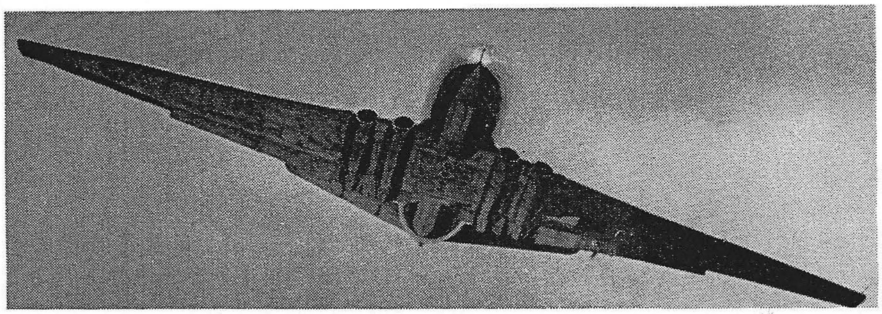

TEST FLYING JET PLANES A PROBLEM IN PRECISION

By D. D. "Des" Murphy
Test Pilot, Dept. of Transport

WITH the high altitudes and speeds made possible by jet-powered aircraft, new problems in stability and test methods are constantly presenting themselves. Knowledge seems to be quite a bit behind experience and not too sure which way to go.

It has been found that stability changes with altitude to a greater extent than was anticipated: aircraft which are stable in every way at lower altitudes often become either neutrally stable or definitely unstable at higher altitudes. This makes it difficult to assess stability in a climb. With high performance aircraft, longitudinal stability in climb becomes difficult to check because of very rapid changes in altitude which changes trim and affects stability. This is further complicated by the rapid fuel consumption which can also affect trim if the fuel is not located on or very near the CG position.

To overcome this, the following methods are becoming the generally accepted ones throughout the United Kingdom. This may, of course, be due to the influence of the Royal Aeronautical Establishment and the Empire Test Pilot's School at Farnborough from which all test pilots interviewed were graduates:

(i) Obtain the stick-force to change speed and note the variation with the trimmed speed. This test must be carried out at a series of speeds and altitudes. It has been found, for instance, that an aircraft may be quite stable at a high trimmed speed and unstable at a low trimmed speed at the same altitude, and vice versa. Care must be taken to eliminate the effects of control friction in all stability tests involving measurements of stick force. If any exists in the system, it can be eliminated by holding the speed with the controls and trimming enough to remove the friction only.

The design of control systems that will be to the greatest possible extent free of control friction is becoming increasingly important in order to enable high-speed aircraft to comply with modern airworthiness qualitative performance requirements.

(ii) Measure Stick Force versus "G." This must be carried out over: (a) A range of "G" to check linearity; (b) Of speed; (c) Of altitude.

(iii) Measure "G" on releasing stick from a dive with the airplane trimmed for various values of flight speed. The effect of altitude and trimmed speed must be carefully noted.

(iv) Check for phughoid oscillation.* (Less importance is now being given to this test than formerly, but it has been found that if the others are positive, this will be also; if one or other of the above tests are neutral or negative this test will be generally unsatisfactory or at best neutral.)

(v) Measurement of stick forces versus trim. This method is being employed also as a method of assessing stability. The AS is held constant by the stick and nose up and nose down trim is applied until a stick force of 20 lb. or so is obtained. The advantage of this is that the great losses or gains of altitude attained in the stick force to change speed method are avoided.

At Boscombe Down, in England, it was considered essential that static stability should be the same at high altitudes, but some fall-off toward neutral dynamic stability is permissible. (Dynamic stability seems to be more critical at altitude because at high Mach numbers increases of speed increase nose-down tendency.) They also stated that in the stick force vs. "G" tests, stick force tends

ABOVE: The D-H Comet, pioneer jet airliner. The author surveys special features of test flying this new breed.

LEFT: John Cunningham, D-H chief test pilot, is one of the most experienced "jet jockeys" in the business.

* *This is a long-period oscillation common to most aircraft. It is a gentle movement, comparable to an ocean swell.—The Editor.*

to become neutral at high altitudes. At the moment this is not considered too serious although not desirable. Any tendency, however, toward reversal viz., tendency to tighten up in turn, is not allowable and modification is required.

