



National Transportation Safety Board
Washington, D.C.

February 26, 1997

To : Party Coordinators

Copy : Al Dickinson
Dr. Bernic Loeb
Wright-Patterson Laboratories

Subject : Comments on Test Plan

As you are all aware, the Safety Board solicits comments and assistance from parties who are capable of technically contributing to an accident investigation. Last week, I solicited input to ensure that we do not miss some test and that our test methods were valid to examine for potential static charging induced by fuel. We have received comments from four parties and are in the process of modifying the test plan.

We try very hard to accommodate party desires and objections, holding the meeting of January 7-10, 1997, to get maximum party input and sending the revised test plan to again solicit your comments. Although the objections to some data points or tests have been noted, please be aware that the final test plan is a Safety Board product, as per the following text from the Independent Safety Board Act Amendment of 1990:

The Board shall have sole authority to determine the manner in which testing will be carried out under this paragraph and under section 701[c] of the Federal Aviation Act of 1958, including determining the persons who will conduct the test, the type of test which will be conducted, and the persons who will witness the test.

The remainder of this letter discusses comments received from the parties.

Three sets of comments contained analysis about the improbability of pressurizing the APU or jettison fuel tubes. However improbable it may have been that those systems may have been pressurized by a wing-mounted pump without recognition by the cockpit crew, the fact remains that the APU and jettison tube pass pressurized fuel through the center wing fuel tank and with a certain set of failure modes, a pump could run. We will not know the amounts of energy that pressurizing these tubes represent until conducting tests at the 42 psi (jettison pump upper pressure limit) test points, as described in the February 19 test plan. Analysis will be welcome at a later point in the investigation.

One party commented about potential difficulties with isolating charging from inadvertent sources. In response, recognition of these difficulties was made early in the test planning. In addition to the fact that the Wright-Patterson (W-P) facility uses a different type

of fuel pump and that differences in tube routing could present differences in charging, a single B-747 has several different types of fuel pump, and differences even in similar boost pumps could exhibit different rates of charge. Rather than attempting to identify and account for numerous (& potentially unknown) possible sources of background noise, a long section of tubing is being installed to allow charge relaxation, followed by an isolated tube section, to be located immediately before or after the test section. The isolated tube section will allow measurement of remaining streaming currents as a total value at the test section for later analysis.

One party objected to measuring breakdown voltage, again, without proposing specific changes to the test methodology. However, the basic formula for spark energy shown below is from the American Petroleum Institute, includes voltage, and is contained in the January 7-10, 1997, test plan that each party initialed:

$$\text{Energy} = \frac{1}{2} \text{ times (Capacitance) times (Voltage)}^2$$

API does refer to other factors that might affect energy, such as losing energy into quenching (cooling) of the points of arcing, and even humidity. In a dynamic case, API notes that the voltage could be a sum of stored energy, + charge rate, - leakage rate. We have already provided for measuring capacitance as a basic part of the formula. Since measurement of the voltage required to cross the air gap is also a basic variable in the energy formula, we are planning to keep this measurement in the test plan. Measuring the rate of charge by various mechanisms is part of the basic function of the testing to be conducted. However, to ensure that we are providing everything possible for later analysis, the test plan will be amended to include measuring humidity and leakage rates of various charged couplings and Adel clamps. I am open to adding further measurements and will include what is possible.

Several parties questioned why the revised test plan includes new potential charging mechanisms. I have maintained that it would be presumptuous of us to claim that every possible way of introducing energy into the fuel tank has been identified. This was confirmed by recognition of four additional potential means of charging after we believed that we had identified every mechanism that we could think of. These four points are in a hand-written note on page three of the test plan dated February 19, 1997. In addition to the previous discussion about the APU and jettison pumps, the following two paragraphs address party questions as to where specific mechanisms came from and how they relate to our test plan.

The first of the four potential charging mechanisms identified in the hand-written note was recognized while we were still at Calverton and involved backflow/leakage through the scavenge system or leaks from that system. The upstream side of the check valve in TW airplane 17109 was seen leaking (externally) at Marana. Although improbable, to account for the possible scenario, test points were added to the test plan that the parties agreed to. The one inch test sections have subsequently been left out of the revision because they would be accounted for by testing the 1 3/4 inch sections.

The group did not consider leaks from the side of body ribs. At Marana, we saw where sealant had been used to fix such leaks. There may also have been reference to such a leak in the January write-ups from airplane 17106, but I am still waiting for clarification from

TWA. That discrepancy report notes that a stream of fluid was created about 18 inches forward of the rear spar.

One commenter noted that electrostatic measurements should be made with the shortest possible test leads and preferably in a faraday cage. This has been recognized in setting up the test. The test section will be in a steel cabinet which will also function as a faraday cage. Dr. Leonard and the Wright-Patterson people are experienced in taking capacitance measurements and are aware of the need for short test leads.

Although we are aware of the need to measure water content in fuel, the method description and specific step of conducting the measurement was not in the test plan. These will be added and we will have opportunity to discuss the methods available when we are in Dayton.

One comment asked whether we would use a cracked "Y" tube that was found in another TWA B-747 (17107). Unfortunately, the cracked "Y" section of tube was reportedly scrapped. Wright-Patterson is preparing test sections with actual cracks for our use.

Again, thank you for your assistance.

Sincerely,



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