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INSPECTION OF WOOD AIRCRAFT AT SALINAS, ECUADOR, APRIL 4, 1943

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INSPECTION OF WOOD AIRCRAFT AT SALINAS, ECUADOR, APRIL 4, 1943¹

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The members of a party making a survey of the forest resources in Ecuador were requested³ to make inspection of any locally available wooden planes, when possible, for the purpose of determining the effect of a tropical climate on the wood members with respect to decay, fungus stain, delamination of glued parts and other factors which might affect service life or strength of the wooden members. It was learned that a few wooden planes were stationed at the Salinas Airport, and accordingly arrangements were made through the American Embassy at Quito and the Ecuadorian Minister of Defense to inspect these planes and Major Peffer of the United States Air Force escorted the writers from Guayaquil to make the inspection.

History of the Planes

According to information supplied, the Ecuadorian Government bought six Curtis trainers eight years ago, three of which are, with the exception of motors, still in serviceable condition, the others having been damaged beyond repair. During their period of service, these planes have been used generally over this country, mostly around Quito, though for some time they have been located at Salinas. New engines have been ordered for these planes, and when received, the planes will again be put into service.

In addition, there were several Fairchild P.T. 19 planes in service at this field for one year, belonging to the United States Army. Also a Bellanca, tri-motor, two-place special racing plane, belonging to the Ecuadorian Government.

¹This mimeograph is one of a series of progress reports prepared by the Forest Products Laboratory to further the Nation's war effort. Results here reported are preliminary and may be revised as additional data become available.

²On assignment from the Forest Products Laboratory to the Latin American Forest Resources Project in cooperation with the Office of the Coordinator of Inter-American Affairs.

³This request was made by Dr. Carl Hartley, Division of Forest Pathology, Bureau of Plant Industry, U. S. Department of Agriculture, who prepared a working plan setting forth the type of information desired.

Type of Field at Salinas

The runway is oiled, the balance of the field is clay. This field is built in what was originally a shallow lake bed, but now drained. Ground water occurs about 18 inches below the surface. After rains, the field has numerous puddles and dries off slowly. Salinas is in a dry, arid belt, but they had 17 inches of rain in March, supposedly a dry month. The atmosphere is very humid, however, due to the water which almost surrounds the field. This coastal area is also subject to heavy mists at night. Salt spray is also carried over the field at times, and salt deposits are quite noticeable on the field.

Other Fields

The fields at Manta, Quito, and Guayaquil are of sod and appear to be well drained. The field at Quito is subject to very frequent showers in the wet season, and rather low temperatures, 45° to 65° F., and to very high humidity for six months during the wet season.

Temperatures

The temperature at Salinas ranges from 80° to 90° F. during the wet season, and somewhat lower in the dry season.

Housing

Until recently, no housing was available for the planes and they stood out in the open. The Curtis and Fairchild trainers are now stored in an open face shed having a bamboo roof that will create shade but will not shed water.

Planes Inspected

Curtis Trainers

These were biplanes, wings covered with fabric, and had been in Ecuador for eight years and belong to the local government. One wing had been stripped of the covering and the entire skeleton could be examined. There was no evidence of blue stain or decay in any part, no loose glue joints and no delamination in the plywood of the step piece. Some of the wing ribs had been broken in service, and it was the intention to repair these parts and put the wing back in use. Moisture content tests made with a Kaydel moisture meter gave readings of 14 percent in the spars. The spars and ribs were of

Sitka spruce, the spars being solid. The type of glue used in the ribs could not be determined definitely, although it was the same color as resin glue. Another wing was examined through the end where it joined on to the fuselage and also at an inspection hole cut in the top of the wing, about midway of the wing length near the trailing edge. There was some evidence that there had been water in the wing, but this wing looked as good in all respects as the wing with the covering removed. The wing drain holes, about 1/8 inch in diameter, were clean and open.

