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QUALIFICATION EVALUATION OF THE TOWER JETTISON MOTOR FOR THE APOLLO SPACECRAFT PROGRAM LAUNCH ESCAPE SYSTEM

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16. ABSTRACT

A summary is presented of the qualification test program (consisting of environmental testing and static test firing) of the Apollo tower jettison motor. In addition, the static-test-firing data are evaluated statistically with regard to the specifications. The environmental testing phase of the qualification test program was conducted by using 15 Apollo tower jettison motors divided into the following environmental test groups: test group A — temperature cycling; test group B — accelerated aging; test group C — temperature cycling and impact testing; and test group D — vibration testing, temperature cycling, and impact testing. The static-test-firing phase of the qualification test program was conducted by using 21 Apollo tower jettison motors of which 15 were tested environmentally and six were not tested environmentally. The 21 motors were assigned to three prefire-conditioning temperature groups: 20° F (nine motors), 70° F (five motors), and 140° F (seven motors). Each motor was static test fired at a nominal pressure altitude of 14.7 psia. From an analysis of the results of the qualification tests, it was confirmed that the tower jettison motor meets the requirements of the Apollo Spacecraft Program.

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SUMMARY

The Apollo spacecraft launch escape system provides the capability for a successful mission abort if any system affecting crew safety should malfunction. The launch escape system is designed to provide this capability from the earliest practicable time following crew insertion into the command module until the launch escape system is jettisoned from, and out of the path of, the command module shortly after the launch vehicle second-stage ignition and staging. If any system affecting crew safety should malfunction, the launch escape system will separate the command module from, and out of the path of, the launch vehicle. Propulsion for the launch escape system is provided by the launch escape, pitch control, and tower jettison motors.

To evaluate the performance of each motor, programs were established for development, qualification, and flight tests. A summary is presented of the qualification test program, which includes environmental testing and static test firing, of the tower jettison motor. In addition, the static-test-firing data are evaluated statistically with regard to the specifications.

The environmental testing phase of the qualification test program was conducted by using 15 tower jettison motors that were divided into the following environmental test groups:

1. Group A — temperature cycling

2. Group B — accelerated aging

3. Group C — temperature cycling and impact testing

4. Group D — vibration testing, temperature cycling, and impact testing

The static-test-firing phase of the qualification test program was conducted by using 21 tower jettison motors of which 15 were tested environmentally and six were not tested environmentally. These 21 motors were assigned to three prefire-conditioning temperature groups: 20° F (nine motors), 70° F (five motors), and 140° F (seven motors). The motors were static test fired at a nominal pressure altitude of 14.7 psia.

The Apollo tower jettison motor specifications require that certain performance parameters meet specific tolerance limits at prefire-conditioning temperatures of 20°, 70°, and 140° F.

Because a solid-propellant rocket motor of fixed geometry and given propellant will yield a different performance at differing prefire-conditioning temperatures, and since there were only a limited number of motors allotted to the qualification test program, all motor performance data were transformed to the specified 20°, 70°, and 140° F prefire-conditioning temperatures to increase the statistical confidence; a statistical analysis was then performed on these transformed data. From an analysis of the results of the qualification tests, it was confirmed that the tower jettison motor meets the specifications of the Apollo Spacecraft Program.

INTRODUCTION

The Apollo spacecraft launch escape system (LES) (figs. 1 and 2) provides the capability for a successful mission abort if any system affecting crew safety should malfunction. The LES is designed to provide this capability from the earliest practicable time following crew insertion into the command module until the LES is jettisoned from, and out of the path of, the command module (CM) shortly after the launch vehicle second-stage ignition and staging. If any system affecting crew safety should malfunction, the LES will separate the CM from, and out of the path of, the launch vehicle (LV).

The LES (fig. 2) consists of the following:

1. The Q-ball assembly (located at the forward extremity of the LES) provides the aerodynamic incidence-angle and dynamic-pressure measurements that are required by the LV and the launch escape emergency detection system.

2. The canard assembly (an aerodynamic control mechanism) reorients the separated CM/LES in a heat-shield-forward attitude to allow satisfactory deployment of the earth recovery system after the LES is jettisoned from the CM and removed from the CM path.

3. The ballast provides aerodynamic stability for the CM/LES after separation from the LV.

4. The launch escape motor (a 3.23-KS-139400 solid-propellant rocket motor) provides the LES propulsion to separate the CM from, and out of the path of, the LV. A nominal thrust-vector angle of approximately 2.75° from the motor longitudinal axis is required for the removal of the CM/LES from the path of the LV. To provide the correct thrust-vector angle, the throat area of one of the two nozzles in the pitch plane is approximately 15 percent larger than the throat area of either of the two yaw-plane nozzles that are approximately equal in size. The throat area of the second nozzle in the pitch plane is approximately 13 percent smaller than the throat area of either of the two nozzles in the yaw plane. During a nominal flight, the launch escape motor can be used to jettison the LES if the tower jettison motor malfunctions.

5. The pitch control motor (a 0.62-KS-2170 solid-propellant rocket motor), which is ignited in conjunction with the launch escape motor, is used to provide a 15° to 20° down-range pitchover of the CM/LES immediately after initiation of a mission abort either from the launch pad or until 41 seconds after lift-off, at which time an altitude of approximately 10 000 feet is reached.

6. The tower jettison motor (a 1.2-KS-33000 solid-propellant rocket motor) provides the primary propulsion to jettison the LES from the CM after the LV second-stage ignition and staging. A nominal thrust-vector angle of approximately 4° from the motor longitudinal axis is required for the removal of the jettisoned LES from the CM path. To provide the correct thrust-vector angle, the throat area of one of the two tower-jettison-motor nozzles is approximately 16 percent larger than the throat area of the other nozzle. During a mission abort, the tower jettison motor is used to separate the LES from the CM (after burnout of the launch escape and pitch control motors) and to remove the LES from the CM path.

7. A tower structure forms the intermediate construction between the CM and the launch escape motor.

8. A boost protective cover shields the CM thermal coating, windows, and forward heat shield from the dynamic-pressure and aerodynamic-heating environment imposed during booster operations and from the launch-escape-motor and tower-jettison-motor exhaust products.

To evaluate the performance of the launch escape, pitch control, and tower jettison motors, programs were established for development, qualification, and flight tests. A summary of the tower-jettison-motor qualification test program, which included environmental testing and static test firing, is presented. In addition, the static-test-firing data are evaluated statistically with regard to the specifications.

SYMBOLS

A_t	throat area, in^2
C^*	characteristic exhaust velocity, ft/sec
$\overline{C}^*$	average characteristic exhaust velocity, ft/sec
F	resultant thrust, lb_f
$\overline{F}_a$	average resultant thrust during action time, lb_f
$\overline{F}_b$	average resultant thrust during web burn time, lb_f
$F_{max.}$	maximum resultant thrust, lb_f

$\overline{F}_t$ average resultant thrust during total time, lb_f

$\overline{F}_{tail}$ average resultant thrust during tailoff time, lb_f

g^2/Hz acceleration density

g_c gravitational conversion factor, 32.174 lb_m-ft/lb_f-sec^2

I resultant impulse, lb_f-sec

I_a resultant impulse during action time, lb_f-sec

I_b resultant impulse during web burn time, lb_f-sec

I_{sp} resultant propellant specific impulse, lb_f-sec/lb_m

I_t resultant impulse during total time, lb_f-sec

I_{tail} resultant impulse during tailoff time, lb_f-sec

$\overline{I}_{sp, a}$ resultant average propellant specific impulse during action time, lb_f-sec/lb_m

$\overline{I}_{sp, b}$ resultant average propellant specific impulse during web burn time, lb_f-sec/lb_m

$\overline{I}_{sp, t}$ resultant average propellant specific impulse during total time, lb_f-sec/lb_m

$\overline{I}_{sp, tail}$ resultant average propellant specific impulse during tailoff time, lb_f-sec/lb_m

