

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA25FA082

MATERIALS LABORATORY

Factual Report 25-028

September 2, 2025

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A. ACCIDENT INFORMATION

Location: Cintrona, Puerto Rico
Date: 12/20/2024
Vehicle: Cessna 172S, N22088
Investigator: Joshua Young

B. COMPONENTS EXAMINED

Portions of control cables and a small portion of wing skin (Figure 1).

C. EXAMINATION PARTICIPANTS

Specialist Joseph Panagiotou
National Transportation Safety Board
Washington, DC

D. DETAILS OF THE EXAMINATION

The portions of the control cables submitted for examination (Figure 1) were labeled with the following names: "Control column interconnect cable", "RH aileron AFT wing", "RH aileron FDW wing", "LH aileron AFT inbd wing", "LH aileron FDW wing", "Flap", "LH Flap" and "Trim". The fractured ends of these cables were examined using a stereo microscope.

The portion of control cable labeled "Control column interconnect cable" exhibited two fractured ends. Examination of those ends revealed cup and cone fracture features as well as slant fractures (Figure 2). These features are consistent with tensile overload.

The portion of control cable labeled "RH aileron AFT wing" exhibited a mix of cup and cone fractures consistent with tensile overstress as well as tapered knife edge fractures consistent with wear (Figure 3). Some of the wires exhibited additional wear spots in discreet locations along their length away from the fractured ends (Figure 4). This "RH Aileron AFT wing" control cable was composed of seven individual strands, and each strand was composed of 19 wires. Each fractured wire in the seven strands was examined and categorized as either exhibiting features consistent with overstress (o) or wear (w). The strands were arbitrarily numbered 1 - 7 and the results of the examination are tabulated in Table 1 of Appendix A. The percentage of wires in strand #1 exhibiting wear was 100%. The percentage of wires in strand #2 exhibiting wear was 58%. The percentage of wires in strand #3 exhibiting wear was zero. Strand #3 was the core strand. The percentage of wires in strand #4 exhibiting wear was 47%. The percentage of wires in strand #5 exhibiting wear was 95%. The percentage of wires in strand #6 exhibiting wear was 74%. The percentage

of wires in strand #7 exhibiting wear was 58%. Overall, 62% of the fractured wires in this control cable exhibited features consistent with wear.

The portion of control cable labeled "RH aileron FWD wing" primarily exhibited cup and cone fractures consistent with tensile overstress. Some tapered knife edge fractures, consistent with wear, were also present. This "RH Aileron FDW wing" control cable was composed of seven individual strands, and each strand was composed of 19 wires. Each fractured wire in the seven strands was examined and categorized as either exhibiting features consistent with overstress (o) or wear (w). The strands were arbitrarily numbered 1 - 7 and the results of the examination are tabulated in Table 2 of Appendix A. The percentage of wires in strand #1 exhibiting wear was zero. The percentage of wires in strand #2 exhibiting wear was 63%. The percentage of wires in strand #3 exhibiting wear was zero. The percentage of wires in strand #4 exhibiting wear was zero. Strand #4 was the core strand. The percentage of wires in strand #5 exhibiting wear was 52%. The percentage of wires in strand #6 exhibiting wear was zero. The percentage of wires in strand #7 exhibiting wear was zero. Overall, 16% of the fractured wires in this control cable exhibited features consistent with wear.

The portion of control cable labeled "LH aileron AFT inbd wing" exhibited a mix of cup and cone fractures consistent with tensile overstress as well as tapered knife edge fractures consistent with wear. Some of the wires additionally exhibited wear spots in discreet locations along their length away from the fractured ends. This "LH aileron AFT inbd wing" control cable was composed of seven individual strands, and each strand was composed of 19 wires. Each fractured wire in the seven strands was examined and categorized as either exhibiting features consistent with overstress (o) or wear (w). The strands were arbitrarily numbered 1 - 7 and the results of the examination are tabulated in Table 3 of Appendix A. The percentage of wires in strand #1 exhibiting wear was zero. Strand #1 was the core strand. The percentage of wires in strand #2 exhibiting wear was 74%. The percentage of wires in strand #3 exhibiting wear was 100%. The percentage of wires in strand #4 exhibiting wear was 78%. The percentage of wires in strand #5 exhibiting wear was 47%. The percentage of wires in strand #6 exhibiting wear was 84%. The percentage of wires in strand #7 exhibiting wear was 37%. Overall, 60% of the fractured wires in this control cable exhibited fracture features consistent with wear.

