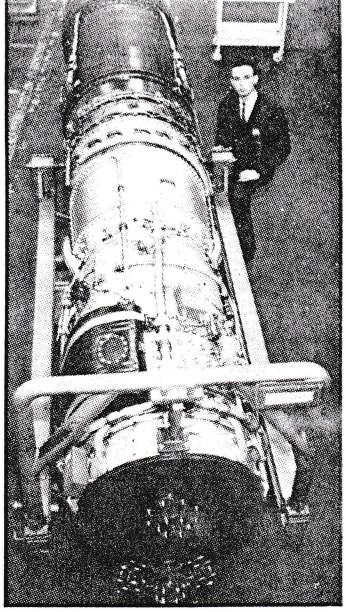
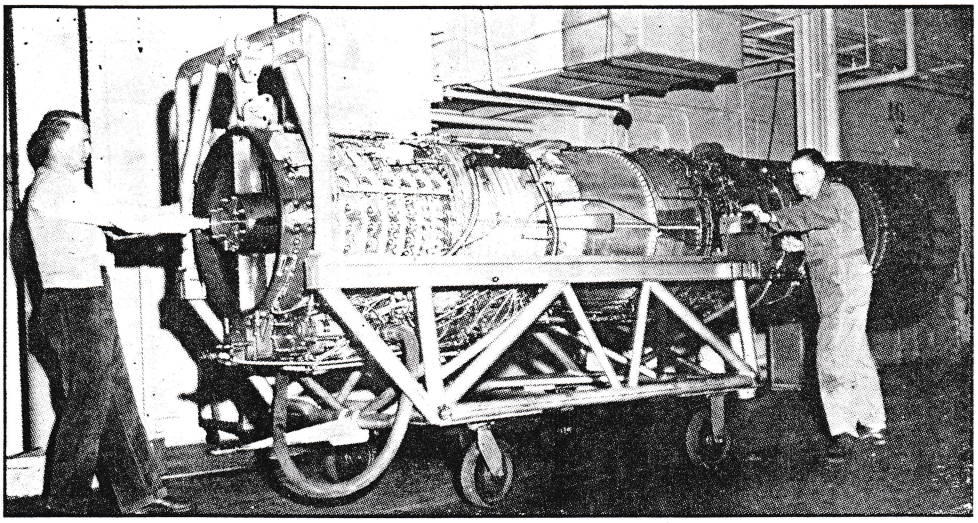
General Electric Power for the RCAF's Starfighters

15,000 pounds of J79-GE-7 thrust propel F-104G at Mach 2 speeds



Scale of J79 engine is evident in this photograph. Shown is a -2 model. RCAF F-104's will have -7.



Engine at left is a J79-7, the same type that is to be manufactured in Canada by Orenda Engines Ltd.

GENERAL Electric's J79 engine bids fair to repeat the success story of an earlier GE product, the workhorse J47, which powered the F-86 Sabre, Boeing B-47, the B-45 and provided the supplementary jet power for the giant Convair B-36 intercontinental bomber. At the present time, the 15,000 lb. thrust J79 is in service as the power package for the F-104 Starfighter, B-58 Hustler, A3J Vigilante, the McDonnell F4H, the F11F-1F Super Tiger, as well as the Regulus II missile. These last two mentioned are presently scheduled for operational use in the early 1960's.

The particular model of J79 which is to come into service with the RCAF's F-104G Starfighters, is the J79-GE-7. The differences between this engine and the J79-3A which powers the F-104A's presently in use with the USAF's Air Defense Command squadrons, are slight. In the J79-7, the turbine diameter is slightly larger than that of the J79-3A, reputedly giving an increased efficiency to the engine. Second major difference lies in the fact that diameter of the J79-7 afterburner is slightly larger than that of the J79-3A, giving an increase in engine efficiency at high altitude.

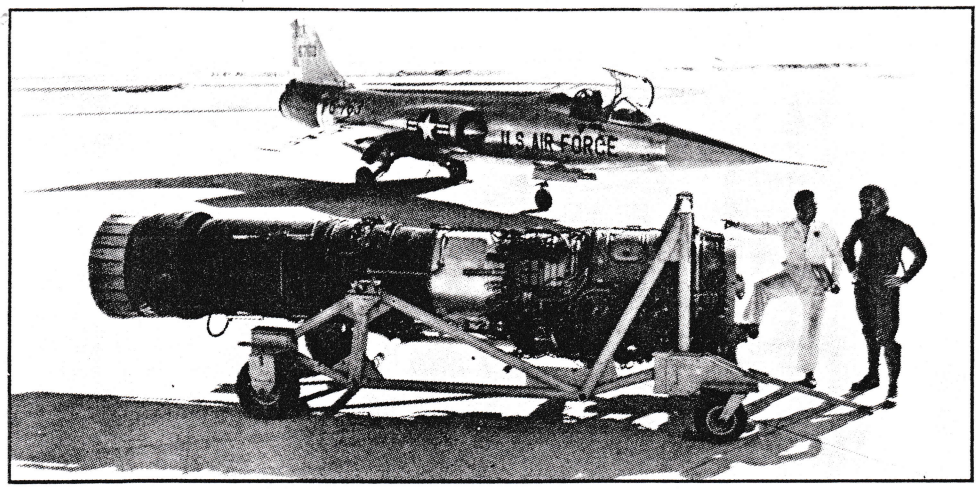
Other physical differences that are not classified as secret are: a new control system in the J79-7 having a greater degree of design simplicity and reliability; a split combustion casing for easier inspection and maintenance.