P chamber pressure, psia

$P_{max.}$ maximum chamber pressure, psia

$\overline{P}_a$ average chamber pressure during action time, psia

$\overline{P}_b$ average chamber pressure during web burn time, psia

$\overline{P}_t$ average chamber pressure during total time, psia

$\overline{P}_{tail}$ average chamber pressure during tailoff time, psia

r	burning rate, in/sec
$\bar{r}_b$	average burning rate during web burn time, in/sec
T	temperature, °F
T_a	autoignition temperature, °F
T_f	flame temperature at 1000 psia, °F
T_p	prefire-conditioning temperature, °F
t	time, sec
t_a	action time, sec
t_b	web burn time, sec
t_d	ignition-delay time, sec
t_f	thrust-rise time, sec
$t_{f_{max.}}$	time of maximum resultant thrust, sec
t_t	total time, sec
t_{tail}	tailoff time, sec
W_p	propellant weight, lb_m
γ	exhaust gas specific heat ratio
θ	resultant thrust-vector excursion angle, deg
ρ	propellant density, lb_m/in^3

Subscripts:

f	force
m	weight

TOWER JETTISON MOTOR DESCRIPTION

The TE-380 solid-propellant rocket motor is a full-scale flightweight motor which was designed and developed as the tower jettison motor (fig. 3) for the Apollo LES. The interstage structure, designed and developed with the motor, is the intermediate structure between the tower jettison motor and the launch escape motor. The cylindrical motor-interstage assembly has a 26-inch diameter, a 55.6-inch length, and a 527-pound weight. Nominal motor performance at a prefire-conditioning temperature of 70° F, during a 1.1-second web burn time, achieves a 1330-psia chamber pressure, a 31 660-lb_f resultant thrust (at sea level pressure altitude), and a 4° pitch angle.

The combustion chamber is constructed from an AISI 4135 steel forging that is machined into a cylinder 26 inches in diameter and 15.4 inches long. The cylinder has an oblique, hemispherical, head-end closure (one piece, no structural welds) and an oblique, hemispherical, bolt-on aft closure that is also machined from an AISI 4135 steel forging. The cylindrical and head-end regions of the combustion chamber are lined with 0.015-inch-thick TL-L-300 liner. The aft closure is lined with 0.030-inch-thick TL-L-300 liner. Attachment rings with clearance holes are integral parts of the combustion chamber head-end closure and aft closure. The head-end closure ring contains 32 equally spaced clearance holes, each of which incorporates an anchor nut, and one offset clearance hole with anchor nut (for an alinement index) by which the tower jettison motor is attached to the upper portion of the LES. The aft closure ring contains 48 equally spaced clearance holes and one offset clearance hole (for an alinement index) by which the tower jettison motor is attached to the interstage structure.

The aft closure incorporates provisions for the installation of a rocket-type igniter, an interstage structure, and two fixed, nonconventional nozzles that are submerged 2.4 inches into the combustion chamber. The nozzles, bolted to the aft closure to form cant angles of 30° to the motor longitudinal center line, extend through the interstage structure wall. Each 10° half-angle oblique-truncated conical nozzle (fig. 4) is machined from an AISI 4130 steel forging and contains an HLM-85 high-density graphite throat insert. An 0.08-inch-thick cylinder of R 42 RPD insulation is installed externally on the forward end of each nozzle to provide thermal protection for the portion of the nozzle submerged into the combustion chamber. To produce the required pitch angle of approximately 4°, the throat area of one of the two nozzles is approximately 16 percent larger than the throat area of the other nozzle. The normal expansion ratio is approximately 4 to 1 at the beginning of the skew and approximately 14 to 1 at the exit plane. Each nozzle contains an HD-300 styrofoam closure that is bonded with TCC TA-L-318A adhesive into the converging region of the nozzle to seal the motor combustion chamber. This seal is used to maintain prelaunch ambient pressure within the motor combustion chamber until motor ignition. Insulation from aerodynamic heating is provided by an 0.3-inch-thick disk of A 2775 insulcork that is bonded to the downstream face of the nozzle closure.

The composite solid-propellant grain consists of approximately 205 lb_m of TCC TP-E-8104 polysulfide ammonium perchlorate propellant (table I), which is cast directly against the TCC TL-L-300 liner. The propellant contains a 10-point double-web internal-burning star perforation (fig. 5).

The interstage structure has a 26-inch diameter, a 30-inch length, and a 90.3-lb_m weight. The interstage cylindrical skin is constructed of a 0.050-inch-thick sheet of 1/4-hard type 301 stainless steel. Two 0.062-inch-thick partial inner sheets (or doublers), also composed of 1/4-hard type 301 stainless steel, are rolled and spotwelded to the length of the interstage structure inner surface that covers the area of each nozzle opening (fig. 3(b)). Additional strength is provided by 18 longitudinal hat-section-type stiffeners of 1/4-hard type 301 stainless steel that are spotwelded to the cylindrical skin inner surface. The arrangement of these stiffeners is devised to allow for four electrical access panels and two elliptical openings for the nozzles. The electrical access panels provide for entrance to the assembled motor for the installation of the igniter cartridges and allied equipment. The elliptical openings, through which the nozzles extend, are located on either side of the interstage structure. A 0.125-inch-thick attachment ring of 1/2-hard type 301 stainless steel is spotwelded and riveted to each end of the interstage structure. Clearance holes and anchor nuts are provided in the rings for the attachment of one end of the interstage structure to the tower jettison motor and for the attachment of the other end of the interstage structure to the launch escape motor.

Each tower jettison motor is ignited by a TE-381 rocket-type igniter (figs. 6(a) and 6(b)). The TE-381 igniter is mounted into a boss in the motor aft closure. The boss is concentric with the motor longitudinal axis. Igniter ignition is accomplished by two pyrotechnic igniter cartridges, each of which consists of a booster charge and the Apollo standard initiator (a hot bridgewire-type initiator) (figs. 6(c) and 6(d)).

The cylindrical TE-381 igniter combustion chamber, machined from a heat-treated AISI 4130 steel forging, is 5.3 inches in diameter and 5.7 inches long. The igniter combustion chamber has a flat head-end closure (one piece, no structural welds) and a screw-in aft closure (nozzle body) that is also machined from an AISI 4130 steel forging. The head-end closure incorporates provisions for the installation of two igniter cartridges, a pressure takeoff port, and a pellet-container assembly, which is machined from an AISI 410 stainless steel forging. The pellet-container assembly contains 12 grams of 2A U.S. Flare boron-potassium nitrate pellets and is sealed at the forward face by an 850 3M tape disk and at the aft end by 473 3M tape (figs. 6(e) and 6(f)). The nozzle body is insulated by GT Gen-Gard V-44 asbestos-filled 0.060-inch-thick buna N rubber that is bonded to the forward face and by 0.188-inch-thick fiberite MX-2625 silica phenolic that is bonded to the aft face.

The composite solid-propellant igniter grain consists of approximately 1.83 pounds of TCC TP-E-8104 polysulfide ammonium perchlorate propellant. The propellant is cast in a liner tube of Mil-P-79-type PBG paper-base phenolic. The tube has a 3.534-inch inside diameter, a 0.050-inch thickness, and a 12-inch length. The cast grain is inserted into the igniter case and bonded into place.

ENVIRONMENTAL TESTING

The environmental testing phase of the qualification test program (table II, refs. 1 and 2) was conducted by using 15 tower jettison motors that were assigned to the following environmental test groups:

1. Group A — temperature cycling
2. Group B — accelerated aging
3. Group C — temperature cycling and impact testing
4. Group D — vibration testing, temperature cycling, and impact testing

The procedures for each test group were conducted in the following manner.

Temperature Cycling

Tower jettison motors serial number (SN) AQ-VII-1, SN AQ-VIII-1, SN AQ-IX-1, SN AQ-IX-2, SN AQ-IX-3, SN AQ-IX-4, and SN AQ-XI-1 were assigned to test group A, temperature cycling. Motors SN AQ-VIII-1, SN AQ-IX-1, SN AQ-IX-2, SN AQ-IX-3 and SN AQ-IX-4 were temperature cycled by successive stabilization at 140°, -20°, 140°, -20°, and 140° F. Motors SN AQ-VII-1 and SN AQ-XI-1 were temperature cycled by successive stabilization at -20°, 140°, -20°, 140°, and -20° F. After being temperature cycled, all motors were inspected visually and found to be free of defect.