Tailplane and fin design are severely critical for stability. As an example, the Meteor tends to become unstable at high Mach numbers with the standard stabilizers. Experiments are being carried out now with thinner-cambered tailplane from an experimental Gloster airplane, and much higher Mach number speeds can be attained without pitching.

Directional stability is very critical on high-speed aircraft. Nearly all such airplanes at first have a tendency to hunt or snake. This can be dangerous, particularly if it approaches a short period oscillation frequency. Nearly all of the high-speed jet airplanes the writer saw in the U. K. had corded trailing edges of rudders.

This snaking sometimes is caused by lateral instability which causes what is called "Dutch Roll." This is a roll to one side with a yaw to the opposite. I have been told that on U. S. jet aircraft with power-assisted controls a gyro-controlled rudder counter movement has been employed to control this flight phenomenon. Aerodynamic balancing of control surfaces becomes critical at high speeds and altitudes, in that controls tend to become overbalanced. It has been found that ice accretion on the the balance has caused dangerous over-balance and loss of control.

There is a growing opinion that **power-operated controls** will be necessary on high-speed aircraft, and experiments are being carried out in most places the writer visited. Experiments with servo controls are under way at Farnborough. Both these systems have serious drawbacks in respect of "feel" and make the assessment of stability extremely difficult to attain.

In some cases artificial feel by spring tensions is provided, and while this is of some assistance to the pilot, its major drawback is that the same feel is provided regardless of the speed of the airplane. This can be dangerous at high speeds when the same stick force required for control at lower speeds will produce excessive loads on the structure at high speeds.

In so far as power controls are concerned, it was universally agreed that "feed back" in "feel" is highly desirable. It is possible however, that airplanes of the future will be

RIGHT: Canadian test pilots are acquiring the special jet - testing techniques discussed in the accompanying article. The test crew discusses results with Avro's Walter Deisher, extreme right, after a flight in the Jetliner.

fully power controlled and "feel" may be eliminated. In such circumstances pilots will be trained to do without this quality and perhaps to fly entirely by instruments which record forces.

In discussions with the Air Registration Board it was stated that where power controls are installed, the design must be such that the failure of any part will not make the airplane uncontrollable and that sufficient reserve facilities are provided to permit full control to be retained under any combination of failures. The Brabazon, for instance, has two complete power control systems and it is understood that they can be both independent and interdependent in operation. From this it will be seen a tremendous amount of expensive testing will required to establish the airworthiness of the system.

Assessment of stability at high altitudes is difficult, because small increases of IAS produce relatively large increases of Mach No. The range of speed between stall and critical Mach No. is small. Minute changes of throttle setting produce large increases of RPM and it takes a long time for airplanes to settle down to the new trimmed speed.

To find the new trimmed speed is difficult and generally requires some juggling to attain. One method is to increase the speed by very slightly depressing the nose until the new speed (estimated as the accurate one by the pilot) is reached. Then the nose is brought up again and the airplane flown steadily for some time to ensure the new speed is the real one.

The drawback of this method is that airplanes at high altitudes tend to assume and maintain a new speed attained without increases of power. To assess stability properly, trimming at any power and speed must be accurate, especially at high altitudes, and calls for the greatest care and considerable experience on the part of the pilot. The ARB is firm in its opinion that full stability must be obtainable throughout the range of altitudes in which an aircraft will operate and would not approve an aircraft of neutral stability at high altitudes however stable it was lower down.

Tests of stability are normally carried out at moderate altitudes, say 2,000 to 10,000 ft. With the advent of the high-altitude high-speed aircraft it has become necessary to test stability throughout the range of altitudes in which the aircraft will be operated. This is not merely a personal opinion but I have found that consideration is being given to writing some such requirement into

HIGH RATE OF CLIMB PLUS SUBSTRATOSPHERE ODDITIES PRESENT NEW PROBLEMS IN TESTING HIGH SPEED JETS — FIRST OF TWO ARTICLES BY THE D.O.T. TEST PILOT

ABOVE: The C-102 Jetliner has completed 25 test flights and is expected to get its certificate of airworthiness after about 100 more flying hours.

the airworthiness standards of other countries.

