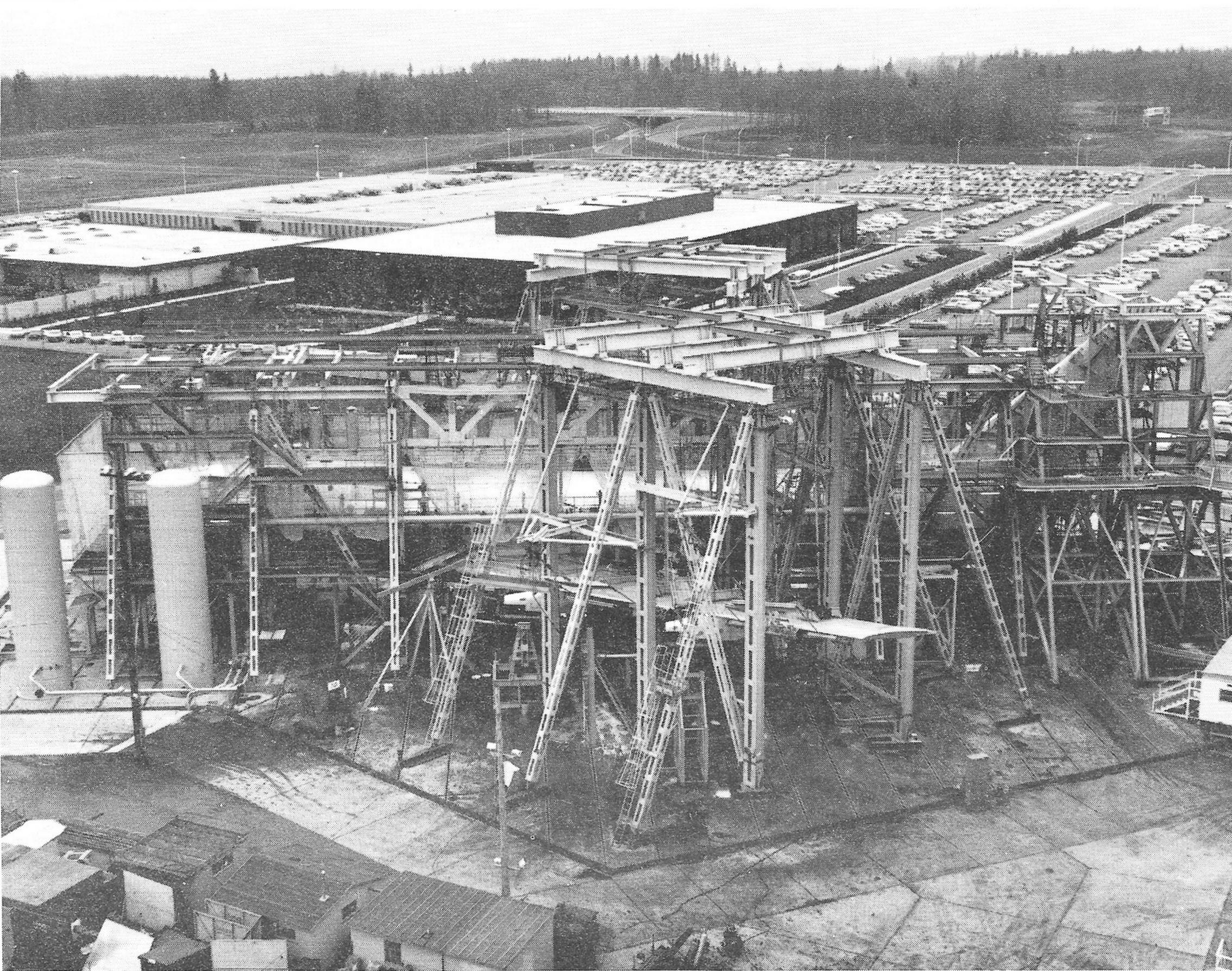


747 FULL SCALE FATIGUE TEST

D6-13050-777

747 FULL SCALE FATIGUE TEST



TEST OBJECTIVES

- To locate as quickly as possible any fatigue critical areas with a program accurately representing typical service loads.
- To provide test data for analytical service life predictions.
- To help develop inspection and maintenance procedures for the airlines.
- To evaluate "Fail Safe" characteristics of major structural parts.