Accelerated Aging

Tower jettison motors SN AQ-X-1 and SN AQ-X-2, assigned to test group B, were aged for 75 days at 160° F. Both motors were then static test fired.

Temperature Cycling and Impact Testing

Tower jettison motors SN AQ-V-1 and SN AQ-V-2 were assigned to test group C for temperature cycling and impact testing. Motor SN AQ-V-1 was placed in a shipping container, and with the shipping container lid removed, the motor was temperature cycled by successive stabilization at 140°, -20°, 140°, -20°, and 140° F. The motor was stabilized at 70° F, and the lid was reinstalled on the shipping container. The container was removed from the temperature-conditioning unit, delivered to the drop-test facility, and positioned with one end of the container base on a sill 5 inches high. The opposite end of the container base was raised to 18 inches and allowed to free fall onto solid, reinforced concrete (fig. 7(a)). This edgewise drop test was applied once to each end of the container. During the edgewise drop-test preparations, the motor and the shipping container were exposed to ambient temperature for 16 minutes.

Motor SN AQ-V-2 was placed in a shipping container, and with the shipping container lid removed, the motor was temperature cycled by successive stabilization at -20°, 140°, -20°, 140°, and -20° F. The motor was stabilized at 70° F, and the lid was reinstalled on the shipping container. The container was removed from the temperature-conditioning unit, delivered to the impact-test facility, and positioned with the longitudinal axis vertical (head end of the motor down). A cable, which had a minimum swing radius of 16 feet, was attached to each of the four shipping container suspension rails. The container was pulled back in a pendulum fashion until the center of gravity had been raised 9 inches. The container then was released and permitted to swing free into a rigid barrier (fig. 7(b)). During the pendulum impact-test preparations, the motor and the shipping container were exposed to ambient temperature for 28 minutes.

Vibration Testing, Temperature Cycling, and Impact Testing

Tower jettison motors SN AQ-IV-1, SN AQ-IV-2, SN AQ-VI-1, and SN AQ-VI-2 were assigned to test group D — vibration testing, temperature cycling, and impact testing. The following procedures were used.

Vibration testing. - Accelerometers (fig. 8(a)) and thermocouples (fig. 8(b)) were mounted on each test-motor assembly. The motors with the igniters in place (minus igniter cartridges and with the cartridge ports plugged) were installed in the longitudinal-axis vibration test fixture (or in the test fixture used for both lateral and transverse vibration testing) and then mounted on a vibration slip plate affixed to an electrodynamic vibration exciter. The two igniter cartridges assigned to each test motor were also mounted on each vibration test fixture in each vibration axis and were subjected to the vibration loads simultaneously with the motor assembly.

All vibration tests were conducted with the motor in the upright position (thrust axis vertical, nozzle end down), and all excitation loads were applied through the motor-interstage-assembly center of gravity in the longitudinal, lateral, or transverse axes. Each motor was attached to the longitudinal-axis vibration test fixture with the anchor nut that is incorporated in each of the interstage aft-attachment-ring clearance holes (fig. 9(a)). Each motor was attached to the lateral (transverse) axis vibration test fixture with anchor nuts that are incorporated in each of the motor head-end-attachment-ring clearance holes (figs. 9(b) and 9(c)).

A box-shaped temperature conditioning unit was installed over the vibration test assembly. Throughout each vibration test, the temperature in the unit was maintained at 140° F for motors SN AQ-IV-1 and SN AQ-IV-2 and at -20° F for motors SN AQ-VI-1, and SN AQ-VI-2 (fig. 9(d)).

The motors were subjected for 5 minutes to random vibration that consisted of white Gaussian noise through the frequency range of 20 to 2000 hertz. The input level was 0.07 g^2/Hz both in the lateral axis (in the plane of the nozzles) and in the transverse axis (perpendicular to both the lateral and the longitudinal axes) and 0.03 g^2/Hz in the longitudinal axis (the motor longitudinal center line).

During vibration testing in the transverse axis of motor SN AQ-IV-2, the potting material (between the end of the nozzle and the interstage structure) was observed to be cracked in several places on both nozzles. These cracks were not considered to be damage or deformation, nor were the cracks severe enough to impair the operation characteristics of the motor or to affect the integrity of the motor-interstage assembly.

Temperature cycling and impact testing. - Motor SN AQ-IV-1 was placed in a shipping container, and with the shipping container lid removed, the motor was temperature cycled by successive stabilization at 140°, -20°, 140°, -20°, and 140° F. At 140° F, the lid was reinstalled on the shipping container. The container was removed from the temperature-conditioning unit, delivered to the drop-test facility, and positioned for edgewise drop testing as previously described for motor SN AQ-V-1 (fig. 7(a)). During the edgewise drop-test preparations, the motor and shipping container were exposed to ambient temperature for 15 minutes.

Motor SN AQ-IV-2 was placed in a shipping container, and with the shipping container lid removed, the motor was temperature cycled by successive stabilization at -20°, 140°, -20°, 140°, and -20° F. The motor was stabilized at 140° F, and the lid was reinstalled on the shipping container. The container was removed from the temperature-conditioning unit, delivered to the drop-test facility, and positioned with one corner of the container base on a block 5 inches high. A block 12 inches high was placed under the other corner of the same end. The opposite end of the container base was raised 18 inches and allowed to free fall onto solid, reinforced concrete (fig. 9(e)). This cornerwise drop test was applied once to each of two diagonally opposite corners of the shipping container base. During the cornerwise drop-test preparations, the motor and the shipping container were exposed to ambient temperature for 15 minutes.

Motor SN AQ-VI-1 was placed in a shipping container, and with the shipping container lid removed, the motor was temperature cycled by successive stabilization at 140°, -20°, 140°, -20°, and 140° F. The motor was stabilized at -20° F, and the lid was reinstalled on the shipping container. The container was removed from the temperature-conditioning unit, delivered to the drop-test facility, and positioned for cornerwise drop testing as previously described for motor SN AQ-IV-2 (fig. 9(e)). During the cornerwise drop-test preparations, the motor and the shipping container were exposed to ambient temperature for 25 minutes.

Motor SN AQ-VI-2 was placed in a shipping container, and with the shipping container lid removed, the motor was temperature cycled by successive stabilization at -20°, 140°, -20°, 140°, and -20° F. At -20° F, the lid was reinstalled on the shipping container. The container was removed from the temperature-conditioning unit, delivered to the impact-test facility, and positioned for pendulum impact testing as previously described for motor SN AQ-V-2 (fig. 7(b)). During the pendulum impact-test preparations, the motor and shipping container were exposed to ambient temperature for 29 minutes.

STATIC TEST FIRING

The static-test-firing phase of the qualification test program (refs. 1 and 2) was conducted by using 21 tower jettison motors of which 15 had been tested environmentally and six had not been tested environmentally (table III).

Installation

The motors were mounted in a thrust cradle that was supported from the cradle support stand by three vertical double-flexure columns (stiff links), one longitudinal (horizontal) double-ball-joint column, and two side (horizontal) double-flexure columns. The longitudinal double-ball-joint column and the two side double-flexure columns incorporated load cells to measure the longitudinal thrust component and the side thrust components, respectively. Schematic diagrams and photographs of the test stand are shown in figures 10(a) to 10(e). The thrust-measuring system is unique because the longitudinal thrust component is measured through the interstage aft attachment ring to the TE-380 motor (load cell in tension).

