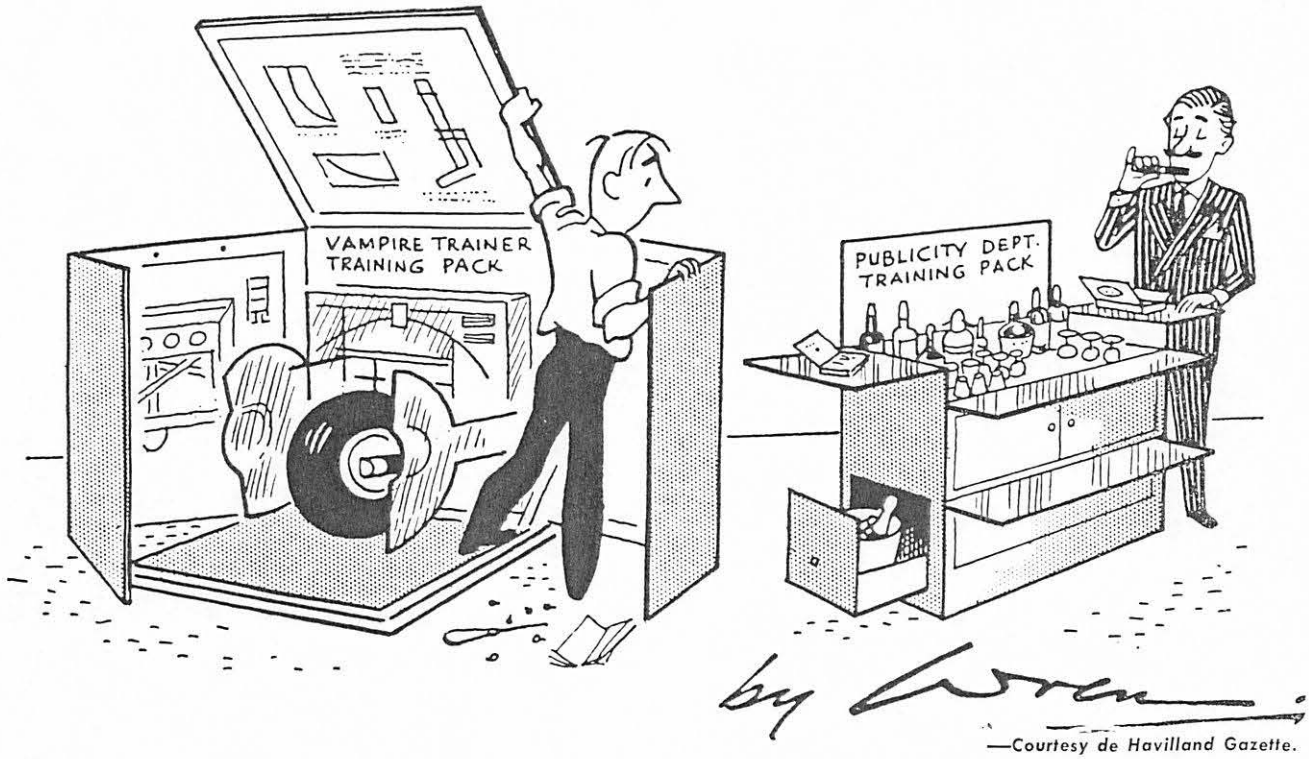


—Courtesy de Havilland Gazette.

Aircraft Systems Trainers

By HARRY McDOUGALL

IN AVIATION, as in any other industry, complexity can breed confusion unless training methods keep pace with the latest techniques.

The days when a man could study a pocket size manual and gain a thorough knowledge of a complete aircraft have long since passed. Visual training aids, training manuals, even lectures illustrated by slides and films are barely adequate to instruct the Air Force technician on the increasingly complicated systems used in modern jet aircraft. The need for a more practical approach has resulted in the development of "Aircraft Systems Trainers"—the most efficient training aids yet devised.

