

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594



May 30, 2018

MATERIALS LABORATORY FACTUAL REPORT

Report No. 18-038

A. ACCIDENT INFORMATION

Place : Santa Paula, California
Date : September 4, 2017
Vehicle : Boeing P-17
NTSB No. : WPR17LA197
Investigator : Stephen Stein

B. COMPONENTS EXAMINED

Two magnetos (figure 1), an ignition harness (figure 2) and a set of sparkplugs (figure 3) were submitted for examination.

C. DETAILS OF THE EXAMINATION

Fourteen spark plugs (Champion REM37BY FAA-PMA 2A16) were submitted for examination. The spark plugs were not numbered as to which cylinder they originated from and were therefore arbitrarily assigned numbers from 1 to 14 (figure 2). The electrical resistance of the spark plugs was measured from the terminal to the center electrode and from the center electrode to the ground electrode (table 1). One of the spark plugs (#3) exhibited an open circuit between the terminal and center electrode.

The ignition harness was examined for electrical continuity from the magneto terminal block end to the spark plug end of each ignition cable. The electrical continuity was established by making resistance measurements using a digital volt meter. The integrity of the insulation was assessed using a digital mega ohm meter with a test voltage of 1kV and measuring the electrical resistance between the ignition cable conductor and the cable's insulation jacket. The mega ohm meter was also used to measure the resistance between the ignition cable conductors and the elbows at the spark plug ends of the cables. The results of these measurements are listed in table 2. The elbows of the ignition harness were examined, and it was found that the elbows for all the bottom (B numbered) spark plugs were nominally bent at 90-degree angles without evidence of buckling of the brass elbow tubing. The elbows for all the top (T numbered) spark plugs were bent at various angles beyond 90 degrees (table 3) and exhibited buckling and deformation of the brass elbow tubing (figure 4).

The magnetos did not exhibit any external damage and their rotors turned smoothly. After removal of the distributor block covers an area of electrical arcing was observed on the distributor rotor of the right magneto (figure 5).

Joseph Panagiotou
Fire Protection Engineer

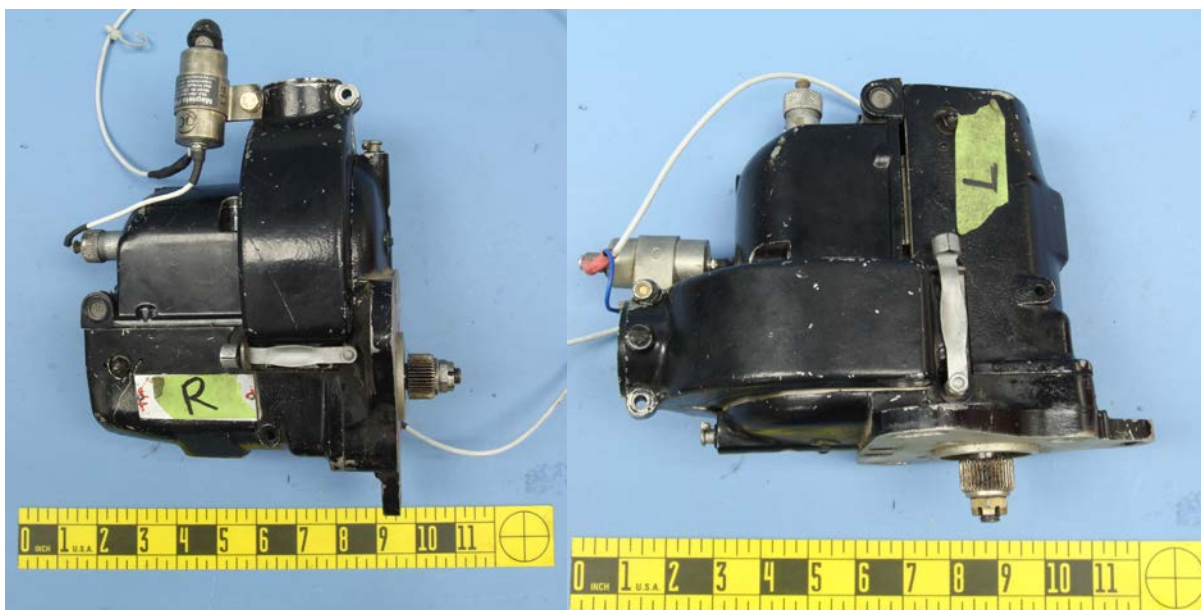


Figure 1: Right and left magnetos.