Instrumentation

Instrumentation was provided to measure longitudinal thrust, forward and aft side thrusts, combustion chamber pressure, igniter chamber pressure, ignition current, and ignition voltage. Instrument ranges, recording methods, and system accuracies for all measured parameters are presented in table IV. Longitudinal thrust was measured by the use of a double-bridge strain-gage-type load cell; forward and aft side thrusts were measured by the use of two double-bridge strain-gage-type load cells; and motor combustion chamber pressure and igniter combustion chamber pressure were measured by the use of bonded strain-gage-type pressure transducers. The output signal of each measuring device was filtered and recorded on magnetic tape from a multi-input high-speed analog-to-digital converter for later reduction by an electronic digital computer.

A photographically recording galvanometer-type oscillograph, operating at a paper speed of 64 in/sec, was used to provide an independent record of data from all operating instrumentation channels. In addition, standard-speed and high-speed motion-picture cameras were used to provide a permanent visual record of the static test firings.

Calibration

The pressure transducers and thrust load cells were calibrated in the laboratory prior to use in the static-test-firing program. The instrumentation systems, with pressure transducers and thrust load cells installed, were calibrated electrically before and after each test firing by using resistances in the transducer circuits to simulate selected pressures or thrust levels. The thrust-measuring systems also were calibrated in place by using hydraulically actuated pull rods that exerted a longitudinal force, a forward side force, or an aft side force through the thrust-cradle, ball-joint, and flexure systems to the measuring load cells and to an accurately calibrated load cell mounted ahead of the forward thrust buttress, the forward side-thrust buttress, and the aft side-thrust buttress. Only the longitudinal inplace calibration system is shown in figures 10(a) and 10(b). Calibration loads were applied in both the positive (compression) and the negative (tension) directions; this calibration technique compensated for a possible slope change on a load cell when switching from a negative- to a positive-applied load. Both the electronic and the hydraulic inplace calibrations were used for the thrust-measuring-system data-reduction technique.

Preselected Controlled Static-Test-Firing Conditions

The 21 motors to be static test fired were divided into three prefire-conditioning temperature groups: 20° F (nine motors), 70° F (five motors), and 140° F (seven motors). Each temperature group was subdivided into the following ignition categories.

1. Category 1 — Simulated only a failed igniter cartridge

2. Category 2 — Simulated only a failed nozzle closure

3. Category 3 — Simulated a failed igniter cartridge and simulated a failed nozzle closure

4. Category 4 — Simulated normal ignition conditions

The nine motors assigned to the 20° F temperature group were subdivided into ignition categories as follows: category 1, one motor; category 2, three motors; category 3, two motors; and category 4, three motors. Motor SN-AQ-III-2 in category 4 of this temperature group experienced a failure of its interstage structure during the ignition transient of the static test firing, with subsequent destruction of the motor assembly. Consequently, all static test performance data for this motor are deleted from the performance evaluation. The justification for deletion of these data is presented in the section entitled "Failure Analysis."

The five motors assigned to the 70° F temperature group were subdivided into ignition categories as follows: category 1, none; category 2, two motors; category 3, one motor; and category 4, two motors. Data are available from all motors in this group.

The seven motors assigned to the 140° F temperature group were subdivided into ignition categories as follows: category 1, one motor; category 2, four motors; category 3, one motor; and category 4, one motor. Motors SN AQ-V-1 and SN AQ-X-1 in category 2 and motor SN AQ-VIII-1 in category 3 of this temperature group displayed unusually long igniter ignition-delay times, which resulted in prolonged ignition-delay times, thrust-rise times, and total firing times for each motor. Consequently, these data were deleted from the performance evaluation. The justification for deletion of these data is presented in the section entitled "Failure Analysis."

Motor Performance Data and Analysis

The static-test-firing motor performance data are summarized in table III and are presented in figures 11 to 23. The motors were static test fired at a nominal pressure altitude of 14.7 psia (sea level). Therefore, all motor performance data are values obtained at approximately sea-level pressure altitude (table III). A technique to correct these performance test values to vacuum pressure altitude values is presented in reference 3.

The specification (ref. 2) for the Apollo tower jettison motor requires that certain performance parameters meet specific tolerance limits at prefire-conditioning temperatures of 20°, 70°, and 140° F. Because a solid-propellant rocket motor of fixed geometry and given propellant will yield a different performance at differing prefire-conditioning temperatures, the motor performance data were transformed to the specified 20°, 70°, and 140° F prefire-conditioning temperatures to increase the statistical confidence; a statistical analysis was then performed on these transformed data. The variation of motor performance as a function of motor operating time transformed to the specified 20°, 70°, and 140° F prefire-conditioning temperatures and the two-sided tolerance limits are presented in tables V to VII and in figures 21 to 23. The minimum and maximum two-sided tolerance limits in figures 21 to 23 are not actual minimum and maximum performance traces, but are only the bounds within which these traces will lie.

The statistical analysis consisted of calculating means, standard deviations, one-sided tolerance limits, and two-sided tolerance limits (for 99 percent of the population with 95-percent confidence). As previously mentioned, the data for motors SN AQ-III-2, SN AQ-V-1, SN AQ-VIII-1, and SN AQ-X-1 have been deleted from the performance evaluation. The justification for deleting these data is presented in the section entitled "Failure Analysis."

The data analysis method used in this report is discussed in reference 3. When more than one instrumentation channel was used to obtain values for a single parameter, the average of these values was used, unless otherwise noted, to calculate the data presented in the following discussion.

Ignition-delay time. - Ignition-delay time is defined as the time interval from the application of ignition voltage to the initiator bridgewire until the first indication that the chamber pressure has increased to a value of 100 psia during the ignition transient (fig. 24(a)). Ignition-delay times (for the 17 motors for which valid ignition-delay, thrust-rise, and total-time data were obtained), independent of the prefire cavity pressure and the number of igniter cartridges used, ranged from 0.028 second (at 140° F, ignition category 4) to 0.062 second (at 70° F, ignition category 3) (table III and fig. 11(a)). The statistical analysis indicates the two-sided ignition-delay-time tolerance limits for these 17 motors to be 0.008 second minimum (at 140° F) and 0.083 second maximum (at 20° F) (table VIII and fig. 11(a)).

Ignition-delay times for the five motors assigned to ignition category 4 ranged from 0.028 second (at 140° F) to 0.046 second (at 70° F) (table III and fig. 11(e)). The statistical analysis indicates the two-sided ignition-delay-time tolerance limits for these five motors to be 0.007 second minimum (at 70° and 140° F) and 0.073 second maximum (at 70° F) (table VIII and fig. 11(e)).

Thrust-rise time. - Thrust-rise time is defined as the time interval from the application of ignition voltage to the initiator bridgewire until the first indication that axial thrust has increased to a value of 90 percent of the maximum ignition thrust (fig. 24(b)). Thrust-rise time is required by specification to be between 0.075 and 0.150 second (ref. 2).

Thrust-rise times for the 17 motors, independent of the prefire cavity pressure and the number of igniter cartridges used, ranged from 0.086 second (for one of the two motors tested in the 140° F temperature group, ignition category 2) to 0.126 second (for the two motors tested in the 20° F temperature group, one in ignition category 2 and one in ignition category 4) (table III and fig. 11(f)). The statistical analysis indicates the two-sided thrust-rise-time tolerance limits for these 17 motors to be 0.071 second minimum (at 140° F) and 0.151 second maximum (at 20° F) (table VIII and fig. 11(f)). Neither the minimum thrust-rise time nor the maximum thrust-rise time indicated by statistical analysis is within the specification requirements.

Thrust-rise times for the five motors assigned to ignition category 4 ranged from 0.108 second (at 70° F) to 0.126 second (at 20° F) (table III and fig. 11(j)). The statistical analysis indicates the two-sided thrust-rise-time tolerance limits for these five motors to be 0.075 second minimum (at 20° F) and 0.159 second maximum (at 70° and 140 ° F) (table VIII and fig. 11(j)). The maximum thrust-rise time indicated by the statistical analysis is not within the specification requirements.

Web burn time. - Web burn time is defined as the time interval from the first indication that the chamber pressure has increased to a value of 100 psia during the ignition transient until the time of web burnout (fig. 24(a)). The time of web burnout is the time at which the bisector of the angle formed by the tangents extended from the two operating levels (one immediately prior to the tailoff transient and one during the initial portion of the tailoff transient) intersects the pressure trace.

