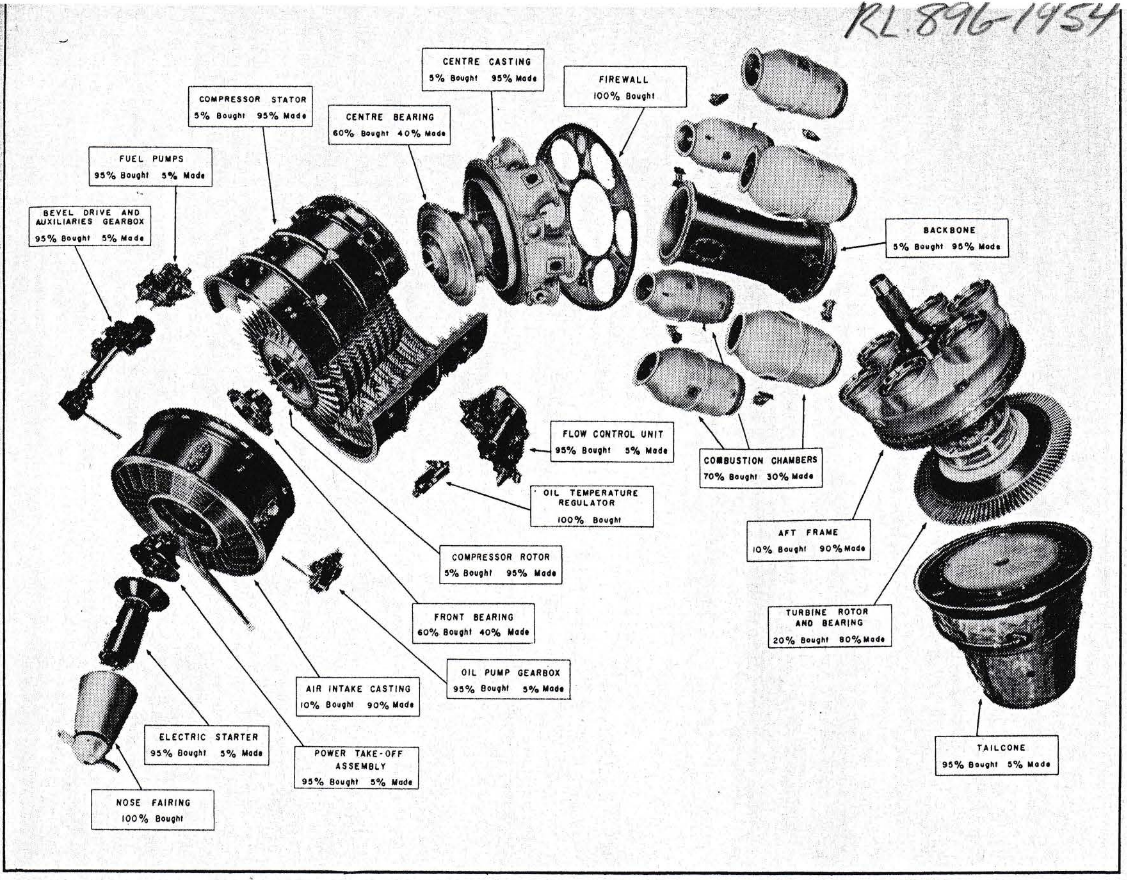
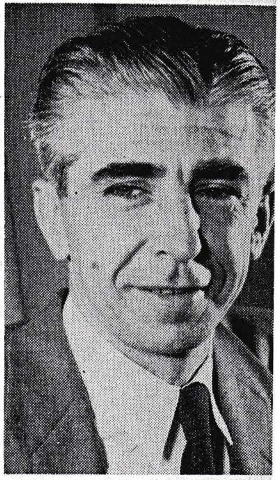


Unit View of Orenda reveals the percentage volume of contracted work involved in Avro's jet engine procurement.