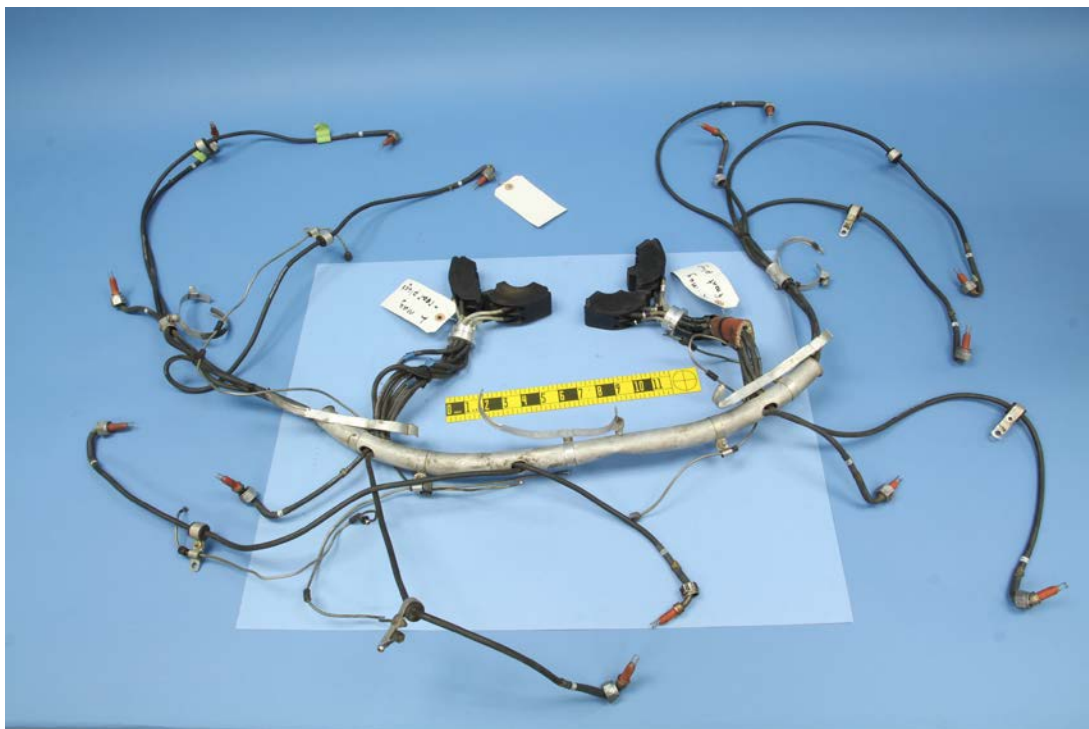


Figure 2: Ignition harness.



Figure 3: Spark plug set.

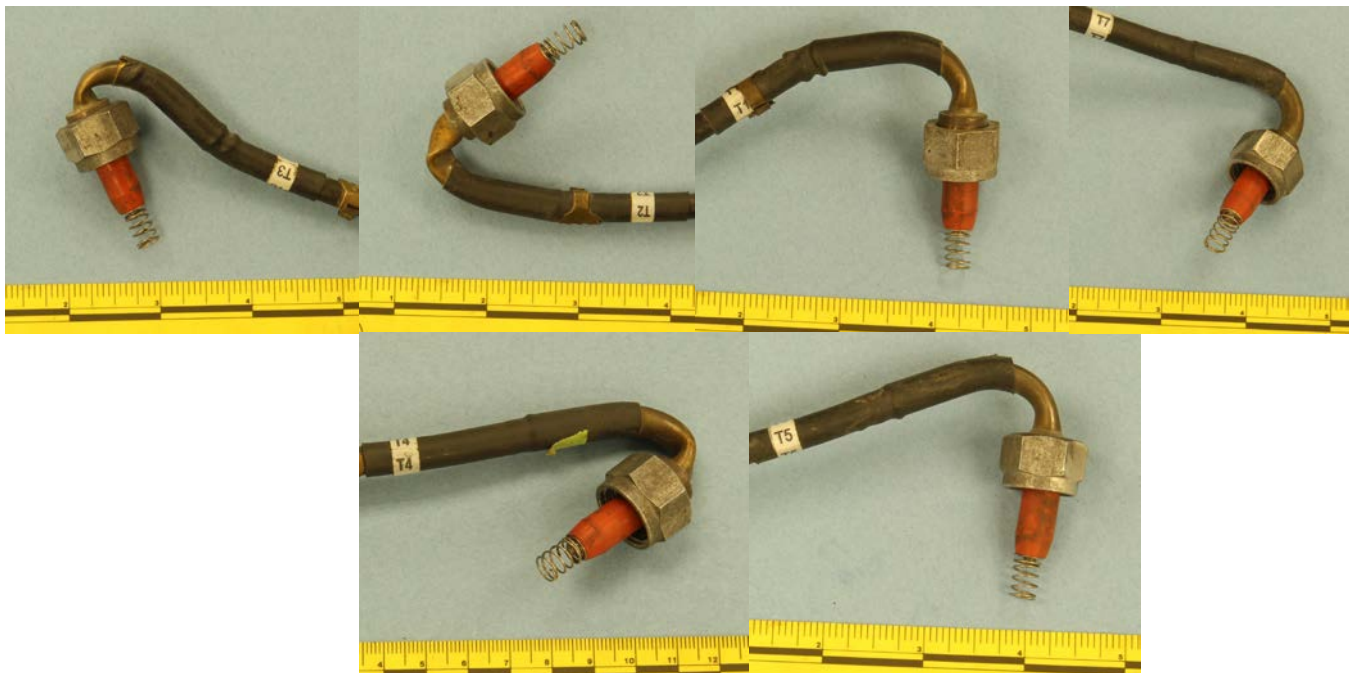


Figure 4: Top (T numbered) spark plug elbows.

