

Fig 3

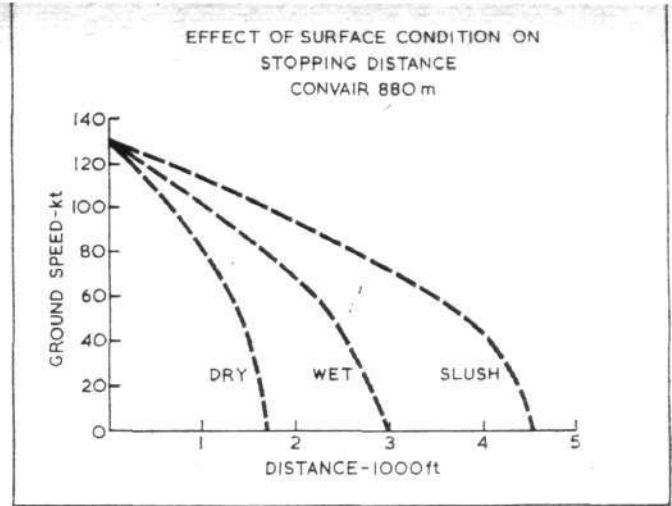


Fig 4

pointed out that with an engine failure during the run, 75 per cent power would not enable him even to reach a 125kt Vr. An inch-and-a-quarter of slush doubles the dry runway take-off run; and an inch-and-a-half trebles it.

Braking in Slush The pilot's feeling about braking in one inch of slush was described as comparable to that of the rider who, having galloped his horse off a cliff, hauls back on the reins in mid-air and yells "Whoa." In fact, the tests left a question whether there is any wheel braking at all in water or slush at more than 80kt to 100kt. At roughly this speed on the 880M the wheels begin to lose effective contact with the runway; they actually begin to spin down, because the vertical pressure of the fluid forward of the axle gives rise to an anti-rotational force component. On a couple of runs one wheel stopped rotating entirely. Calculations show that the nosewheels were completely hydroplaning at 100kt and the main wheels at 110kt. Under these conditions braking effectiveness is practically non-existent, and anti-skid systems proved no help.

Fig 3 shows the results of a number of brake tests under different conditions compared with the dry-runway results. In all the former cases braking coefficient falls with increasing speed. Fig 4 illustrates the Convair 880M's stopping distance on different surface conditions, taking into account all retarding forces, including aerodynamic, and light slush drag.

Slush Damage Two very important aims of the tests were to record the spray patterns and evaluate probable damage and malfunctioning from slush impact and accumulation on the airframe. A good feature of the 880M's layout is indicated by the fact that at no speed, nor in any depth of slush, was there a noticeable amount of slush ingestion by the engines. The observed spray patterns suggest that this might not have been the case with rear-fuselage-mounted engines. A measure of the force and potentially destructive power in the spray at higher speed can be gauged from the fact that on several occasions the cargo door push-to-release handle was sprung out.

In general, the Convair 880M came through all the tests with a remarkably small amount of damage. However, the tests showed that spray damage and accumulation must be considered very carefully in the early design stages, when the majority of these problems could be avoided.

Measuring Slush and Traction Before any new regulations can be introduced to compensate for slush on the runway, a reliable system must be devised for actually measuring the conditions and relating them to the basis of the corrections.

By using a number of different vehicles for deceleration-sampling or continuous-deceleration drag measurement it was found possible to measure slush depths of less than one inch to within a quarter of an inch of actual mean depths. A quarter inch, however, makes quite a difference in take-off acceleration or landing roll. With that degree of possible error it would be necessary to have a safety factor of 1.7 for acceleration parameters, which is rather high.

"Flight International" photograph



FAR-FLUNG FRONTIER

WHILE most of the US local service airlines have been busy converting to turboprop F-27s one of the largest of their number, Denver-based Frontier Airlines, has kept its faith in the much maligned piston. And well placed that trust appears to be, for 1961 was, according to the opening line of their 1961 annual report, "the best year your company has enjoyed in its 15 year history." The airline is now believed to be seriously considering the purchase of BAC One-Elevens.

The economic characteristics of the Convair 340—of which Frontier operates a fleet of eight—were a major factor in a doubling of profits last year. That this aircraft has proved more suitable to Frontier than to other local service carriers would appear to be because of the relatively far flung nature of Frontier's network which stretches the entire depth of the country from Canada down to the Mexican border. Other factors which pushed up commercial

revenues in 1961 by \$4m to a record \$8m were improved interline schedules and the development of package tours, particularly to Colorado's prime attraction, the Grand Canyon. Last year also enjoyed an unexpected windfall in the form of traffic diverted from the trunk operators at the time of the flight engineers' strike.

Operating costs rose even more sharply, however, by close on \$1m to exceed \$14m. Although it can therefore be said that the airline's increased profits are a result primarily of a \$4m rise in mail subsidy to as much as \$7m, the fact remains that it is only by generating traffic and cutting costs that the local airlines' need for subsidy will eventually be eliminated. Seen in this light, the additional subsidy required to finance Frontier's Convair programme is a worthwhile investment. Further strengthening of Frontier's route pattern, coupled with recent fare increases, means that 1962 might well have seen Frontier's subsidy subside.