EARLE K. BROWNRIDGE

Procurement Poses Problems In Jet Engine Development

By Earle K. Brownridge,
General Works Manager,
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"GENTLEMEN," the RCAF officer announces, "we would like you to commence design of a power plant as soon as possible. Our requirements generally are these: thrust 5,500 lb., weight under 3,000 lb., length 10 ft. 6 in., diameter 3 ft., ceiling 40,000 ft., etc."

That is how procurement starts; however the most important question is; when would the engine be required in production quantities?

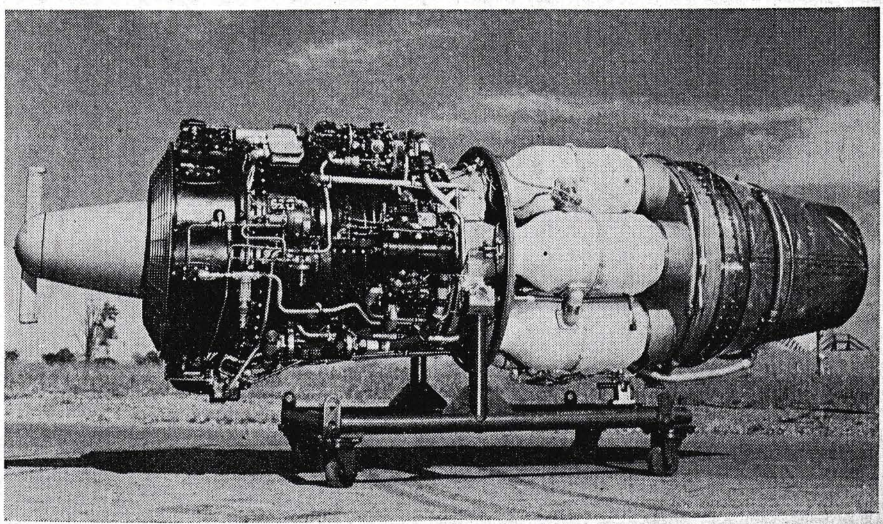
It is here that we meet our first schedule; from here on in, the aim is never to let lack of engines hold up the delivery of completed aircraft. Sometimes there are two or more airframes using the same type of engine, in which case we have two basic schedules to contend with.

Under Utopian conditions, which would allow each phase of the design - development - production cycle to be completed before the next one began, it would take approximately seven to eight years from the designer's drawing board to the planned production peak of, say, 60 engines per month. However, under present conditions of "hot" and "cold" wars, such Utopia cannot be. Instead, this cycle must be compressed into as short a period of time as possible, so that it usually works out to about five years.