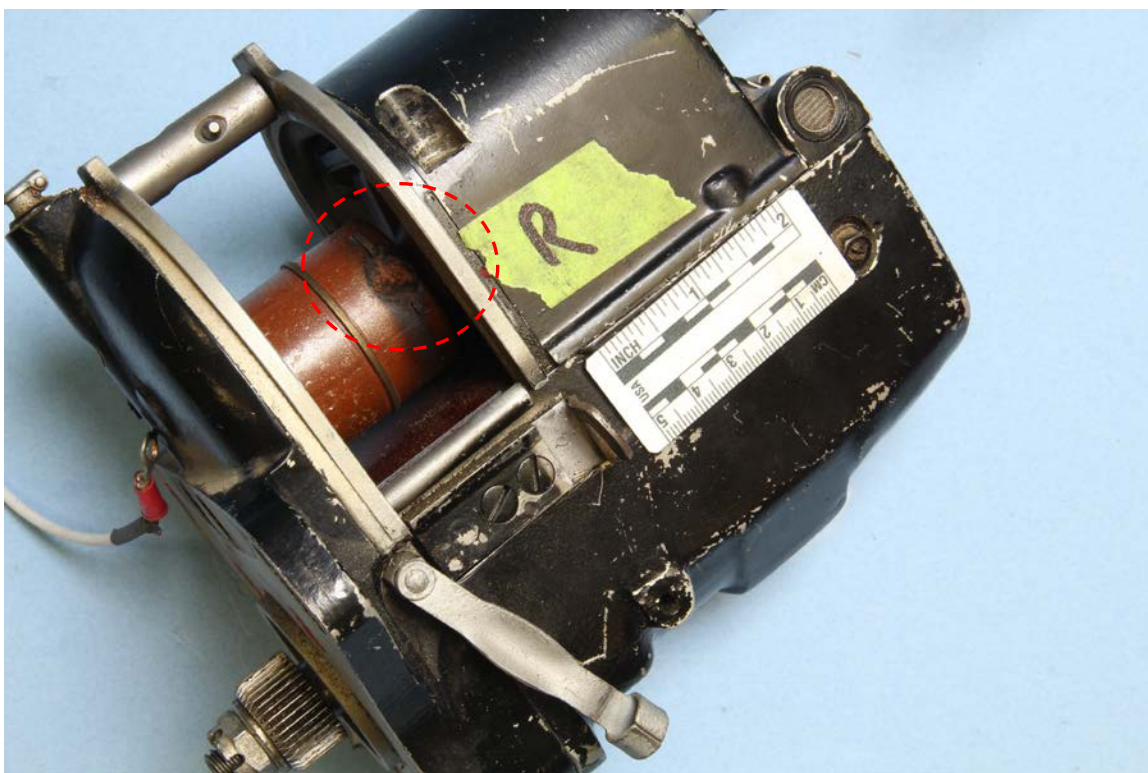


Figure 5: Distributor rotor with evidence of electrical arcing damage (in area circled).

Table 1: Spark plug resistance measurements

spark plug #	Spark plug terminal to center electrode resistance (k Ω)	Center electrode to ground electrode resistance (G Ω)
1	1.99	>11
2	1.89	>11
3	OPEN circuit	>11
4	2.24	>11
5	2.58	>11
6	2.72	>11
7	2.45	>11
8	2.58	>11
9	2.66	>11
10	1.65	>11
11	2.87	>11
12	2.45	>11
13	2.12	>11
14	3.24	>11

Table 2: Ignition cable conductor and insulation resistance.

Ignition cable		1 kV test voltage		
Spark plug end	Distributor block end	End to end resistance (Ω)	Conductor to elbow resistance ($G\Omega$)	Conductor to insulation resistance ($G\Omega$)
T1	R1	2.2	6.7	>11
T2	R5	1.9	> 11	>11
T3	R2	2.9	0.8	>11
T4	R6	2.5	6	>11
T5	R3	2.9	8.1	>11
T6	R7	2.7	0.0001	>11
T7	R4	2.4	9.8	>11
B1	L1	1.6	>11	>11
B2	L5	2	>11	>11
B3	L2	2.2	>11	>11
B4	L6	2.6	>11	>11
B5	L3	2.1	>11	>11
B6	L7	2.2	>11	>11
B7	L4	1.6	>11	>11

Table 3: Ignition cable elbow bend radius measurements.

Elbow	Bend ($^{\circ}$)
T1	110
T2	140
T3	150
T4	150
T5	120
T6	160
T7	110
B1	90
B2	90
B3	90
B4	90
B5	90
B6	90
B7	90