The portion of control cable labeled "LH aileron FDW wing" exhibited a mix of cup and cone fractures consistent with tensile overstress as well as tapered knife edge fractures consistent with wear. Some of the wires additionally exhibited wear spots in discreet locations along their length away from the fractured ends. This "LH Aileron FWD wing" control cable was composed of seven individual strands, and each strand was composed of 19 wires. The fracture occurred near a fitting on the control cable and one entire strand had been pulled out of the fitting and was not present to be examined. One of the remaining six strands still present within the fitting was missing 4 wires. Each fractured wire in the six strands that remained

present was examined and categorized as either exhibiting features consistent with overstress (o) or wear (w). The strands were arbitrarily numbered 1 - 6 and the results of the examination are tabulated in Table 4 of Appendix A. The percentage of wires in strand #1 exhibiting wear was 79%. The percentage of wires in strand #2 exhibiting wear was 42%. The percentage of wires in strand #3 exhibiting wear was zero. Strand #3 was the core strand. The percentage of wires in strand #4 exhibiting wear was 26%. The percentage of wires in strand #5 exhibiting wear was 89%. The percentage of wires in strand #6 exhibiting wear was zero. Strand #6 was the one missing 4 wires. Overall, excluding the missing strand, 39% of the wires present exhibited fracture features consistent with wear.

The portion of the control cable labeled "Flap" exhibited wires with fracture features predominantly consistent with overstress with a few singular wires exhibiting evidence of wear.

The portion of the control cable labeled "LH Flap" exhibited multiple locations with individual wire fractures and or entire strand fractures along the length of the cable. The fractured wires exhibited fracture features consistent with overstress.

The portion of the control cable labeled "Trim" consisted of two separate sections of cable. One section had one end that was intentionally cut and one end that was fractured. The other section had two fractured ends. Two of the fractured ends exhibited wires with predominantly overstress fractures. The remaining fractured end exhibited wires with mostly wear fractures except for the core strand which was entirely overstress (Figure 5). The trim cable also exhibited regions along its length that had not fractured but exhibited wear (Figure 6)

The portion of wing skin that was submitted for examination contained a focused spot of dark discoloration of the white paint (Figure 7). This spot was surrounded by a region of less discolored paint which exhibited a pinkish-purple hue. The focused spot of dark discoloration was examined using the stereo microscope which revealed that there was no missing material or melted material at the location of the spot (Figure 8).

Submitted by:

Joseph Panagiotou
Fire Protection Engineer



Figure 1. Portions of control cables and wing skin as received.



Figure 2. Wires exhibiting overstress fractures on "Control column interconnect" cable.



Figure 3. Wires exhibiting a mix of overstress and wear fractures in a strand of the "RH aileron AFT wing" cable.



Figure 4. Wear spot along length of "RH aileron AFT wing" control cable.



Figure 5. Fractured wires from "Trim" control cable exhibiting wear and overstress fractures.



Figure 6. Wear spots along the length of "Trim" control cable.



Figure 7. Portion of wing skin with discoloration.