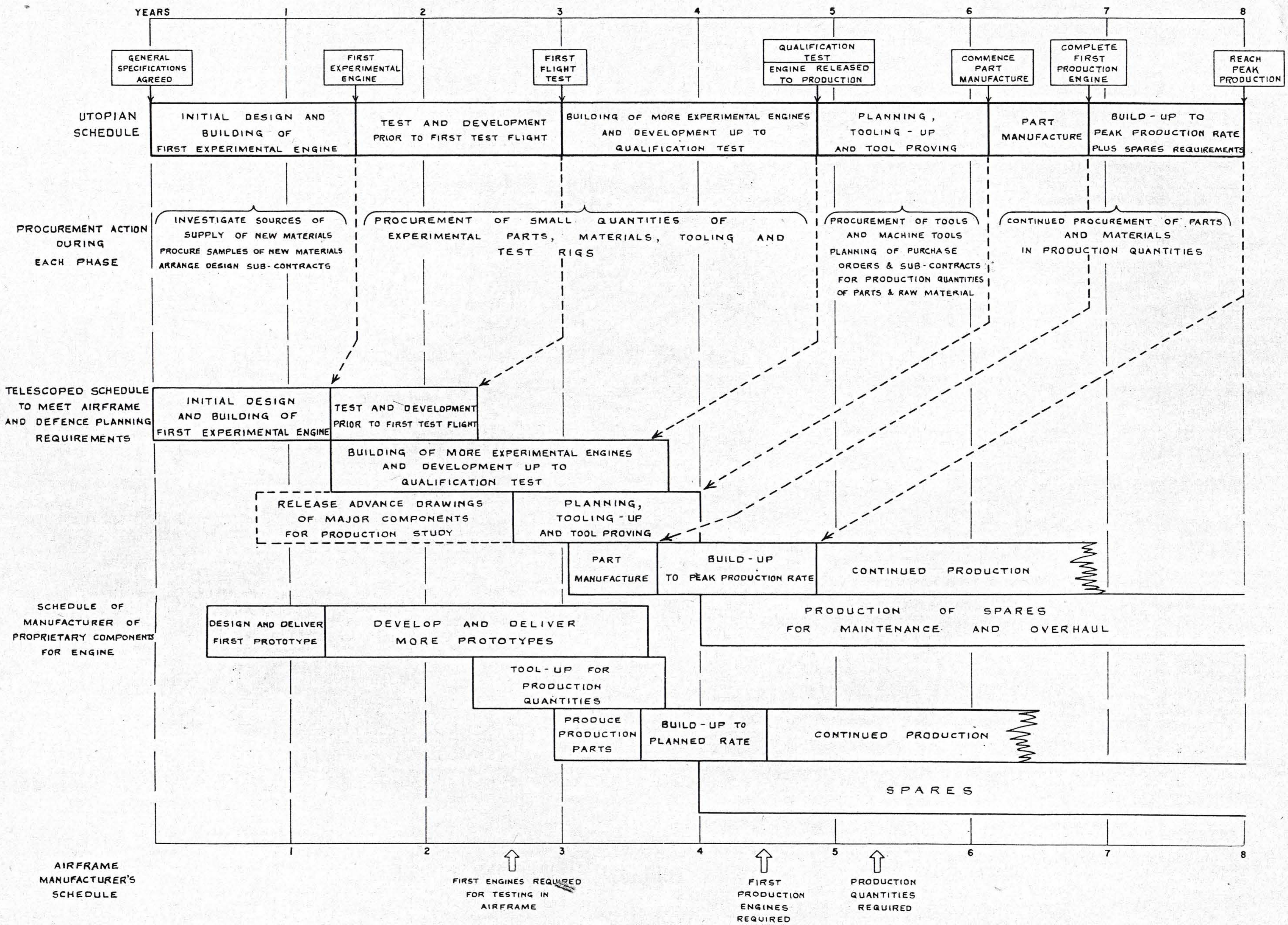
To meet this compressed schedule it is necessary to overlap as many of the phases as possible. This inevitably means that the procurement boys are in for a rough time.

The designers have not been at their task long before they are on the phone to Procurement asking for information about the availability of some new metal that would

(Continued on page 74)



COMPLETED ORENDA, as shown above, is now being fitted to Avro Canada's CF-100 all-weather fighters, and to the F-86 Sabre jet as built by Canadair Limited of Montreal.