Web burn times for the 20 motors for which valid performance data were obtained (that is, all the performance data being valid except for ignition-delay, thrust-rise, and total times) ranged from 1.026 seconds (at 140° F) to 1.192 seconds (at 20° F) (table III and fig. 11(k)). The statistical analysis indicates the two-sided web-burn-time tolerance limits to be 0.987 second minimum (at 140° F) and 1.227 seconds maximum (at 20° F) (table VIII and fig. 11(k)).

Action time. - Action time is defined as the time interval from the first indication that chamber pressure has increased to a value of 100 psia during the ignition transient until the first indication that chamber pressure has decreased to a value of 100 psia during the tailoff transient (fig. 24(a)).

Action times for the 20 motors ranged from 1.208 seconds (at 140° F) to 1.370 seconds (at 20° F) (table III and fig. 11(l)). The statistical analysis indicates the two-sided action-time tolerance limits to be 1.169 seconds minimum (at 140° F) and 1.408 seconds maximum (at 20° F) (table VIII and fig. 11(l)).

Tailoff time. - Tailoff time is defined as the time interval from web burnout to the first indication that thrust has decreased to a value of 0 lb_f during the tailoff transient (fig. 24(b)). Tailoff times for the 20 motors ranged from 0.590 second (at 20° F) to 0.766 second (at 140° F) (table III and fig. 11(m)). The statistical analysis indicates the two-sided tailoff-time tolerance limits to be 0.503 second minimum (at 20° F) and 0.838 second maximum (at 140° F) (table VIII and fig. 11(m)).

Total-time. - Total time is defined as the time interval from the application of ignition voltage to the initiator bridgewire until the first indication that thrust has decreased to a value of 0 lb_f during the tailoff transient (fig. 24(b)). Total times for the 17 motors ranged from 1.745 seconds (at 70° F) to 1.790 seconds (at 20° F) (table III and fig. 11(n)). The statistical analysis indicates the two-sided total-time tolerance limits to be 1.715 seconds minimum (at 70° F) and 1.830 seconds maximum (at 140° F) (table VIII and fig. 11(n)).

Average resultant thrust. - Average resultant thrust during web burn time is required by specification (ref. 2) to be, at sea-level pressure altitude, within the following limits:

1. 28 000 to 32 400 lb_f at 20° F

2. 29 400 to 33 900 lb_f at 70° F

3. 31 200 to 36 000 lb_f at 140° F

The following are the limits for average resultant thrust during web burn time for the 20 motors (table III and fig. 14(a)):

1. 29 202 to 30 092 lb_f at 20° F

2. 30 920 to 32 023 lb_f at 70° F

3. 32 570 to 33 767 lb_f at 140° F

The statistical analysis indicates the two-sided tolerance limits for average resultant thrust during burn time to be the following (table VIII and fig. 14(a)):

1. 28 360 to 31 057 lb_f at 20° F

2. 30 223 to 33 097 lb_f at 70° F

3. 31 742 to 34 760 lb_f at 140° F

Resultant impulse. - Resultant impulse is defined as the time integral of resultant thrust. Web-burn-time resultant impulse for the 20 motors ranged from 34 052 lb_f-sec (at 20° F) to 35 057 lb_f-sec (at 20° F) (table III and fig. 15(a)). The statistical analysis indicates the two-sided web-burn-time resultant-impulse tolerance limits to be 33 679 lb_f-sec minimum (at 20° F) and 35 579 lb_f-sec maximum (at 70° F) (table VIII and fig. 15(a)).

Action-time resultant impulse is required by specification to be within the following limits (ref. 2):

1. 35 700 to 37 500 lb_f at 20° F

2. 35 800 to 37 600 lb_f at 70° F

3. 35 900 to 37 700 lb_f at 140° F

The following are the limits for action-time resultant impulse for the 20 motors (table III and fig. 15(b)):

1. 36 150 to 36 914 lb_f-sec at 20° F

2. 36 338 to 36 624 lb_f-sec at 70° F

3. 36 520 to 37 210 lb_f-sec at 140° F

The statistical analysis indicates the two-sided tolerance limits for action-time resultant impulse to be the following (table VIII and fig. 15(b)):

1. 35 630 to 37 289 lb_f-sec at 20° F

2. 35 710 to 37 373 lb_f-sec at 70° F

3. 35 954 to 37 629 lb_f-sec at 140° F

The minimum action-time resultant impulse indicated by statistical analysis for both the 20° F and the 70° F groups are not within the specification requirements.

Tailoff-time resultant impulse for the 20 motors ranged from 1589 lb_f-sec (at 20° F) to 2695 lb_f-sec (at 140° F) (table III and fig. 15(c)). The statistical analysis indicates the two-sided tailoff-time resultant-impulse tolerance limits to be 1144 lb_f-sec minimum (at 20° F) and 3422 lb_f-sec maximum (at 140° F) (table VIII and fig. 15(c)).

Total-time resultant impulse for the 20 motors ranged from 36 318 lb_f-sec (at 20° F) to 37 415 lb_f-sec (at 140° F) (table III and fig. 15(d)). The statistical analysis indicates the two-sided total-time resultant-impulse tolerance limits to be 35 817 lb_f-sec minimum (at 20° F) and 37 868 lb_f-sec maximum (at 140° F) (table VIII and fig. 15(d)).

Resultant average propellant specific impulse. - Resultant average propellant specific impulse is defined as the resultant impulse delivered for each pound of propellant expended during a specific time interval. The resultant average propellant specific impulse during total time for the 20 motors ranged from 177 lb_f-sec/lb_m (at 20° F) to 182 lb_f-sec/lb_m (at 140° F) (table III and fig. 16(d)). The statistical analysis indicates the two-sided tolerance limits for the total-time resultant average propellant specific impulse to be 174.2 lb_f-sec/lb_m minimum (at 20° F) and 184.9 lb_f-sec/lb_m maximum (at 140° F) (table VIII and fig. 16(d)).

Characteristic exhaust velocity. - Characteristic exhaust velocity is a measure of the effectiveness with which the chemical reaction is accomplished in the combustion chamber. Characteristic exhaust velocity is used frequently to compare the performance of different rocket motors. Average characteristic exhaust velocity is defined by

$$\overline{C}* = \frac{g_c A_t \int P\,dt}{W_p} \qquad (1)$$

The average characteristic exhaust velocities for the 20 motors ranged from 4494 ft/sec (at 20° F) to 4702 ft/sec (at 140° F) (table III and fig. 17). The statistical analysis indicates the two-sided average-characteristic-exhaust-velocity tolerance limits to be 4388 ft/sec minimum (at 20° F) and 4815 ft/sec maximum (at 140° F) (table VIII and fig. 17).

Burning rate. - The combustion of a solid propellant is localized entirely on the propellant-exposed surface. Solid propellants burn in parallel layers; that is, all burning surfaces regress in a direction normal to the original propellant surface. The velocity at which a solid propellant is consumed is called burning rate, the measurement of which is made in a direction normal to the original propellant surface and is expressed in inches per second. The average burning rates during web burn time ranged from 0.839 in/sec (at 20° F) to 0.975 in/sec (at 140° F) (table III and fig. 18). The statistical analysis indicates the two-sided tolerance limits for the average burning rate during web burn time to be 0.813 in/sec minimum (at 20° F) and 1.010 in/sec maximum (at 140° F) (table VIII and fig. 18).

Structural Integrity and Physical Measurements

Structural integrity. - Prefire and postfire inspection of the motors revealed that no severe nozzle or motor chamber deterioration was apparent, and satisfactory integrity of the motor assembly was thereby indicated. However, motor SN AQ-III-2 (the third motor static test fired in the qualification test program) experienced a failure of its interstage structure after 0.15 second of static test firing. The failure, which originated in the interstage structure at the forward and aft mounting rings, was caused by shear failure of the spotwelds that attached the rings to the adjacent interstage structure. Corrective action to prevent future failures of the interstage structures consisted of supplementing the welds with high-shear rivets in all remaining interstage structures and the introduction of proof testing at 1.15 times the design load. Motor SN AQ-III-4 was added to the qualification test program to replace motor SN AQ-III-2. A detailed discussion of this problem is presented in the section entitled "Failure Analysis."

