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AEROSPACE RECOMMENDED PRACTICE

ARP 775

Test Procedure to Determine Surge Potential
of Ground Pressure Fueling Systems

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Revised

1. INTRODUCTION

In recent years aircraft have been fueled by ground pressure fueling systems to reduce the servicing time and the hazards associated with possible spillage of the gravity fueling means. The higher flow rates associated with pressure fueling can cause and in some instances have caused damaging surge pressures on aircraft fuel systems.

"Surge pressure" is defined as "the sum of the initial pressure at the point of measurement, the surge rise, and the recovered hydraulic losses from pump to point of measurement." The "sum" appears as the maximum, or peak, instrumentation readout, and shall not exceed 120 psi for most present-day aircraft. These surge pressures occur with the closure of valves within the airplane. They are not caused solely by the aircraft fuel system for the reason that the surge characteristic of the ground system is also a contributing factor. When a ground pressure fueling system is connected to an airplane and flow into the airplane is established, the two systems must be considered one for the purpose of evaluating surge. The principal factors affecting surge in such a combined system are:

- The closure time and rate of change of flow area of the aircraft level control or shutoff valves.
- Surge prevention features of the level control valves.
- Line velocities.
- Length and modulus of elasticity of pipe, tubing and hose.
- Bulk modulus of the fuel.
- Temperature and specific gravity of the fuel.
- Flow pressure.
- Surge suppression devices, such as accumulators in the ground system.
- Response rate of surge control devices in the ground system.

For additional discussion, reference is made to SAE AIR 74, "Consideration on Limiting Pressure Surge During Ground Pressure Refueling of Aircraft".

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2. SCOPE

This ARP establishes an allowable surge limit and a method of testing to determine the surge potential, under conditions specified herein, of ground pressure fueling systems used in refueling most present-day aircraft and applies to both fixed and mobile systems. The principal conditions describing aircraft that may be fueled with a ground refueling system, meeting the requirements of this procedure, are as follows:

- Design fueling nozzle pressure of 50 ± 5 PSIG.
- Allowable surge peak of 120 PSIG maximum.

NOTE: The valve closure time, pressure and plumbing configurations specified in this procedure were selected to be compatible with aircraft designed to be fueled using established ground fueling equipment such as specified in MIL-F-26887C (Fuel Servicing Unit, Type MH-2A). They were not designed to simulate an actual aircraft fuel system. Some aircraft may not necessarily be designed for fueling with equipment meeting the requirements of this procedure. In these special cases it will be necessary to establish different test shutoff times, acceptance criteria, etc. Those concerned with surge evaluation of these ground systems are referred to SAE AIR 74.

3. PROCEDURE

3.1 Test Equipment

3.1.1 Single Hose System: The ground pressure fueling system shall be connected to a test setup, for a single hose system, as shown in Figure 1. The ground pressure system shall terminate in a pressure fueling nozzle (2), which has connected to it a pressure gage (1). The nozzle shall be coupled to an adapter (3) which is fastened to a segment of line (4). This line shall be of a diameter matching the size of the ground system fueling hose with the distance from the adapter to the test shutoff valve equal to approximately 30 diameters of servicing hose. A pressure transducer (5) of suitable pressure range shall be installed in the section of line between the adapter and a test shutoff valve (6). The test shutoff valve shall be capable of closing within 0.5 second, in a near linear manner, and shall include a means of measuring its shutoff time within $\pm 5\%$. To insure adequate flow through the test system, the pressure drop of the test shutoff valve, in its full open position, shall not be greater than that equivalent to 50 diameters of its adjacent tubing. The pressure transducer shall be connected to a surge pressure measuring device, such as an oscillograph. The surge pressure measuring equipment shall have a suitable pressure range and shall have a minimum frequency response of 600 CPS.

The outlet of the test shutoff valve shall be connected to a length of discharge line (7), terminating in a catch tank of suitable volume (9). A flow control valve (8), shall be installed in the discharge line segment as illustrated. The flow control valve shall be readily adjustable for throttling and shall have a maximum pressure drop in its full open position equivalent to 100 diameters of its matching line. The overall length of the discharge line segment shall not exceed 50 diameters.