Easy to See: The systems trainer is basically a rig incorporating all the prime components of an individual system, each component connected to the others in such a manner that the operation of the complete system can be simulated so as to be readily understood by the student.

To simulate the operation of complicated fuel systems, power operated flying control systems, hydraulic systems, etc., calls for considerable ingenuity on the part of the designer, particularly as the trainer must be made reasonably portable to facilitate transportation and must operate from any Hydro outlet.

A set of Aircraft Systems Trainers was recently designed and built by Avro Aircraft for delivery to the RCAF to facilitate training on the CF-100 aircraft. The trainers comprise five groups: airframe group; aero engine group; munitions and weapons group; instrument and electrics group; and telecommunication group. By the use of these trainers and their associated diagrams, the operation of virtually every system in the CF-100 can be taught in the classroom, so that when the student begins work on an aircraft, he need only familiarize himself with the physical location of the components.

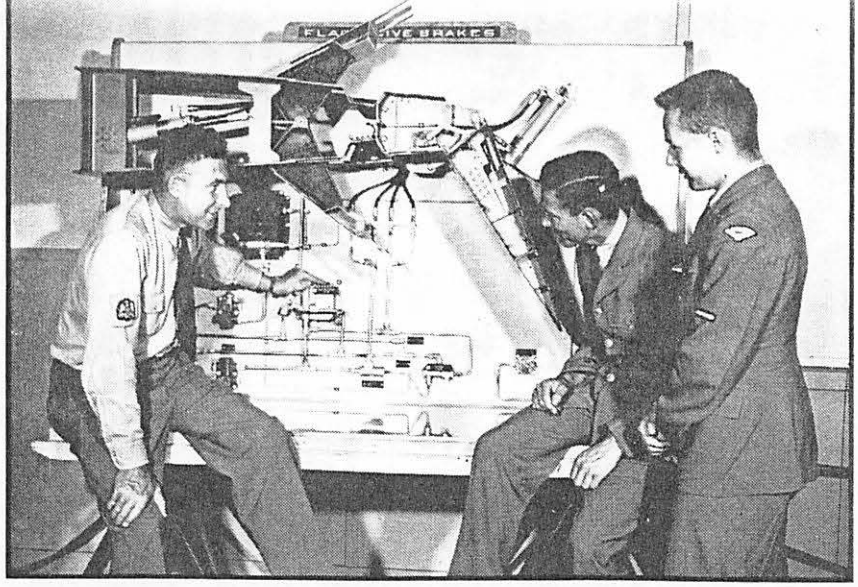
Each group of trainers draws power from Westinghouse rectifier units which convert the normal Hydro power to the equivalent of that supplied to the systems in the aircraft.

Hydraulic power is supplied by a separate unit which is normally installed outside the classroom where the noise of its operation will not disturb the lecturer. Certain of the Trainers must be inter-connected—thus the Flying Controls Trainer must be operated through the Hydraulic System Trainer.

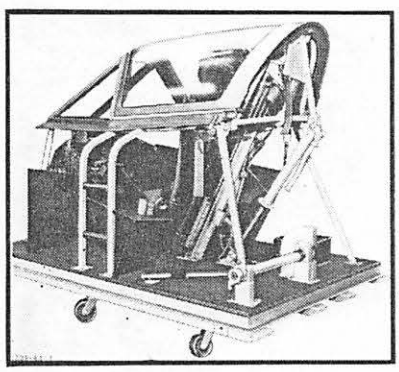
Basic Components: With a few exceptions, each Trainer consists of a baseboard and a vertical panel to which their individual units are attached. Sockets are provided in the baseboards to receive quickly detachable castoring wheels.

The largest group of Trainers is that comprising the airframe group. The main feature of the Trainer used to instruct students in the operation of the flying controls is an aileron installation which is also representative of the other hydraulically assisted controls. This is not identified with any particular circuit in the aircraft but is intended to show how the hydro booster units are installed and demonstrate their method of operation.