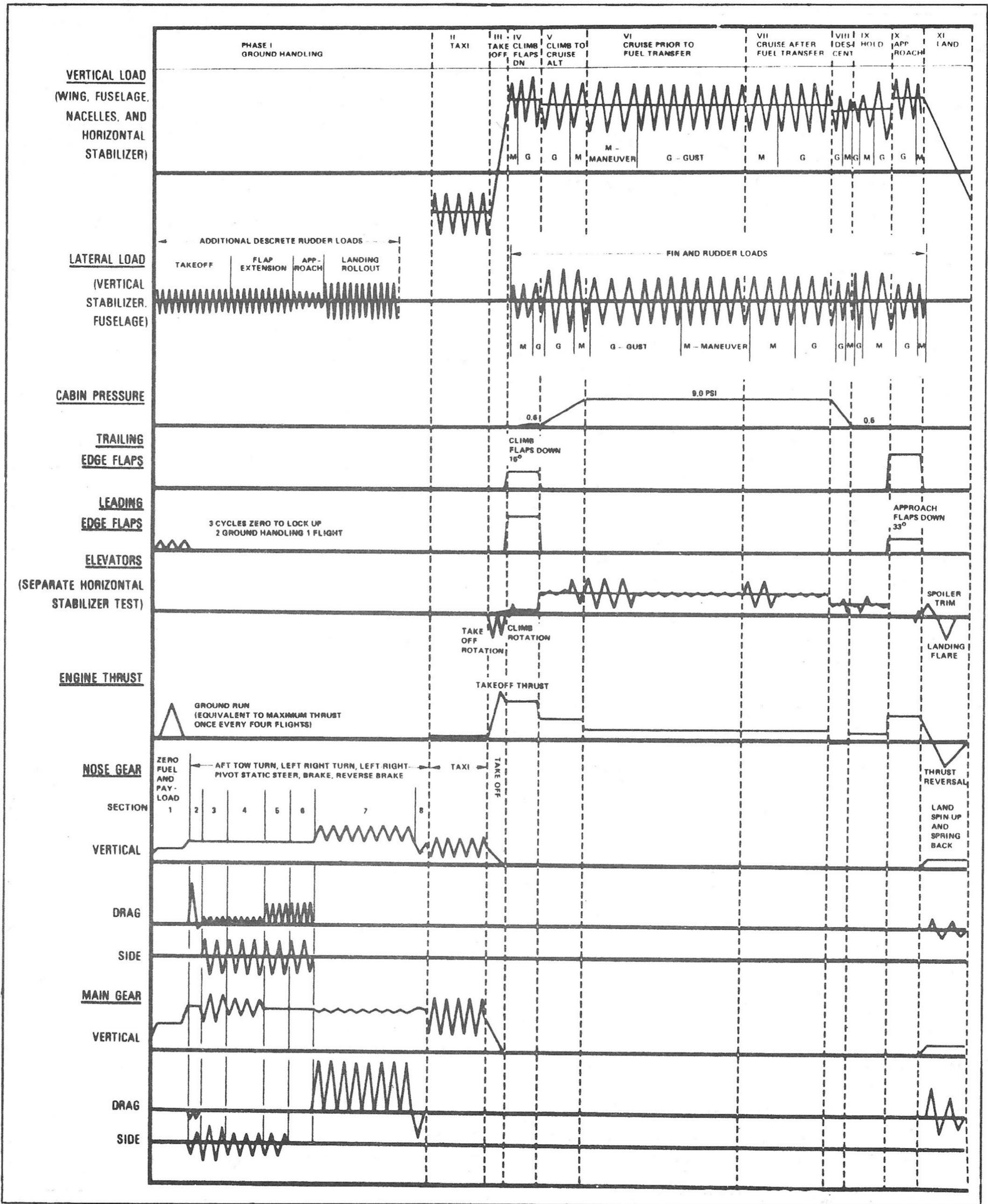
TEST SPECIMEN

The test specimen is a structurally complete 747 airframe of typical production configuration. Omitted are main and nose landing gear, trailing edge flaps except lefthand inboard, leading edge flaps except lefthand flap numbers 3, 7 and 12, ailerons, spoilers, engine pod and the horizontal stabilizer which is tested separately. Except for the ailerons and spoilers, loads are applied through representative dummy structure for the major components omitted from the test.

TEST LOADS

A flight by flight load spectrum is being applied in less than ten minutes. The test spectrum represents an average 3 hour flight derived from analysis of airlines expected usage of the airplane. Included in the spectrum are loads representing damage caused by vertical and lateral gusts and maneuvers, discrete rudder loads, leading and trailing edge flap loads, taxi, ground handling and engine thrust loads. Horizontal tail loads and elevator loads are applied in the separate stabilizer test with the same resultant loads applied through a dummy stabilizer on the major test. Cabin pressure is applied in conjunction with the other loads in a representative manner. (See diagram of test spectrum.) The current plan is to test the airframe and horizontal stabilizer to two lifetimes, or the equivalent of 120,000 hours typical service flying.

