B-47 landing with its drag 'chute will soon be a familiar sight to Canadians living in Toronto, Montreal and Ottawa. This will be used as the flying test bed for Orenda's PS-13 engine which will be slung in a pod down on the side of the rear fuselage.

Orenda to fly its power giant

Orenda's new 20,000 plus thrust (including afterburner) PS-13 twin-spool 60% titanium engine will probably soon go into service as one of the most powerful turbojets in the world.

Slated initially for production models of the new Avro CF-105 supersonic successor to the CF-100, it's already being eyed by the RAF, USAF and US Navy as a power plant for both fighters and bombers.

It will get its first airborne tests this fall in the B-47. Canadair is building a special pod modification on the fuselage aft of the wing on the test craft to give the PS-13 a flying test bed clear of wing turbulence and easily serviceable.

In the air Orenda engineers will determine operating efficiency at various altitudes and power settings; efficiency of fuel systems, compressor stages; as well as detecting possible blade vibration faults.

By VICTOR KOBY

Orenda Engines Ltd. will be pacing the future when it starts flight testing its new engine this fall in the specially modified B-47 jet bomber.

As Orenda test pilots Mike Cooper-Slipper and Leonard Hobbs close the canopy for their first test flight the eyes of the world's air forces and aeronautical industries will be watching.

For these two men will have the responsibility of flight testing one of the most powerful jet engines the world has yet to see (for it's still wrapped in security).

▶ **Pay Off.** After almost two years' static screaming in padded test cells at Orenda Engines, Malton, the engine will be considered of sufficient reliability to put into the air this fall.

Then come the first hurdles preliminary to hours, weeks and months of operating analysis, trouble shooting and improvements.

These hurdles will be: an initial flight rating test to show what thrust power the engine will give at various altitudes as compared with engineers' predictions; and a 50-hour endurance test to prove the engine is as rugged a product as the thousands of smaller Orenda engines now in service.

▶ **Why Use B-47?** This aircraft was chosen because it was the only one which could approach the speed of sound, fly the test engine safely at full power and at the same time carry the large quantity of data measuring and recording equipment needed.

No fighter could meet all these requirements. Also the B-47 is a proven aircraft and was available.

Flight testing is not to prove the engine will run. This has been done. But what will be the effects of atmospheric pressure at 34,000 ft.—one quarter of sea-level pressure? What will be the effects at 53,000 ft. when the pressure drops to 1/10 of sea-level pressure? These are the unknowns.

- Low pressure at altitude will affect the flow of air through the engine and when you reduce air flow you reduce fuel flow. The metering out of fuel in small quantities then becomes a critical problem that can only be tested at altitude where the mass flow is reduced and the engine performs sluggishly.
- Another control system to test is that supplying fuel to the afterburner. Low pressure means low afterburner efficiency without changes in fuel to air ratio.
- At altitude the incoming air is colder but there's less of it so the cooling effects of the incoming air vary as altitude increases. Changes in temperature of engine component parts can change the aerodynamics of the engine. Flight testing will show where the balance is, at what altitude for various power settings, between the cooling ability of the air and the air temperature.
- To determine the degree of blade vibrations, altitude flights are necessary because only then will it be possible to produce the vibrations caused

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Orenda's Giant

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by lower temperatures and ram pressures across the compressor at low power settings.

▶ **Black Boxes.** To accurately carry out the job of measuring the performance of the engine has called upon all the ingenuity of Chief Performance Engineer George C. Best's group who will have to analyze the results of the measurements.

In front of a special panel containing all standard and special jet engine instruments will be mounted lights and a fixed camera. This will be sufficient for readings which vary at no greater than movie camera speed.

But for such rapid changes as fuel system pressures and the movement of actuators for the nozzles which control exhaust gases, an oscillograph recorder will be used.

This will be no ordinary pen oscillograph. A transducer will change pressure changes and movements into voltage changes which—using a galvanometer, mirrors and a beam of light—will record at high speed on rapidly moving photographic paper.

Another method: because of the high frequency of blade vibrations at the compressor stage only an oscilloscope (with "Y" sweep) can show changes in the frequencies. The light on the scope will be recorded on photographic paper moving in front of the scope.

To determine what the frequencies are and seek the cause of vibrations and stresses of various parts of the engine and blades, strain gauging will be carried out.

No attempt will be made to make these readings in the aircraft because of the amount of high accuracy equipment needed. Instead, they will be transmitted to ground receivers as electrical pulses. (Range of this equipment is about 50 miles.)

▶ **Analysis.** To make head or tail of the results of all this testing would take months if not years done by slide-rule—too slow if they are to contribute to minor modifications of engines in production for waiting airframes.

The solution: electronic brains spewing out answers in minutes. It's planned to put in a system to convert quantity measurements into voltages which will by pulses be translated into digits. These in turn will be fed onto tapes ready for the IBM 650 computer which is on order now. (Orenda already has IBM CPC computers.)

This flight testing will probably go on for two years—as the Orenda was tested.