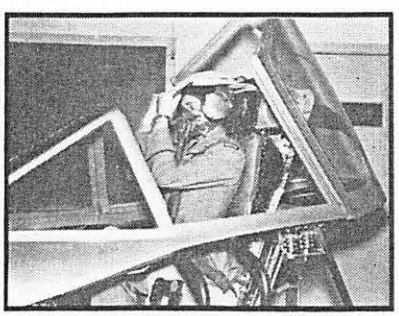
Two dummy control surfaces, representing the ailerons, are mounted across the upper part of the Trainer on hinge brackets. Immediately beneath them are the hydro-booster units. One unit is operative either manually or by hydraulic power. The other is sectioned to show its internal operation and is manually operative only. The Trainer incorporates a control pedestal complete with handgrips. By a system of chains and cables representa-



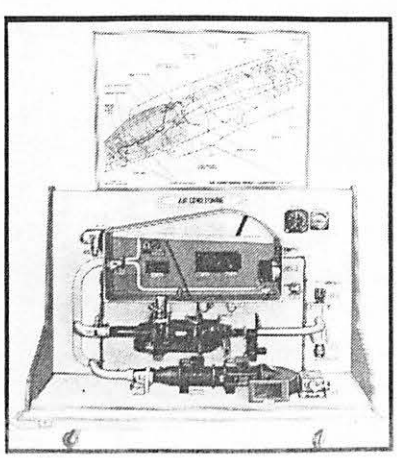
Top, with help of mobile training aid, airmen receive instruction on CF-100 flap & dive brake operation.



Above, an ejection seat trainer, comprising a real ejection seat installed in a CF-100 cockpit mock-up.



Above, practice ejection in trainer. Below, CF-100 air conditioning system trainer with sectioned parts.



tive of the control runs in the aircraft the necessary movement can be imparted to the hydro boosters to demonstrate their function.

Power Supply: When the Trainer is prepared for use, the pressure and return lines are connected to a pair of couplings on the Hydraulic Power Supply Trainer. The controls then function in the same way as on the aircraft.

The controls can be demonstrated with power "on" and the operation of the hydro boosters becomes apparent so that the student can readily see how they assist the manual efforts of the pilot. The lecturer can also demonstrate the effect of loss of hydraulic power, then end the sequence of operations by disengaging the boosters and reverting to manual control. Warning lights which operate exactly as they do in the aircraft are incorporated into the Trainer so that the pupil knows precisely what indications the pilot has at each stage in the sequence.

In addition to the powered controls, the operation of the trimmer tabs can be demonstrated by means of a mechanical assembly comprising Teleflex controls, chain and sprocket drive and trimmer screw jacks.

Blow by Blow: The Air Conditioning Trainer is a virtually complete representation of the aircraft system. The centre portion of the Trainer represents the cabin of the aircraft. The cabin pressure regulator, and all relevant valves and switches are installed in approximately correct relationship. The blower, refrigeration unit and other components are installed outside the cabin, with piping connecting all the units in correct sequence.

No attempt has been made to simulate the flow of air but all the controls and the relevant instruments are incorporated into the Trainer to facilitate instruction.

Most of the components are sectioned, since an understanding of the operation of a modern aircraft air conditioning system depends largely on an appreciation of the function of each individual component as well as of the system as a whole.

Suspended above the trainer is a large diagram showing where each component is located, so that the student, having learned the operation of the system can readily find each individual component on the actual aircraft.

The components are wired as they are in the aircraft so that any selection of the switches produces the desired effect. Thus the student, on making a selection, can actually watch the component working and can see how each operates in conjunction with the others to produce the required effect.

Toss-up Teacher: The Seat Ejection Trainer is used to instruct both flight and ground personnel. It simulates the action of both the canopy jettison and seat ejection except that on ejection the seat makes only a token upward movement of a few inches instead of throwing the pupil through the roof (!!).