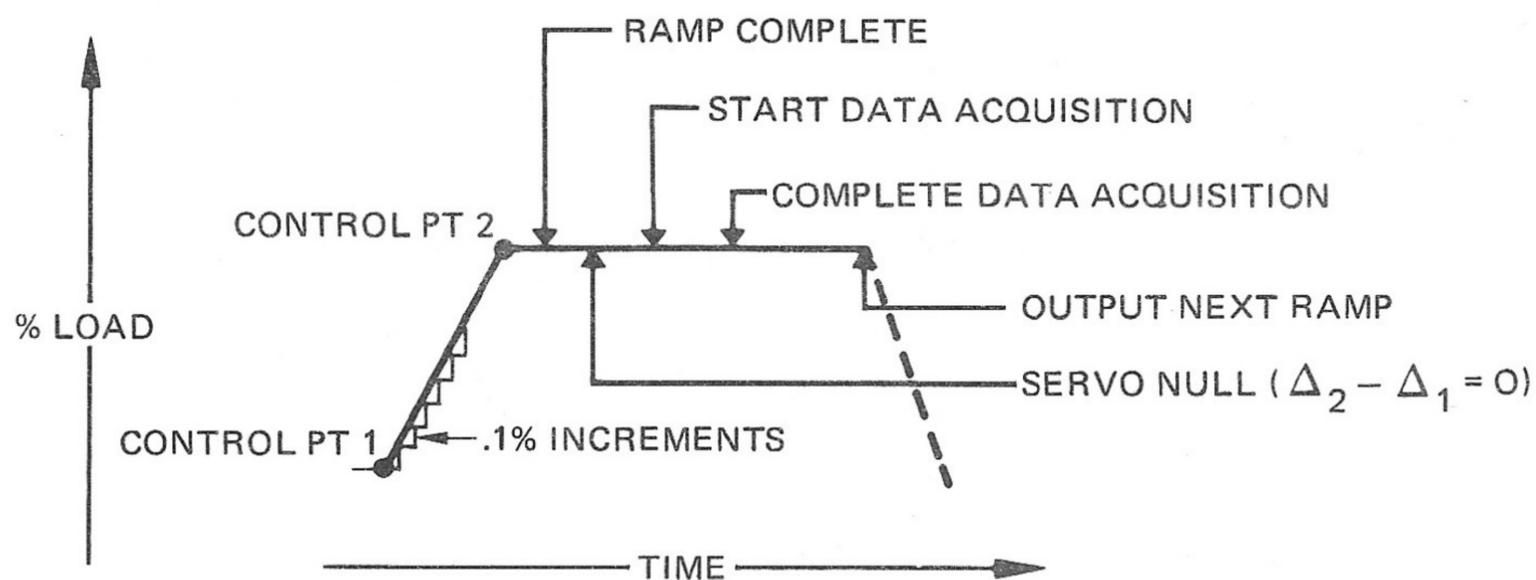
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MAJOR TEST

Loads are applied to the airplane using 86 hydraulic actuators. These are controlled by an automatic closed loop electro hydraulic servo system. The command or program signal is supplied to the servo systems by a digital programmer. This programmer and the data acquisition functions for the test are controlled by a Digital Equipment Corporation PDP-8 computer. The computer is also used to automate many of the operating functions of the test.

The sequence of events or commands at each spectrum control point is shown:



Sequence of Events

- The computer outputs the ramp between control pt 1 and control pt 2 in .1% increments.
- After the program signal arrives at the control pt value, the programmer holds until all systems are applying the control point load value within the assigned tolerance.
- The data acquisition system takes a scan of data for all systems and stores the values. Applied load values for one spectrum are held in storage.
- The computer then outputs the next ramp.

Specimen Protection

To protect the test specimen against error in the test loads a lockup manifold is installed on each hydraulic actuator. When the lockup system is actuated the actuator becomes a solid link and remains that way until the problem is corrected.