Combustion chamber. - Combustion chamber burst pressure (the internal chamber pressure necessary to cause structural failure of the motor case) is required by specification to be a minimum of 2550 psia (ref. 2). During developmental testing, one motor was tested to determine burst pressure. At a chamber pressure of 2710 psig, the aft closure bolts failed, but the failure caused no apparent motor damage. Since each motor case could not be tested separately to determine burst pressure, each motor case was proof pressure tested to 1955 psia. Proof pressure is the internal chamber pressure to which each individual motor case is tested hydrostatically prior to propellant casting.

The maximum combustion chamber pressure is required by specification not to exceed 1700 psia (ref. 2). Maximum combustion chamber pressures for the 20 motors ranged from 1295 psia (at 20° F) to 1496 psia (at 140° F) (table III and fig. 19). The statistical analysis indicates a maximum combustion chamber pressure of 1532 psia (at 140° F) as the one-sided tolerance limit (table VIII and fig. 19).

Throat measurements. - As previously mentioned, the tower jettison motor incorporates two nonconventional nozzles. To produce the required pitch angle of approximately 4° (fig. 4), the throat area of one of the two nozzles is approximately 16 percent larger than the throat area of the second nozzle. To simplify the discussion that follows, the large-throat nozzle is designated as nozzle A, and the small-throat nozzle is designated as nozzle B. The throat area of each nozzle was measured before and after each static test firing (table IX).

The prefire nozzle throat area of nozzle A ranged from 10.173 to 10.190 in^2, with an average of 10.184 in^2. For nozzle A, the statistical analysis indicates the two-sided prefire-throat-area tolerance limits to be 10.168 and 10.199 in^2 (table X).

The postfire nozzle throat area of nozzle A ranged from 10.094 to 10.230 in^2, with an average of 10.202 in^2. For nozzle A, the statistical analysis indicates the two-sided postfire-throat-area tolerance limits to be 10.096 and 10.307 in^2 (table X).

The prefire nozzle throat area of nozzle B ranged from 8.756 to 8.777 in^2, with an average of 8.765 in^2. For nozzle B, the statistical analysis indicates the two-sided prefire-throat-area tolerance limits to be 8.747 and 8.784 in^2 (table X).

The postfire nozzle throat area of nozzle B ranged from 8.735 to 8.809 in^2, with an average of 8.780 in^2. For nozzle B, the statistical analysis indicates the two-sided postfire-throat-area tolerance limits to be 8.706 and 8.853 in^2 (table X).

Weights. - Each motor (including the interstage structure) was weighed before and after static test firing (table IX). The prefire motor weight is required by specification to be a minimum of 512 lb_m and a maximum of 535 lb_m (ref. 2). The prefire motor weight ranged from 523.0 to 529.2 lb_m, with an average of 527.2 lb_m (table X). The statistical analysis indicates the two-sided prefire-motor-weight tolerance limits to be 521.5 and 533.0 lb_m (table X).

The postfire motor weight is required by specification to be a minimum of 305 lb_m and a maximum of 325 lb_m (ref. 2). The postfire motor weight ranged from 315.2 to 319.7 lb_m, with an average of 317.9 lb_m (table IX). The statistical analysis indicates the two-sided postfire-motor-weight tolerance limits to be 313.0 and 322.8 lb_m (table X).

The expended motor mass, determined by subtracting the postfire motor weight from the prefire motor weight, ranged from 204.3 to 211.5 lb_m, with an average of 209.4 lb_m. The statistical analysis indicates the two-sided expended-mass tolerance limits to be 208.5 and 210.2 lb_m (table X).

The propellant weight ranged from 203.3 to 206.8 lb_m, with an average of 205.2 lb_m. The statistical analysis indicates the two-sided propellant-weight tolerance limits to be 201.5 and 208.8 lb_m (table X).

Resultant thrust-vector excursion angle. - The resultant thrust-vector excursion angle is defined by

$$\theta = \tan^{-1} \frac{\text{instantaneous side thrust}}{\text{instantaneous longitudinal thrust}} \tag{2}$$

The average resultant thrust-vector excursion angle during web burn time is required by specification to be no less than 3.0° and no more than 4.5° (ref. 2). The average resultant thrust-vector excursion angles for the 20 motors ranged from 3.57° to 4.19°, with an average of 3.784° (table IX and fig. 20). The statistical analysis indicates the two-sided tolerance limits for the average resultant thrust-vector excursion angle during web burn time to be 3.15° and 4.43° (table X and fig. 20).

Average location of the resultant thrust vector. - The effective point of application of the resultant thrust vector is the intersection of the resultant thrust vector with the longitudinal center line of the motor from the datum D (fig. 10(a)). The average location of the resultant thrust vectors during web burn time for the 20 motors (fig. 24(b)) ranged from 18.23 to 25.04 inches, with an average of 20.84 inches (table IX and fig. 20). The statistical analysis indicates the two-sided tolerance limits for the location of the resultant thrust vector during web burn time to be 13.94 and 27.73 inches (table X).

Failure Analysis

The thrust-rise times of motors SN AQ-V-1 and SN AQ-X-1 during static test firing exceeded the specification. The static test performance of these motors was normal except for the unusually long igniter ignition-delay times, which resulted in prolonged ignition-delay times, thrust-rise times, and total times. The cause of these unusually long igniter ignition-delay times was traced to low input current to the bridgewires of the initiators. The low input current was caused by an improperly used firing harness (ground support equipment) that connects the igniter cartridges to the ignition circuit (also ground support equipment). A firing current of 5 amperes should have been applied to each of two bridgewires in each of the two initiators. Instead, the improperly used firing harness resulted in the application of a firing current of only approximately 2.5 amperes to each of the two bridgewires in each initiator. This condition was corrected for all subsequent testing by fabricating two special firing harnesses. One of these firing harnesses was used for static test firings of motors assigned to ignition categories 1 and 3, of which both duplicated a failed igniter cartridge; the other special firing harness was used for static test firings of motors assigned to ignition categories 2 and 4, of which both duplicated normal igniter ignition conditions. Because the failures of motors SN AQ-V-1 and SN AQ-X-1 were a direct result of improperly used ground support equipment rather than the result of a motor malfunction, the ignition-delay times, thrust-rise times, and total times obtained from these motors were deleted from the performance evaluations.

The thrust-rise time of motor SN AQ-VIII-1 during static test firing also exceeded the specification. The static-test-firing performance of this motor was normal except for an unusually long igniter ignition-delay time, which resulted in prolonged ignition-delay, thrust-rise, and total times. A thorough check of the electrical and instrumentation systems confirmed that the proper firing current, cartridge resistances, and igniter harness were used. The precise cause of this failure could not be determined from the available information; however, the following were regarded as possible factors contributing to the malfunction.

1. Inert debris from the igniter cartridge

2. Relatively small-diameter flame ports (fig. 6(a)) in the igniter case

3. Premature expulsion of the booster powder charge from the igniter cartridge

4. Deflection of the igniter cartridge flame by the igniter cartridge closures into the heat-sink area of the igniter case

The corrective action included modification of the igniter assembly to permit greater tolerance for the debris associated with the igniter cartridge. The diameter of the flame ports in the igniter case were enlarged from 0. 375 to 0. 500 inch to preclude passage blockage. The two-layer vinyl tape cover on the boron-potassium nitrate pellet container was reduced to a single-layer tape cover to permit easier tape burnthrough. These modifications were effected for test motor assemblies SN AQ-V-2 and SN AQ-IX-1.