Instrumentation for test purposes is becoming increasingly complicated. Attempts are now being made to quantitatively measure qualitative performance. On very large aircraft this is made possible because of space, but is not quite so critical because of the ability of large aircraft to carry more observers; nevertheless it was interesting to note the extensive instrumentation and recording apparatus installed in large aircraft undergoing tests in the U. K.

With small aircraft, particularly single-seaters, the necessity for recording instrumentation is even more imperative to relieve the pilot from the necessity of making detailed quantitative notes and leave him to fly the airplane and to note for later report the more subtle phenomena which may occur at the high speeds and altitudes made possible by turbine power.

It will be appreciated that the noting of such phenomena in time to avoid a dangerous situation and to provide the designer with information, is highly desirable. On most prototype aircraft undergoing a test in the U. K. during the past year, attempts were made to measure stability by means of instruments.

I was advised that there is a strong suspicion that A.S.I. the Position Error of the Airspeed Indicator at very high altitudes is considerably changed from that established in tests carried out in the usual way. Some experiments are being carried out to test for high altitude PE by tracking with radar. I gathered that they are quite sure there is a change in error, but are not yet certain how much.

In the U. K., in all my visits, I met only one or two test pilots who were not Empire Test Pilot School graduates. The ETPS, which has been in operation since 1943, has had the effect of standardizing test-flying techniques and procedures as well as producing a body of exceptionally well-trained and well-informed test pilots.

Although at the time they had their course at the ETPS the test pilots whom I met were serving officers in the RAF, most of them had retired from the service when their tour of duty as test pilot was up and they were posted to ordinary duties at a RAF station.

This trend was not opposed by the RAF, since these men immediately went into industry where, as test pilots of training and experience, their work was still in the national interest. From conversations I had with these men and observation of their work I was much impressed with the standard of training the ETPS had given, especially in respect of the assessment of qualitative airworthiness which does require a sound knowledge of theory of flight. This sort of background of training experience and knowledge is, I would say, mandatory in testing modern aircraft.

The operation of turbine engines is relatively simple for the pilot, that is there are few instruments to watch at present, and with the very few working parts in the engines themselves, the possibility of engine failure is considerably decreased. However, there are problems which yet have to be solved in order to make the turbine engine foolproof.

Turbine engines rotate at very high rpm, viz., up to 15/16,000. The thrust curve of all jets and prop-jets is very flat through the first 2,000 to 6,000 rpm. In this range it is necessary, with the present-type burners, to open the throttles very slowly to avoid resonance. Resonance is caused by an over-supply of wet fuel which continues burning back past the turbine blades and into the jet pipe; this causes severe over-heating, and rapid deterioration, of both. It is the heating and cooling cycles which most severely affect the life of jet engines and it was stated that the length of life is directly proportional to the number of times the throttle is moved. It was also observed that it can be confidently expected that jet engines installed in transport-type airplanes should have a much longer life than in military fighter types, because the power will be changed far less often, and this will be possible also because of the greater fuel capacity and range of action.

At Rolls Royce-Flight Test Airdrome, Hucknall, experiments are being carried out on all problems associated with jet engines. One interesting experiment was adjusting the throttle linkage so that the increase of thrust rather than the increase of rpm was proportional to the throttle movement. This should only be for use with the new Duplex and Duple burners which permit more rapid throttle openings at low thrust and hp.

At high altitudes very small changes in throttle setting produce quite large changes in rpm and thrust. For a fighter pilot this requires giving more attention to engine instruments than is desirable. The use of the throttle system mentioned above permits coarser movements of throttle at high altitudes and with the new burners at low openings.

Re-lighting jets in the air has been a serious problem. It is easy to put the flame out at high altitudes if the throttle is closed too far. It then becomes necessary to descend below 10,000 ft. to re-light. To re-light an engine successfully it is also necessary to slow down as much as the airplane will permit without stalling—other-

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Test Flying Jet Planes

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wise the ram effect gives too much air and also rotates the engine too fast. It is believed the new burners remove this requirement also.

New burners, notably the Duple, are being developed which will permit rougher use of throttle at all points and assure re-lighting up to 25,000 ft. or higher. At an air show at Woodford, W. Heyworth, a Rolls-Royce test pilot, gave an amazing display of flying in a Meteor IV in which he stopped either engine completely by closing off the high-pressure cock, and finally dived at the airdrome, flew across it with both engines out and re-lit both while zooming almost straight up from the dive.