Fairchild P.T. 19

Several of these planes were at Salinas, and had been in service there for one year, having had a total of 550 hours in the air. They had stood in the open until one week previous to the inspection. The engines for these planes were at present being overhauled. The wings were covered with plywood, which in turn was covered with doped cloth. The spars were of Sitka spruce, built up and glued. The ribs were Sitka spruce, with mahogany plywood gussets at the joints. Inspection was made at the open section at the inner end of the wing and through inspection holes. This inspection did not permit examination of such critical points as the inner portions of trailing edges and box spars. No evidence was found of stain, decay, loose glue joints, or delamination. Water stains and some dirt were present inside of the wing, particularly near the trailing edge. Drain holes were clean and open. It was said that these were inspected regularly and frequently. Paint or varnish was flaking off over glue joints, the glue appearing to be incompatible with paint and varnish, but all other coatings inside the wing and on the outer surface were in excellent condition.

The plywood covering of the wing had developed "ripples" between wing ribs, apparently caused by expansion of the plywood. On the top of the wing, the ripples ran from front to back, being elevated between ribs. On the bottom there seemed to be a diagonal pattern to the ripples, crossing the wing at 45° with the axis. This may have been the result of expansion of the plywood in both directions. The top of the wing appeared to have expanded in only one direction, namely from rib to rib. No place on the top or bottom could be found where covering had separated from the rib. Even with the diagonal pattern on the bottom, the ripples did not cross the ribs. In the opinion of Major Peffer and the Ecuadorian officers, this particular wing was "rippled" the most of all of those at the field, though it was common in other wings. The ripples had been noticed some time ago, but were apparently getting worse.

The spars had a moisture content of 14 percent, according to the moisture meter.

Some broken wings were also inspected, where it was possible to see parts not visible from the end or through inspection holes. All breaks were clean and with long splinters. No evidence of stain or decay could be detected. These parts, stored in an open crate, were exposed to sun and rain and had been in this crate since last October. In spite of this exposure, there were no

apparent glue failures. The glue appeared to be of the resin type. The moisture meter indicated a moisture content of 12 percent in the spar.

A moisture meter reading on an unpainted part of a hangar indicated 15 percent moisture content.

Bellanca

This was a tri-motor, two-place special racing plane, purchased by the Ecuadorian Government in the United States. This plane was not being flown, but was being held for ground instruction. It was a composite type, the fuselage being mostly of metal and the wings mostly of wood. It was delivered to the Salinas Airport in October and has been standing in the open since that time. No vent holes were found on the underside of the wings. The only place available for inspection was the inspection hole in the left wing. All around this plate⁴, the wood frame was blue-stained and all struts in the ribs that could be reached were loose, due to glue failure. The plywood gussets fell off when touched. The plywood wing covering was delaminating around the opening. One of the Ecuadorian officers said that these same conditions were observed when the plane was delivered. The glue in the ribs appeared to be of the casein type. In view of the excellent condition of the other older planes, the lack of vent holes, and the history of this plane, it is doubtful if its condition should be charged against tropical exposure.

Propellers

Two wooden propellers were inspected. These propellers were made in Lititz, Pennsylvania, by Sensenich Brothers. One propeller had been discarded, splits or checks separating the end grain of the wood. The checks were continuous from one face to the other, extending through all laminations. The other propeller showed no such checks, but had been discarded because of a broken end caused in a landing crack-up. Neither propeller showed any signs of delamination or glue failure.

⁴There was evidence that the screws had not been replaced in the plate after the original inspection and the plate was loose at the time of removal for the inspection here reported which would permit water to enter and could account for the condition as found.

Summary

The excellent condition of the wood and of the glue joints in both the Curtis and Fairchild planes indicates that the climatic conditions in Ecuador have little detrimental effect upon the wooden parts of planes of good design, workmanship, and properly maintained. The effect of the local conditions on the Bellanca exposed to the weather for six months is questionable, since its condition was reported as unsatisfactory by the Ecuadorian officers at the time it was received.

The many years of satisfactory service of the Curtis trainers with reference to the condition of the wood and the glue joints quite strongly indicates that the tropical conditions represented have not shortened the useful life of these planes.