Following the completion of the tower jettison motor qualification test program, an igniter test program was conducted by which it was verified that the igniter modifications were successful (ref. 4). It should be noted, however, that the Apollo Spacecraft Program systems are required to demonstrate success following only a single failure. The malfunction of motor SN AQ-VIII-1 occurred during the time that the motor was duplicating a double failure mode (a failed initiator cartridge and a failed nozzle closure), and the tower jettison motor is not required to demonstrate success under these conditions. Because the igniter assembly was modified and because a double failure mode was being duplicated, the ignition-delay, thrust-rise, and total times obtained during testing of motor SN AQ-VIII-1 were deleted from the performance evaluation.

Failure of the interstage structure of motor SN AQ-III-2 (the third motor static test fired) during static test firing caused the subsequent destruction of the motor assembly. The failure, which originated at the interstage structure forward and aft attachment rings (ref. 5), was caused by shear failure of the spotwelds that attached the rings to the interstage structure. Because the rings became detached, the TE-380 solid-propellant rocket motor pulled free from the test stand, and the impact on the head-end wall of the test bay shattered the motor assembly. During postfire inspection, an apparent weakness of the spotwelds was noted. The interstage aft attachment ring was still bolted to the test stand, and the forward attachment ring remained bolted to the motor aft closure. By examination of the sheared spotwelds on both rings, evidence of inadequate welding was obtained. Typical spotwelds on the failed interstage forward-attachment ring were sectioned. By metallurgical examination of these sections, an inadequate spotweld condition was found to have existed. Little actual spotweld nugget formation could be found. Most of the sheared spotweld areas on the ring surfaces were smooth and exhibited little evidence of the typical metal tears associated with proper welding. Consequently, only a small force would be required to shear the spotwelds. During subsequent investigation of the spotwelding operation, it was ascertained that improper mating of the components to be welded could have been an important factor contributing to the inadequate welds. It was concluded that the integrity of the spotwelds on all remaining interstage structures was questionable; therefore, to prevent future failures, the spotwelds of all remaining interstage structures were supplemented with high-shear rivets. The rivet design was adequate to provide the required design margin of safety. Proof-load testing at 1. 15 times the design load was also instituted, and motor SN AQ-III-4 was added to the qualification test program to replace motor SN AQ-III-2. To verify the structural integrity of the redesigned interstage assembly, interstages SN 06 and SN 40 were subjected to three cycles of proof-loading after which the two interstages were loaded to failure. Failure was considered to be the point at which the interstage structure deformation continued without a corresponding load increase. The two interstages failed at pull loads of 2. 5 and 2. 6 times the design loads, respectively, which is well above the ultimate-load requirement of 1. 5 times the design load. No rivet or spotweld connections failed during the ultimate-load tests. The primary permanent distortion was the result of compressive buckling of the outer skin and of the doubler around the nozzle opening. As a result of the successful proof- and ultimate-load testing, the structural adequacy of the interstage redesign was demonstrated. Because the failure of motor SN AQ-III-2 occurred during the ignition transient and because motor SN AQ-III-4 was added to the qualification test program to replace motor SN AQ-III-2, all static-test-firing data for motor SN AQ-III-2 have been deleted from the evaluation.

CONCLUSIONS

During the qualification test program, the Apollo tower jettison motor met all environmental and structural integrity requirements and satisfied all performance specifications. A statistical analysis was performed on the motor static-test-firing data. The specifications do not require that the values obtained by statistical analysis satisfy the specifications, but the following two points should be noted.

1. The statistical analysis for the thrust-rise time of the five motors static test fired (duplicating normal ignition conditions) indicates that 95 percent (rather than the desired 99 percent) of the population will satisfy the specification requirements with 95-percent confidence.

2. The statistical analysis for the action-time resultant impulse of the 20 motors static test fired also indicates that 95 percent (rather than the desired 99 percent) of the population will satisfy the specification requirements with 95-percent confidence.

The product variance of the thrust-rise time will have only a negligible effect on the performance of the launch escape system because the product variance of the worst case indicates that the tower jettison motor will reach 90 percent of maximum thrust only 0.009 second in excess of the specification requirement of 0.150 second. The product variance of the action-time resultant impulse for the 20 motors static test fired will have only a negligible effect on the performance of the launch escape system. From the results of the qualification test evaluation, it was confirmed that the tower jettison motor is qualified for the Apollo Spacecraft Program because the motor will jettison the launch escape system safely from the command module and out of the command module path either shortly after the launch vehicle second-stage ignition and staging or during a mission abort.

Manned Spacecraft Center
National Aeronautics and Space Administration
Houston, Texas, March 11, 1970
914-50-60-01-72

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TABLE I. - PROPELLANT FORMULATION FOR

THE APOLLO TOWER JETTISON MOTOR

(a) Composition

Ingredient	Function	Weight, percent
Ammonium perchlorate, NH_4ClO_4	Oxidizer	72.00
Aluminum powder, Al	Fuel	2.00
Polysulfide polymer, LP-33	Fuel/binder	18.81
Benzyl mercaptan, $C_6H_5CH_2SH$	Curing accelerator	(a)
p-quinonedioxime, GMF	Curing agent	1.39
Sulfur, S	Curing agent	.01
Magnesium oxide, MgO	Curing accelerator	1.00
Ferric oxide, Fe_2O_3	Burning-rate catalyst	2.00
Dibutyl-carbital, TP-903	Plasticizer	2.09
Diphenyl guanidine, DPG	Curing agent	.70

[a]To obtain specific physical properties, the amount of benzyl mercaptan may be varied between 0.00 and 0.09 percent by direct substitution for a like percentage of polysulfide polymer.

(b) Properties

Exhaust gas specific heat ratio, γ	1.176
Propellant density, ρ, lb_m/in^3	0.0633
Autoignition temperature T_a, °F:	
1 hr	355
8 hr	320
Flame temperature at 1000 psia, T_f, °F	4404

TABLE II. - SUMMARY OF ENVIRONMENTAL TESTING

Motor SN	Environmental testing group	Accelerated aging	Vibration testing	Temperature cycling	Packaged impact testing		
					Edgewise drop	Cornerwise drop	Pendulum
AQ-IV-1	D	--	At 140° F	(a)	At 140° F	--	--
AQ-IV-2	D	--	At 140° F	(b)	--	At 140° F	--
AQ-V-1	C	--	--	(a)	At 70° F	--	--
AQ-V-2	C	--	--	(b)	--	--	At 70° F
AQ-VI-1	D	--	At -20° F	(a)	--	At -20° F	--
AQ-VI-2	D	--	At -20° F	(b)	--	--	At -20° F
AQ-VII-1	A	--	--	(b)	--	--	--
AQ-VIII-1	A	--	--	(a)	--	--	--
AQ-IX-1	A	--	--	(a)	--	--	--
AQ-IX-2	A	--	--	(a)	--	--	--
AQ-IX-3	A	--	--	(a)	--	--	--
AQ-IX-4	A	--	--	(a)	--	--	--
AQ-X-1	B	75 days at 160° F	--	--	--	--	--
AQ-X-2	B	75 days at 160° F	--	--	--	--	--
AQ-XI-1	A	--	--	(b)	--	--	--

[a]Temperature cycled by successive stabilization at 140°, -20°, 140°, -20°, and 140° F.
[b]Temperature cycled by successive stabilization at -20°, 140°, -20°, 140°, and -20° F.