Five to One: The engine weighs approximately 3200 lbs., and is rated at 15,000 lbs. thrust. Frame size is 32 inches; overall length 204 inches. It has a 17 stage, axial flow, single-rotor compressor with a pressure ratio of 12:1. The first six stator stages and the inlet guide vanes are variable to assure performance over a wide range of flight conditions.

The rotor consists of thin webbed discs and spacer rings bolted together with the blading attached to the rim sections by conventional dovetails. For convenience in maintenance and inspection, the top and bottom sections of the compressor casing may be removed. Anti-icing is supplied for inlet guide vanes and struts by compressor discharge air.

The turbine is three-stage, with the turbine wheels being coupled to the compressor rotor by a conical shaft for low weight and high strength. This conical turbine shaft can transmit up to 70,000 hp at maximum rpm, yet weighs much less than equivalent cylindrical shafts of the same torsional strength. The lightweight turbine casing consists of fabricated sheet metal split for easy access in routine inspection and maintenance.

Two Systems: The power control system on the J79 has two separate and distinct fuel systems: main fuel system; and afterburner fuel system. Both systems feature flow controlling type units. The hydro-mechanical control system has electrical trim with hydraulic and electric power required to operate the system being supplied by



The engine/airframe combination that brought the absolute speed and altitude records back to the U.S. is shown here.

the engine. This makes the complete engine control system integral with the basic engine.

Comprising the integrated and synchronized composite system are: (1) main fuel system; (2) afterburner fuel system; (3) nozzle area control system; and (4) variable stator control system, which is integrated with the main fuel control.

The afterburner features a fully modulated, variable area with a converging-diverging exhaust nozzle. This provides, automatically, optimum engine performance for all flight conditions.

Variable Pitch Stators: Of particular interest is the fact that the J79 is the first operational jet engine to employ the principle of variable stator blades in the engine's compressor section. High pressure ratio engines have posed many design problems, the greatest being the design of the compressor. The fundamental problem exists not at the design condition (i.e. high speeds) but during off-design operation (i.e., low speed and acceleration). It is here that excess air tends to disrupt the smooth flow pattern and induce compressor stall.

Use of the variable stator achieved the objectives of design speed efficiency and stall-free, low-speed operation and acceleration. Prime advantages of this system are: (1) reduced stall problems at low engine operating speeds; (2) maximum compressor efficiency under all flight conditions; and (3) optimum match of engine and aircraft induction system for good stall margin at Mach 2 speeds.

The choice of variable stator as opposed to the dual-rotor rigid blade concept, permitted GE engineers to use the slimmer and more efficient single-rotor design requiring only three main bearings. The design of the actuation system for the variable stators utilizes fuel pressure from the fuel control, and is automatically scheduled as a function of engine speed and compressor inlet temperature. This relieves the pilot of any need to directly control the variable stator mechanism.

Exploiting Opportunities: Lightweight opportunities afforded by the variable stator single-rotor design have been exploited to the utmost. New techniques in sheet steel welding were applied, not only to achieve light weight, but also as a remedy for excessive thermal stress and warping.

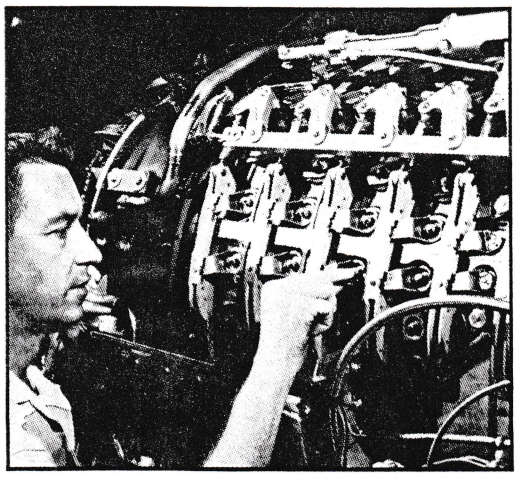
Basically, the structural configuration uses three bulkhead sections: front frame; compressor rear frame; and turbine frame, as support and alignment members. Mounting loads and bending stresses are imposed on the outer shell of the engine, eliminating the need for weighty internal support structures as buttresses to the over-all engine strength and rigidity.

The J79 was put into volume production in 1957. Prior to this however, it had performed for the first time in Lockheed's new F-104 Starfighter, with its first public demonstration flight being held in April 1956. Six months later four J79's powered the maiden flight of the B-58 Hustler.

The engine came into operational service in February 1958, when it joined the USAF's Air Defense Command with the first squadron of F-104 interceptors. Today there are four operational Starfighter squadrons in the Command, with two different models of Starfighters, the Sidewinder-armed A's and the M61 Vulcan machine gun equipped C's. Two other current production models are both trainer versions seating two in tandem.

The F-104G model destined for the RCAF, will likely be fitted with the M61 for its tactical ground support role in Air Division.

Licensing arrangements for the manufacture in Canada of the J79-7 engine to power the RCAF's F-104G's, are being handled entirely by Canadian General Electric Co. Ltd.



A GE technician makes an adjustment on one of the unique variable stators of the J79 jet engine.