YEARS
1
2
3
4
5
6
7
8
GENERAL SPECIFICATIONS AGREED
FIRST EXPERIMENTAL ENGINE
FIRST FLIGHT TEST
QUALIFICATION TEST
ENGINE RELEASED TO PRODUCTION
COMMENCE PART MANUFACTURE
COMPLETE FIRST PRODUCTION ENGINE
REACH PEAK PRODUCTION
UTOPIAN SCHEDULE
INITIAL DESIGN AND BUILDING OF FIRST EXPERIMENTAL ENGINE
TEST AND DEVELOPMENT PRIOR TO FIRST TEST FLIGHT
BUILDING OF MORE EXPERIMENTAL ENGINES AND DEVELOPMENT UP TO QUALIFICATION TEST
PLANNING, TOOLING - UP AND TOOL PROVING
PART MANUFACTURE
BUILD - UP TO PEAK PRODUCTION RATE PLUS SPARES REQUIREMENTS
PROCUREMENT ACTION DURING EACH PHASE
INVESTIGATE SOURCES OF SUPPLY OF NEW MATERIALS
PROCURE SAMPLES OF NEW MATERIALS
ARRANGE DESIGN SUB-CONTRACTS
PROCUREMENT OF SMALL QUANTITIES OF EXPERIMENTAL PARTS, MATERIALS, TOOLING AND TEST RIGS
PROCUREMENT OF TOOLS AND MACHINE TOOLS
PLANNING OF PURCHASE ORDERS & SUB-CONTRACTS FOR PRODUCTION QUANTITIES OF PARTS & RAW MATERIAL
CONTINUED PROCUREMENT OF PARTS AND MATERIALS IN PRODUCTION QUANTITIES
TELESCOPED SCHEDULE TO MEET AIRFRAME AND DEFENCE PLANNING REQUIREMENTS
INITIAL DESIGN AND BUILDING OF FIRST EXPERIMENTAL ENGINE
TEST AND DEVELOPMENT PRIOR TO FIRST TEST FLIGHT
BUILDING OF MORE EXPERIMENTAL ENGINES AND DEVELOPMENT UP TO QUALIFICATION TEST
RELEASE ADVANCE DRAWINGS OF MAJOR COMPONENTS FOR PRODUCTION STUDY
PLANNING, TOOLING - UP AND TOOL PROVING
PART MANUFACTURE
BUILD - UP TO PEAK PRODUCTION RATE
CONTINUED PRODUCTION
PRODUCTION OF SPARES FOR MAINTENANCE AND OVERHAUL
SCHEDULE OF MANUFACTURER OF PROPRIETARY COMPONENTS FOR ENGINE
DESIGN AND DELIVER FIRST PROTOTYPE
DEVELOP AND DELIVER MORE PROTOTYPES
TOOL - UP FOR PRODUCTION QUANTITIES
PRODUCE PRODUCTION PARTS
BUILD - UP TO PLANNED RATE
CONTINUED PRODUCTION
SPARES
AIRFRAME MANUFACTURER'S SCHEDULE
FIRST ENGINES REQUIRED FOR TESTING IN AIRFRAME
FIRST PRODUCTION ENGINES REQUIRED
PRODUCTION QUANTITIES REQUIRED

sibility of other logistics staffs. These include:

(a) Emergency and safety equipment
(b) Chemicals, textiles and metals
(c) POL, heating and packaging
(d) Mobile equipment
(e) Hospital supplies and equipment
(f) Barrack equipment
(g) Clothing
(h) Shop equipment
(j) Hand tools
(k) Ground handling equipment
(l) Musical instruments.

SEGO is responsible for all logistics aspects pertaining to this equipment.

JET ENGINE PROCUREMENT

(Continued from page 51)

be ideal for the job, if the supply and price were right. Of course, whenever possible it must be a Canadian source, which adds to Procurement's task. Soon the requests come along for samples of the proposed materials which can be sent to "the lab" where they will be subjected to tests of all types to see whether they will meet the demands of the new engine.

Once the design takes shape, it becomes necessary to bring the probable manufacturers of special proprietary components, such as fuel controls, starters, etc., into the picture, so that they can proceed with advance designing and planning. Their schedule is even tighter than ours, as they must deliver their products with enough lead time for us to meet our own delivery schedules. The procurement team have to arrange all the necessary subcontracts and purchase orders.

Soon the first experimental engine is being assembled and the demands come in for small quantities of materials, for parts, tools and test rigs, etc. The laborious task of testing and developing the design has begun. Before the engine can be submitted for its Qualification Test, it must log approximately 8,000 hours of test-bed running and a further 2,000 hours of flight test. During this phase there is not much "volume" buying to be done, but rather a lot of small difficult items, generally required "yesterday!"

It is at the commencement of this testing phase, that we come into contact with something that is to become our constant companion once the design is released to Production, the Design Change Notice.

