane defence dollar—and in many cases we get more."