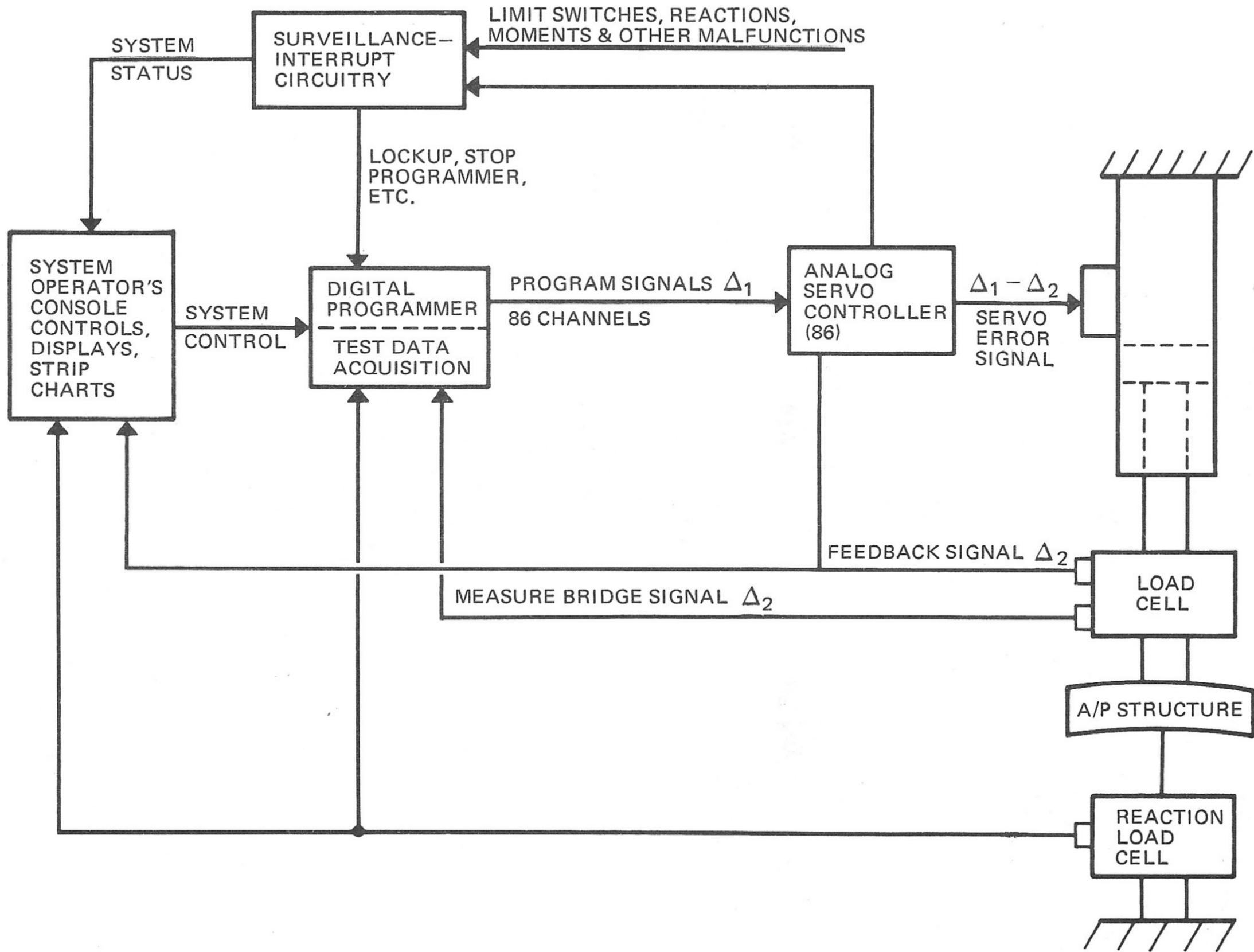
Stainless steel safety links are included in all load systems attached to the airplane. These are designed to yield before local airplane structure is damaged by inadvertent overloading.

A two way load relief valve is also installed in the hydraulic system at each load system to limit the actuator pressure and thereby prevent an overload.

STABILIZER

The fatigue test of the horizontal stabilizer is conducted as a separate test. The hydraulic supply is shared with the major test. The method of load application and control is similar to that used on the major test since both tests use digital programming and analog control. Fourteen load control systems are used on the stabilizer fatigue test.

FATIGUE TEST CONTROL & DATA SYSTEM



Actual load or load cell output Δ_2 is subtracted from the programmer output Δ_1 at the servo controller. The difference in signal $\Delta_1 - \Delta_2$ controls the action of the servo valve which outputs hydraulic pressure in proportion to the input signal. A zero signal ($\Delta_1 - \Delta_2 = 0$) means that the actual load being applied is equal to the programmed or desired load.