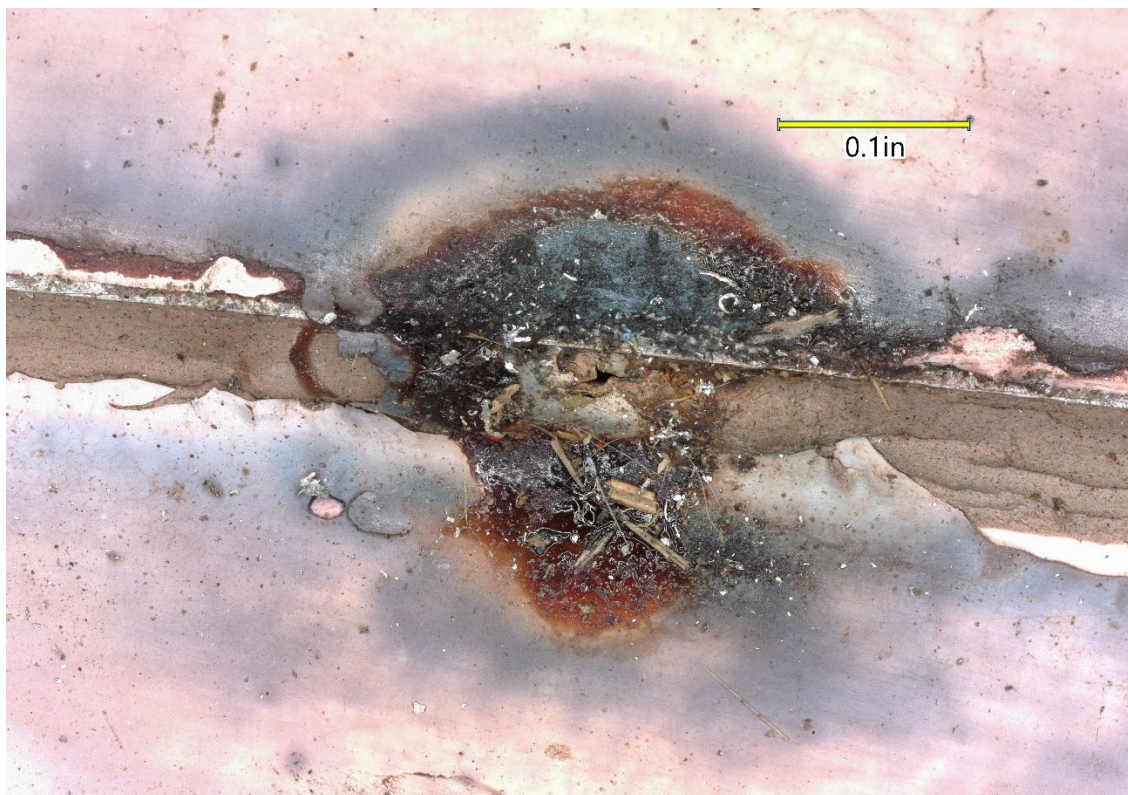


Figure 8. Close up of dark spot in the middle of the discolored region.

APPENDIX A

Table 1. RH aileron AFT wing

Cable name: RH aileron AFT wing (62% wear overall)							
Wire #	Strand #1	Strand #2	Strand #3	Strand #4	Strand #5	Strand #6	Strand #7
1	w	w	o	w	w	w	o
2	w	w	o	w	w	w	o
3	w	w	o	w	w	w	w
4	w	w	o	w	w	w	w
5	w	o	o	w	w	w	w
6	w	w	o	w	w	w	w
7	w	w	o	w	w	w	w
8	w	w	o	o	w	o	w
9	w	w	o	o	w	w	w
10	w	w	o	o	o	w	o
11	w	w	o	w	w	w	o
12	w	w	o	w	w	o	w
13	w	o	o	o	w	o	w
14	w	o	o	o	w	o	w
15	w	o	o	o	w	o	w
16	w	o	o	o	w	w	o
17	w	o	o	o	w	w	o
18	w	o	o	o	w	w	o
19	w	o	o	o	w	w	o

Table 2. RH aileron FWD wing

Cable name: RH aileron FWD wing (16% wear overall)							
Wire #	Strand #1	Strand #2	Strand #3	Strand #4	Strand #5	Strand #6	Strand #7
1	o	w	o	o	o	o	o
2	o	w	o	o	o	o	o
3	o	w	o	o	o	o	o
4	o	o	o	o	o	o	o
5	o	o	o	o	w	o	o
6	o	o	o	o	w	o	o
7	o	w	o	o	w	o	o
8	o	w	o	o	w	o	o
9	o	w	o	o	w	o	o
10	o	w	o	o	w	o	o
11	o	w	o	o	w	o	o
12	o	w	o	o	w	o	o
13	o	w	o	o	w	o	o
14	o	w	o	o	w	o	o
15	o	w	o	o	o	o	o
16	o	o	o	o	o	o	o
17	o	o	o	o	o	o	o
18	o	o	o	o	o	o	o
19	o	o	o	o	o	o	o

Table 3. LH aileron AFT wing

Cable name: LH aileron AFT wing (60% wear overall)							
Wire #	Strand #1	Strand #2	Strand #3	Strand #4	Strand #5	Strand #6	Strand #7
1	o	w	w	w	o	w	w
2	o	w	w	w	o	w	w
3	o	w	w	w	o	w	o
4	o	o	w	w	w	w	o
5	o	o	w	o	w	w	o
6	o	o	w	o	w	w	o
7	o	o	w	o	w	w	o
8	o	o	w	o	w	o	o
9	o	w	w	w	w	w	w
10	o	w	w	w	o	w	w
11	o	w	w	w	o	o	o
12	o	w	w	w	w	o	w
13	o	w	w	w	w	w	w
14	o	w	w	w	w	w	w
15	o	w	w	w	o	w	o
16	o	w	w	w	o	w	o
17	o	w	w	w	o	w	o
18	o	w	w	w	o	w	o
19	o	w	w	w	o	w	o

Table 4. LH aileron FWD wing

Cable name: LH Aileron FWD wing (39% wear overall) *excluding strand #7							
Wire #	Strand #1	Strand #2	Strand #3	Strand #4	Strand #5	Strand #6	Strand #7
1	o	w	o	w	w	o	n/a
2	w	w	o	w	w	o	n/a
3	w	w	o	w	w	o	n/a
4	w	w	o	o	w	o	n/a
5	w	w	o	o	w	o	n/a
6	w	w	o	o	w	o	n/a
7	w	w	o	o	w	o	n/a
8	w	w	o	w	w	o	n/a
9	w	o	o	w	w	o	n/a
10	w	o	o	o	w	o	n/a
11	w	o	o	o	w	o	n/a
12	o	o	o	o	w	o	n/a
13	w	o	o	o	o	o	n/a
14	w	o	o	o	o	o	n/a
15	w	o	o	o	w	o	n/a
16	w	o	o	o	w	n/a	n/a
17	w	o	o	o	w	n/a	n/a
18	o	o	o	o	w	n/a	n/a
19	o	o	o	o	w	n/a	n/a