This was possible only by reason of the latest developments in burners. It was amusing to note the utter disbelief of other noted test pilots who were well experienced in the problems of re-lighting. It is understood that Derwent V engines to be supplied to Avro Canada later on, will be equipped with the new Duple burners.

During the climb to high altitudes, the revs. of jet engines tend to "creep" or increase. It becomes necessary to ease back continually on the throttle. New burners and other refinements in the fuel system are under way to overcome this factor.

As far as could be ascertained, axial-flow jets are developing greater thrust than centrifugal compressor types, though some large types of the latter were seen that will develop great thrust. The great advantage of axial-flow jets is of course their small diameter which will permit them to be completely buried in the wings of large aircraft and make installation in fighter aircraft fuselages a simple matter.

Lancaster bombers and Lancastrians are universally used in the U. K. as flying test beds for various types of jet and prop-jet engines. These aircraft are large enough to permit the installation of the great amount of instrumentation necessary and have a high maximum never-exceed speed necessary in the testing of jet engines. It is usual to put the jet engines on the outboard settings, leaving two Merlins inboard. It has been found that a truer picture of engine endurance can be gained from flying test beds than fixed ground ones.

At Derby two full afternoons were spent at the Rolls-Royce engine school where a special instructor was alloted to give an abbreviated course on jet engines, especially the Derwent V. The school is replete with splendidly-sectioned engines and parts, cut away in such a manner as to show their workings to full advantage.

The manufacture of jet engines in all details was observed at Armstrong-Siddley Motors, Coventry, and Rolls-Royce, Derby. During the course of these tours the ingenuity of machining such parts as compressors, compressor and turbine blades was observed. At Rolls-Royce, metals are being developed and cast in their own foundry, modifications to parts which give most trouble are constantly being carried out, providing a constant flow of experimental projects which keep the test beds and staff of test pilots fully employed.

One statement that is worth consideration was made at Derby, viz., "that although jet engines are now quite simple to operate, development leading to more efficiency, especially in fuel consumption, will inevitably lead to complication and more instruments for the pilots to watch."

To Be Continued

New Canadian Helicopter

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No. 6A4-165B3F flat six-cylinder type delivering 178 hp at 3,000 rpm. It has an integral cooling system consisting of a fan and shroud. The cold air intake is mounted in the cooling shroud just behind the fan, so that the resulting ram effect compensates for the ducting losses.

The cockpit instrument panel, of unusual diamond shape, is designed for good visibility. Rotor and engine tachometer are combined in one instrument. It and the manifold pressure gauge are on the horizon level. The Airspeed indicator and engine gauge unit are in the centre row, with the sensitive altimeter and engine oil temperature gauge in the bottom panel. All switches are on the left panel. The carburetor heat adjustment is on the stick and is electrically operated to enable the pilot to apply heat near the ground without taking his right hand from the stick. Mixture control is mounted on the ceiling in front of the cockpit and is accessible to both pilots.

PROBLEM IN PRECISION -

TEST FLYING JET PLANES

SPECIAL PROBLEMS IN TEST FLYING TURBINES AS SEEN BY D.O.T. TEST PILOT

CONCLUDING INSTALLMENT — By D. D. "Des" MURPHY

THERE is intensive research and development of jet engines currently proceeding in the U. K. Several engines were seen which will develop as yet unheard-of thrust and many known engines are now standing up to long periods of endurance.

At Hatfield, advice was given that the Ghost engine had passed the 1,000-hour mark.

The following are some of the points which require care on the part of pilots flying jets:

1. Jet pipe temperatures must be watched carefully. Too-high temperatures cause the turbine blades to creep when combined with high rpm with subsequent failure. Jet-pipe deterioration also occurs.

2. RPM creep up with altitude, must be watched to prevent over-revving.

3. Throttle must be used carefully at high altitudes to prevent over-revving—very small movements produce correspondingly large changes in rpm.

4. Some care is required in lighting the engines to prevent resonance. This requires careful use of the high-pressure cock.