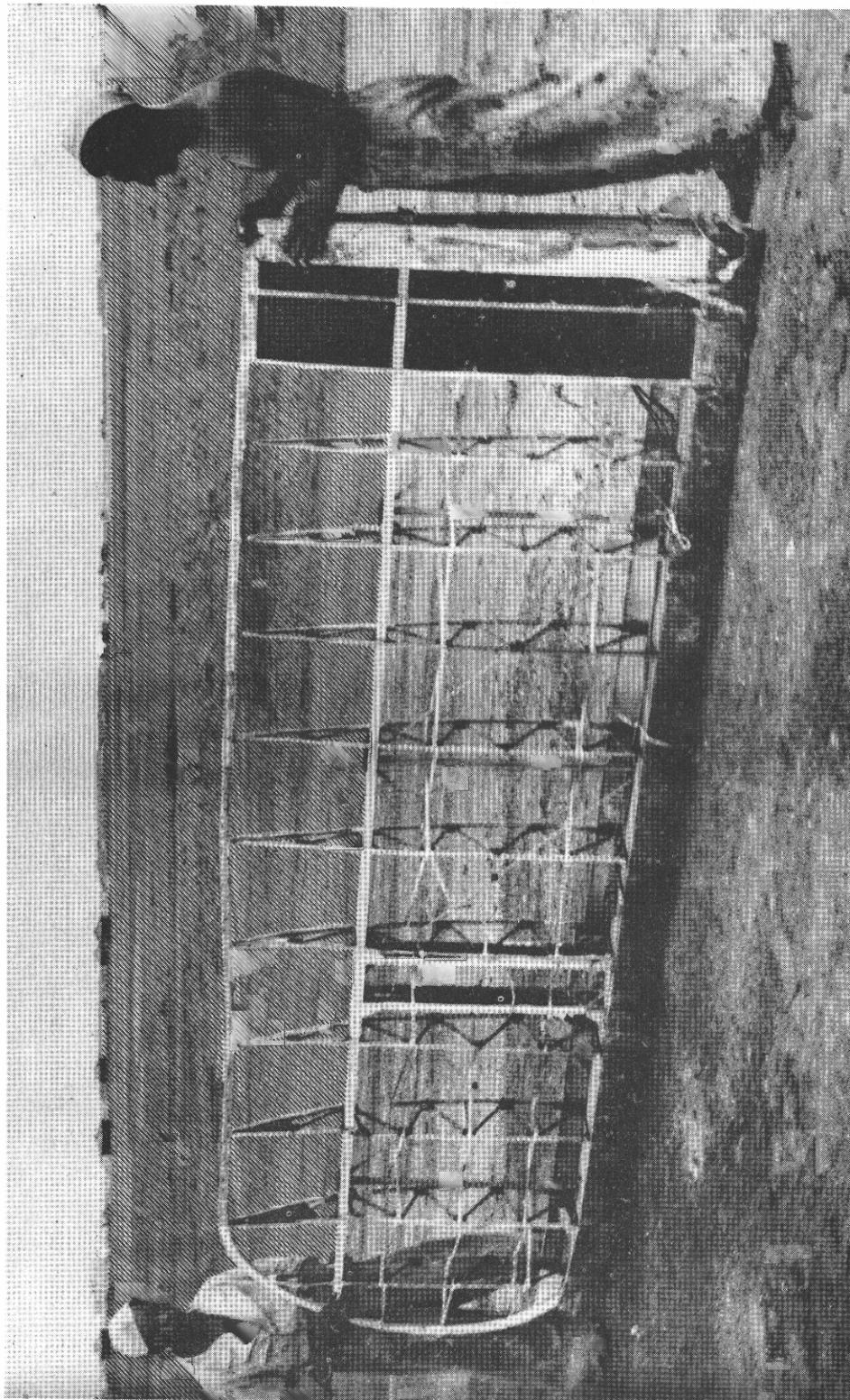


Figure 1.--Wing of Curtis trainer biplane which has been in service in Ecuador for 8 years. Wing covering removed to repair wing ribs damaged in landing crash. No evidence of stain, decay, or glue failure.