From now on, Procurement will be in the thick of it. Agreements must be reached with Production as to what will be bought out, and what made on the premises. Then tentative schedules of delivery for both raw materials and finished parts are arranged, first with the production team and then with the selected suppliers after tenders have been submitted.

During this time, requests are coming in for tooling of all kinds, machine tools and equipment, some of which may take up to 18 months to procure. Unfortunately, until the engine has passed its qualification test, nothing is concrete and changes come along at short notice.

Then comes the day when the engine has passed its qualification test and is officially released to Production. Production schedules become firm, and the tremendous task of placing the necessary purchase orders begins. Then follows the expediting of parts and materials to the all-important schedule, remembering constantly, that it only needs one part behind schedule to set back the whole program. The engines cannot fly until they are complete. Procurement are frequently called upon to make spot buys of parts which are scheduled for manufacture in the plant, but which are held up due to delays in machine tool deliveries, etc. Under such circumstances a source of supply has to be found quickly and a crash schedule of delivery arranged.

Once the design has passed its test and been accepted, all major changes are then subject to the formal approval of the customer. For this purpose, the "Engineering Change Proposal" is brought into use so that all the facts, both technical and financial can be fully set out. Prior to this time changes were mainly at the discretion of the company's engineers. No procurement action on changed parts can commence until formal approval has been received.

Each design change to a bought-out part usually means an adjusted schedule and a fresh round of negotiation with the supplier regarding prices and deliveries, but no matter what else happens, deliveries must keep pace with production requirements.

So far we have only concerned ourselves with our own schedules, but the schedules of both the airframe manufacturers and the customer are subject to change when conditions so demand. Any such change is bound to cause another round of re-scheduling within our own area with all its consequences to Procurement.

Having started the production line well on its way, the task does not lessen; at this stage the requirements of spares for both maintenance and overhaul purposes become known. All of these are tied to delivery schedules of their own, which must be met just as definitely as the production schedules, otherwise engines in service will be kept out of use.

Design changes in turn affect spares in many cases and require Modification Kits for fitment to delivered engines, some of which may be grounded until the kits are available — all of which tends to play havoc with the delivery schedules.

As you can see, the task of procurement is not an easy one, especially when the problems of meeting a schedule are complicated by having two or more different engines going through the same cycle of events but a year or so out of phase.

Once the engines get into service, they are subjected to operating conditions which could not be duplicated under any other circumstances; this again is likely to produce requests to change the design of some component, and so the whole cycle of events begins again.

All of this adds up to the fact that a procurement organization in an aircraft engine plant must be as flexible as possible and prepared to perform impossible feats of delivery at a moment's notice.

TCA VISCOUNT

(Continued from page 54)

Certain changes have been made to the engine to facilitate low temperature starting. These were (a) use of a synthetic low viscosity lubricating oil, (b) redesign of flame interconnecting tubes, and (c) introduction of high energy ignition. With these changes it will be possible to start the engine at 30 deg. below zero after soaking for 12 hours at that temperature.

Automatic flame temperature control has been developed to considerably reduce the load on the pilot under warm temperature conditions. Formerly, manual fuel trim was necessary in order to guarantee that engine temperatures were not exceeded for air temperature above standard.

The standard Viscount fuel system in use on European airways was changed for TCA to give each of the four engines an independent fuel supply, while at the same time permitting inter-engine connection and cross feed if desired. In order to cope with the possibility of ice crystals forming in the fuel system, an automatically controlled engine fuel heating system was developed. The Dart engines will use wide cut gasoline, JP-4 fuel, both for economic and safety reasons. This fuel is standard on military turbo prop aircraft, but TCA will be the first airline to use it. JP-4 fuel is at least 10% cheaper than kerosene. TCA decided against kerosene because of the unknown factors, such as static electricity, effect of lightning and other things from a safety standpoint.

A pre-select type of pressure filling has been installed for the water-methanol system. This, along with the standard pressure refueling sys-