5. Throttles should not be fully closed below 7,000 ft. to 10,000 ft. or flame likely to go out.

6. Re-lighting is difficult above 10,000 ft. and impossible above 15,000 ft. (Note: New burners under development will eliminate last two mentioned.)

The most common cause of failure is broken compressor or turbine blades. Strangely enough, these do not always cause complete disintegration of either the compressor or turbine. Blades have been known to come off axial compressors and go right through the engine without damaging anything else. The slightest vibration in a turbine indicates trouble, and the engine should be immediately shut off by closing the high-pressure cock. Vibration sometimes is so slight and subsequent disintegration so rapid, however, that the pilot does not have time to shut off.

Icing can be a problem and although every effort has been made to find icing conditions which would permit observation of ice accretion, no one has yet found the necessary conditions in or around the U. K. The opinion was given that, particularly in axial-flow jets, should a piece of ice go back through the engine, it would completely ruin the compressor, which in turn would ruin the turbine.

ABOVE—Author D. D. "Des" Murphy, 49, has 30 years of flying experience, joined the Dept. of Transport in 1937, and has been official test pilot since 1940. He recently spent nine months in Britain studying jet testing techniques. Some of his findings are reported in this series.

I have been told that at Mount Washington some icing tests on a turbine engine were carried out and that a 60% loss of power occurred in three minutes. It is generally believed, however, that icing is less of a problem with turbine than reciprocating engines and since the rate of climb of turbine-powered aircraft is great it is easier to get out of icing. This is a point which can only be proven by extensive tests. In any case such aircraft normally operate well above any severe icing.

There has been little or no experience to date in the operation of turbine-powered aircraft in a civil air transport along modern airways systems. Assuming that a turbine-powered aircraft has met modern airworthiness requirements, there yet remain many problems associated with its operation in transport work.

Jet-powered aircraft are only efficient when operated at optimum altitude and speed, because of excessive fuel consumption which occurs at lower altitudes. The reserves of fuel required by modern operational standards is, in the case of jet-powered aircraft, excessive, when sufficient reserve is carried to provide for a missed approach at the destination and diversion to a planned alternate at lower altitude than the optimum for fuel economy.

It was found that in the U. K. that

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Aircraft Industry

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second prototype ready for demonstration flights.

Fred T. Smye, assistant general manager of Avro Canada, summarizes his company's 1950 plans in the following words:

"With limited preproduction contracts for the Orenda and the CF-100 fighters, we are now busily engaged in tooling and in all other respects preparing for their production. We have reasonable assurances that there will be further production contracts soon if the CF-100 proves successful and if its performance comes up to its design specification.

"In 1950 more of our energy will be devoted to production of Orendas and CF-100 fighters or more specifically to the plans and preparations for their production and delivery.

"There will be substantial plant rearrangement, including the establishment of a production layout for the CF-100 and a production shop for the Orenda. Most of the tool design and tooling for both engine and fighter should be completed during the year.

"Materials, bought-out parts and equipment will be purchased and a substantial amount of work should be in progress so that our products can come off the line in early 1951. In fact, the first of the production fighters are scheduled for completion during the latter half of 1950.

"As far as the Jetliner is concerned, this year will be devoted to extensive test flights, construction of the second aircraft and a concentrated sales effort."

During a recent visit to Canada, Sir Roy Dobson, who is a director of the parent Hawker-Siddeley Aircraft group in England and president of Avro Canada, indicated that the know-how of the English group deserved a lot of credit for the achievements at Malton. However, he said, "the operation here is 95% or 98% Canadian right now. Maybe it's higher."

Referring to the degree of achievement by the Canadian industry he said:

"I am delighted. I think it has surprised everybody at home. And I think it has surprised a lot of people in Canada too."

Test Flying Jets

(Continued from page 30)

there were two schools of thought for optimum fuel economy—one was that it was more economical to climb to optimum altitude and provide for a long slowly-descending approach, and the second was for cruising at the optimum altitude until close to destination, then descending rapidly by employing air brakes. It would appear that before this argument can be resolved, operational data will have to be compiled for comparison.

The use of air brakes or an air brake flap system is almost mandatory in high-speed high-altitude turbine-powered aircraft, for the reason that since maximum efficiency is attained only at optimum altitude and speed it follows that the stalling speed increases to the point where there is considerably less margin between the stall and the critical Mach number.