An ejection seat is installed inside a dummy cockpit. A set of shock cords, adjustable for tension, serves as a substitute for the cartridges which normally fire the seat from the aircraft. The shock cord mechanism is connected to a safety handle outside the cockpit this being to prevent the pupil from attempting to eject before the canopy has been jettisoned. The safety handle must be released by the instructor.

A CF-100 canopy, suitably sectioned is fitted to the Trainer and is made to operate from the same controls as in the aircraft. As there is obviously no "slipstream effect" in a classroom, the action of the airflow is simulated by a mechanical system.

The interior of the cockpit is fitted with dummy flying and engine controls so that the complete canopy jettison and seat ejection drill can be taught.

Fuel Flow: The Fuel System Trainer is different from the others in that its prime function is to teach fuel flows under various phases of flight rather than the mechanical operation of individual components. The front of the Trainer is a large panel in the shape of an outline of the aircraft. On the panel is a simplified representation of the fuel system, each line, valve and

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previously carried out had involved the replacement of a fuel pipe seal which had been seeping due to being cut during assembly, and the changing of a refuelling actuator. Up till the time of arriving at Montreal, each engine had used only about two pints of lubricant.

The final leg between Montreal and London was eventually completed on December 28, when the Comet flew non-stop over the 3,350 miles in 6 hrs. 8 mins. at an average speed of about 548 mph. A further ten minutes were used to make a GCA landing.

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pump being identified. The lines are shown as cutouts, covered with a coloured transparent material. Behind the lines are installed lights which, when illuminated, can be made to show various fuel flows.

All the fuel system controls, switches and warning lights are installed on the front of the panel, together with the relevant circuit breakers.

A key to the coloured lines is shown at the top of the Trainers. To demonstrate any particular fuel sequence the instructor makes the appropriate selection on the control panel. The action illuminates the lights which, by shining through the transparent material show the particular lines along which the fuel would be flowing.

On the rear of the Trainer are suitably sectioned examples of each of the components installed in the system. These can be removed and passed around the class for closer inspection.

The Consumer: The Engine Fuel System Trainer comprises all the component parts of the system, some suitably sectioned, and pipes representing the fuel lines from the tanks. A single combustion chamber, also sectioned to assist the instructor in explaining the system, represents the engine. The pipes are colour coded to indicate fuel flows.

Blaze Away: For the Fire Extinguisher Trainer, a miniature model of one of the nacelles was constructed, the skin being cut away to expose the firewall, spray rings and some of the fire detectors.

A photograph of the relevant controls is located on the face of the Trainer. On the rear of the Trainer is a carbon dioxide bottle which is tied into the system and is operated through a solenoid operated valve. The instructor controls the Trainer by means of a rotary handwheel. When this is turned it simulates a fire by illumination through coloured panels. When the illumination reaches a certain intensity the fire warning light is illuminated. The instructor then presses the extinguisher operating switch, discharging carbon dioxide through the spray rings. Simultaneously the lights go out representing extinction of the fire.

To assist the instructor in lecturing with the Trainer, a set of transparencies is supplied. The transparencies are reproductions of illustrations in the Canuck operating manuals. These are particularly useful in instructing on electrical systems, since the circuits can be projected on a screen large enough to be shown to the entire class at the same time.

A prime feature of the Air Systems Trainers is their portability. A crate cover is provided to protect each Trainer in transit. After removal, the cover can be collapsed and stored flat. The entire set of Trainers is readily transportable by air.

CANADAIR

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Development, and Dynamic Analysis Groups, and works closely with the Automatic Computing Group in a three-way attack on aircraft and missile dynamics problems.

Automatic Computing: This group functions essentially as a staff service to Engineering; any engineering problem which can be more quickly and conveniently solved on the machines is funneled into one or the other of the computers.

Electronic Standards: This lab provides a medium for checking and calibrating electronic test equipment and gauges used by Quality Control and Manufacturing departments.

Materials & Process: Under the jurisdiction of the Engineering Div., the Materials & Process Laboratory also carries out many functions of a production nature. Its functions include raw material testing, process control, and trouble shooting.