At high altitudes, the slightest depression of the nose results in rapid increases of speed where a dangerous condition might result by too close an approach to the critical Mach number. The careful manipulation of the throttles also is required at high altitudes to avoid losing engines. It is here that the air brake becomes necessary to slow down sufficiently to maintain safe control and also to lose altitude rapidly without dangerous increases in air speed.

For both operational and stability reasons it is generally considered essential that the application of dive brakes should result in a zero change of trim no matter what the speed or airplane configuration may be. The reasons for this requirement are many; for instance it may be necessary to slow down quickly if the critical Mach number is being exceeded or uncontrollability appears; in the event of explosive decompression with its dangerous impairment of human faculties, the pilot needs to have as few things requiring care and judgment to do as possible; during an approach or descent it becomes necessary sometimes to apply and release dive brakes frequently when it would be intolerable to have trim changes; dive brakes might also be used to shorten landing distances which may well be critical in turbo-jet airplanes and no change of trim would be acceptable when retraction became necessary as in the case of a baulked approach or landing.

Better Traffic Control

It was very definitely stated everywhere in the U. K. that before jet-powered aircraft can be used operationally in air transport work, the provision of more efficient traffic control and radio aids under instrument conditions, is mandatory. This is the thorniest problem of all, since it is generally held that even with the civil air transports currently in use, present landing aids for use in bad weather are even now inadequate. Even when turbine-powered aircraft cut out half their engines and cruise on the remaining while stacked, fuel consumption is still so high that large amounts of reserve fuel must still be carried to provide for holding missed approaches and diversion to alternate airdromes.

It was the opinion of one chief engineer of an aircraft manufacturer, that the use of jet-powered aircraft in scheduled air transport is still 20 years away for both high-altitude airworthiness performance and operational reasons. It was the opinion of this gentleman and others, that interim aircraft will be the prop-jet-powered airplanes.

Jet aircraft have many advantages over reciprocating engine propeller aircraft in that the jets can be grouped together, close inboard on the wings, and due to the absence of propeller disc, loss of power on one side scarcely affects controllability. Minimum controllability speed almost invariably will be below the stalling speed of the airplane, and loss of an engine on take-off should have far less disastrous consequences.

It is not anticipated that **take-off distance** will be critical in jet powered aircraft because, although initial acceleration is slower than with propellered airplanes, thrust actually builds up with acceleration due to ram, with jet aircraft, and falls off with acceleration in propellered aircraft. It is anticipated that take-off distances will remain virtually the same for aircraft of the same weight, equipped with different type power units.

Several test pilots express the opinion, however, that wing loading appears to be more critical in respect to turbo-jet-powered aircraft at take-off in so far as take-off distance is concerned, than with propellered aircraft.

It is expected that the landing distance will be critical with jet-powered aircraft, due to the absence of the propeller disc, and the braking effect of windmilling engines. One difficulty at present is that due to the care which must be exercised to avoid resonance during the first few thousand rpm of jet engines, it is customary to approach to land with the throttles set at that point where they may be opened rapidly without resonance or excessive jet-pipe temperature rises.

Fortunately, through the initial range of throttle opening, the thrust curve is very flat; nevertheless there is an appreciable increase of thrust. It is common practice to close the throttles only when a landing is obviously possible, and due to the absence of propeller discs, the aircraft floats a considerable distance without much decrease in speed.

It is the intention of the Air Registration Board when measuring landing distances of jet-powered aircraft, to require the manufacturer to make a declared throttle setting for the approach to land and to require the throttles to be in this position until the touchdown is made, after which the throttles may be closed. On very large, clean, tricycle undercarriage aircraft, the landing distance obviously would be great.

Among the other problems associated with the operation of jet-powered aircraft is that of **explosive decompression.** Above 40,000 ft. and certainly at 45,000 ft. life is possible only for a few seconds without pressurizing, and even 100% oxygen is not sufficient to sustain life for very long. Flying medical authorities at RAF Farnborough, told me that 100% oxygen would have to be available within three seconds after explosive decompression at 45,000 ft. and a rapid descent possible to at least 35,000 ft. for even that to sustain life. This would appear to be another reason why the provision of air brakes will be essential. They should be capable of being applied at optimum speed and quick acting.

In a jet aircraft with high pressure differential, the complete loss of a whole window, which might be considered explosive decompression, nevertheless takes quite an appreciable time for pressure equalizing between the interior and exterior. This is a slight safety factor. However, it would appear that passengers will have to remain strapped in throughout the flight to avoid the danger of being ejected out of the window.

Considerable experimenting is taking place with transparent materials which will withstand the great pressure differentials and the extreme differences in temperature between the interior and exterior without fracturing. It is understood that to date no really satisfactory material has been evolved.

One of the worst problems associated with high altitude flight is the **frosting of windows** and windshields when rapid descents essential with jet-powered aircraft are made. The frosting occurs on both surfaces and is extremely hard to remove. No entirely-satisfactory frost removal system has yet been evolved. Frosting is aggravated by the heating and humidification made necessary by the high altitudes and their low temperatures and humidity. I have heard of cases where a rainshower of thawing condensed moisture has occurred when descents have been made from very high altitudes.

Another problem visualized in the operation of jet aircraft is that of fuel losses through boiling. Let us take the case of a jet aircraft which has been refueled in high ground temperatures and has been sitting in a hot sun. Due to the high performance in climb provided by turbine power the aircraft will reach its operational height in a relatively short time, since this is necessarily a great altitude the fuel will boil and boiling will be more rapid with increasing altitude. Fuel losses experienced from this cause have been as high as 30% with gasoline. In large, long-distance turbine-powered transport airplanes this would be a serious problem since it is conceivable that it would take an appreciable time for the large mass of fuel to cool down enough to stop boiling.

During all the talks I had with manufacturers, test pilots, Ministry of Civil Aviation and Air Registration Board officials in the U. K. I found that thinking had not jelled in any way with respect to turbine-powered aircraft. Everyone appears to be keeping a very open mind and to be certain of very little at the present moment.

No one would venture, for instance, to prophesy as to when turbo-jet-power transports could be used efficiently in civil air transport. All felt that there were still too many problems to be overcome.

Reader's Voice

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ing my flight test I learned that the hours put in on my own plane would not count on the subsidy plan. My training had to be taken in a school plane.

Well, O.K., I'd lease the Luscombe to the Club and the D.O.T. said this would be fine. After another month or so the lawyer came out of his shell with a fine looking lease presumably covering everything. It was signed by club directors (after another few weeks waiting for a meeting) and copies were sent to the D.O.T. Ah! at last I was on my way! My hours started piling up again — almost 30, when the D.O.T. wrote saying that the lease was "not properly drawn up" as no stipulated amount for rental was in the agreement. I guess they figured I should lease the plane to the club for $10 an hour and the club should in turn rent it to me for $10 an hour (perhaps this would ease the unemployment, another book-keeper would have a job).

By this time I was fuming, so made a visit to Mr. Saunders in Toronto and suggested that I had better either quit flying or go through on the 40-hour plan and forget the subsidy. Mr. Saunders, by the way, was very nice to me but explained that rules were rules and he could not change them. And that's how I finally got my license — on the 40-hour plan— no $100.

However my complaint is that I DID go to ground school and paid for it, I DID take instruction from a qualified instructor, I DID pass all the written exams and the flight test, I DID sign the agreement, I DID put in the required number of hours. In fact I did everything but get that elusive $100 simply because I trained in my own plane.

Isn't a privately owned plane constructed exactly the same as a school plane? It seems to have wings, ailerons, fuselage, elevators, rudder, etc., the same as the other planes in the hangar and yet the training I received in it does not count.

Has anyone else got stuck in this manner? I certainly would like to hear the experiences of some other plane owners who tried for their license in their own planes.

By the way, though, I still haven't given up! After reading Mr. Cox's letter I got steamed up again and wrote directly to Ottawa to see if I could get any action there. No reply yet of course as I presume the D.O.T. puts letters of this sort in what I term their "fortnight file" (to be answered in a couple of weeks).

In the meantime if Mr. Cox doesn't want his check tell him to send it on to an eager receiver.

Very truly yours,

Dorothy Rungeling
Niagara St. N.,
Welland, Ontario.