TABLE III. - SUMMARY OF MOTOR PERFORMANCE DATA

Parameter	Motor SN and date static test fired									
	AQ-II-1 Aug. 18, 1964	AQ-II-2 Aug. 31, 1964	AQ-III-2 Sept. 9, 1964 (a)	AQ-III-4 Nov. 10, 1964	AQ-IX-2 Nov. 13, 1964	AQ-XI-1 Dec. 3, 1964	AQ-IX-4 Dec. 14, 1964	AQ-III-1 Dec. 22, 1964	AQ-X-2 Jan. 11, 1965	AQ-X-1 Jan. 13, 1965
Prefire-conditioning temperature, °F	70	70	20	20	70	70	70	20	20	140
Ambient pressure, psia	14.7	14.7	14.7	14.8	14.7	14.8	14.8	14.8	14.8	14.7
Ambient temperature, °F	74	84	82	58	74	46	44	42	29	29
Number of igniter cartridges energized	2	1	2	2	2	2	2	1	2	2
Prefire cavity pressure, psia	14.7	.145	14.7	14.7	14.6	.156	.077	14.7	.077	.077
Environmental test group	NA[b]	NA	NA	NA	A	A	A	NA	B	B
Time, t, sec:										
Ignition delay, t_d	0.046	0.062	--	0.042	0.034	0.047	0.041	0.037	0.058	(c)
Thrust rise, t_r	.117	.110	--	.126	.108	.112	.108	.122	.126	(c)
Maximum thrust, $t_{F_{max.}}$	.700	.650	--	.700	.700	.650	.650	.700	.700	.700
Web burn, t_b	1.110	1.073	--	1.165	1.123	1.083	1.085	1.178	1.192	1.054
Action, t_a	1.300	1.268	--	1.338	1.296	1.263	1.279	1.353	1.337	1.222
Tailoff, t_{tail}	.630	.727	--	.593	.643	.717	.715	.622	.608	.658
Total, t_t	1.762	1.745	--	1.788	1.788	1.765	1.770	1.782	1.780	(c)
Chamber pressure, P, psia:										
Maximum, $P_{max.}$	1400	1430	--	1318	1370	1385	1402	1304	1306	1450
Average web burn time, $\overline{P}_b$	1331	1357	--	1249	1311	1318	1328	1237	1234	1377
Average action time, $\overline{P}_a$	1195	1220	--	1144	1194	1198	1192	1133	1152	1255
Average tailoff time, $\overline{P}_{tail}$	136	138	--	145	130	128	130	139	118	140
Average total time, $\overline{P}_t$	887	892	--	862	870	861	866	866	867	892
Chamber pressure integral, $\int P\,dt$, psia-sec:										
Web burn time, $\int_{t_b} P\,dt$	1477	1456	--	1455	1472	1427	1441	1457	1471	1451
Action time, $\int_{t_a} P\,dt$	1554	1547	--	1530	1547	1513	1525	1534	1540	1534
Tailoff time, $\int_{t_{tail}} P\,dt$	86	100	--	86	83	92	93	86	72	92
Total time, $\int_{t_t} P\,dt$	1563	1556	--	1541	1555	1519	1531	1534	1543	1543

[a]Motor SN AQ-III-2 experienced a failure of the interstage structure during static test firing, with subsequent destruction of the motor assembly; therefore, all the static-performance data are deleted from this evaluation. The justification for deletion of these data is presented in the section entitled "Failure Analysis."

[b]Not applicable.

[c]Motors SN AQ-V-1, SN AQ-VIII-1, and SN AQ-X-1 experienced unusually long igniter ignition times, which resulted in prolonged ignition-delay, thrust-rise, and total times for these motors; therefore, all the static-performance data are deleted from this evaluation. The justification for deletion of these data is presented in the section entitled "Failure Analysis."

TABLE III. - SUMMARY OF MOTOR PERFORMANCE DATA - Continued

Parameter	Motor SN and date static test fired									
	AQ-II-1 Aug. 18, 1964	AQ-II-2 Aug. 31, 1964	AQ-III-2 Sept. 9, 1964 (a)	AQ-III-4 Nov. 10, 1964	AQ-IX-2 Nov. 13, 1964	AQ-XI-1 Dec. 3, 1964	AQ-IX-4 Dec. 14, 1964	AQ-III-1 Dec. 22, 1964	AQ-X-2 Jan. 11, 1965	AQ-X-1 Jan. 13, 1965
Prefire-conditioning temperature, °F	70	70	20	20	70	70	70	20	20	140
Ambient pressure, psia	14.7	14.7	14.7	14.8	14.7	14.8	14.7	14.8	14.7	14.7
Ambient temperature, °F	74	84	82	58	74	46	44	42	29	29
Number of igniter cartridges energized	2	1	2	2	2	2	2	1	2	2
Prefire cavity pressure, psia	14.7	.145	14.7	14.7	14.6	.156	.077	14.7	.077	.077
Environmental test group	NA[b]	NA	NA	NA	A	A	A	NA	B	B
Resultant thrust, F, lb_f:										
Maximum, F_{max}	33500	33974	--	32450	32700	33895	33830	31129	31050	35000
Average web burn time, $\bar{F}_b$	31359	32023	--	30092	30920	31995	31933	29202	29283	33021
Average action time, $\bar{F}_a$	27952	28687	--	27521	28109	28998	28590	26722	27245	30040
Average tailoff time, $\bar{F}_{tail}$	2843	3070	--	3415	2961	2946	2972	3172	2613	3234
Average total time, $\bar{F}_t$	20737	20970	--	20740	20485	20830	20776	20412	20504	21348
Resultant impulse, I, lb_f-sec:										
Web burn time, I_b	34809	34361	--	35057	34723	34651	34647	34400	34905	34804
Action time, I_a	36338	36375	--	36823	36429	36624	36566	36155	36427	36709
Tailoff time, I_{tail}	1791	2232	--	2025	1904	2112	2125	1973	1589	2128
Total time, I_t	36539	36593	--	37084	36628	36765	36773	36375	36498	36932
Resultant average propellant specific impulse, $\bar{I}_{sp}$, lb_f-sec/lb_m:										
Web burn time, $\bar{I}_{sp,b}$	181	179	--	180	180	180	180	177	179	181
Action time, $\bar{I}_{sp,a}$	179	178	--	179	180	179	180	177	179	181
Tailoff time, $\bar{I}_{sp,tail}$	160	169	--	176	175	170	172	172	167	174
Total time, $\bar{I}_{sp,t}$	179	178	--	179	180	179	180	177	179	181
Average characteristic exhaust velocity, $\bar{C}^*$, ft/sec (based on total time, t_t)	4670	4620	--	4541	4663	4516	4572	4577	4609	4614
Average burning rate, $\bar{r}_b$, in/sec (based on web burn time, t_b)	0.901	0.932	--	0.858	0.891	0.923	0.922	0.849	0.839	0.949

[a]Motor SN AQ-III-2 experienced a failure of the interstage structure during static test firing, with subsequent destruction of the motor assembly; therefore, all the static-performance data are deleted from this evaluation. The justification for deletion of these data is presented in the section entitled "Failure Analysis."

[b]Not applicable.

TABLE III. - SUMMARY OF MOTOR PERFORMANCE DATA - Continued

Parameter	Motor SN and date static test fired										
	AQ-V-1 Jan. 15, 1965	AQ-I-3 Jan. 19, 1965	AQ-IX-3 Jan. 29, 1965	AQ-VIII-1 Feb. 2, 1965	AQ-VII-1 Feb. 9, 1965	AQ-IV-1 Mar. 25, 1965	AQ-IV-2 Apr. 13, 1965	AQ-VI-1 Apr. 19, 1965	AQ-VI-2 Apr. 23, 1965	AQ-V-2 May 19, 1965	AQ-IX-1 May 25, 1965
Prefire-conditioning temperature, °F	140	140	140	140	20	140	20	140	20	20	20
Ambient pressure, psia	14.9	14.8	14.6	14.7	14.9	14.9	14.6	14.8	14.8	14.7	14.8
Ambient temperature, °F	14	24	27	30	49	34	54	44	61	81	72
Number of igniter cartridges energized	2	1	2	1	1	2	2	2	2	1	2
Prefire cavity pressure, psia	.077	14.7	14.7	.048	.029	.029	.034	.050	.038	.029	14.7
Environmental test group	C	NA[b]	A	A	A	D	D	D	D	C	A
Time, t, sec:											
Ignition delay, t_d	(c)	0.034	0.028	(c)	0.059	0.035	0.045	0.039	0.050	0.057	0.030
Thrust rise, t_f	(c)	.108	.113	(c)	.122	.086	.105	.092	.112	.115	.112
Maximum thrust, $t_{f_{max.}}$	.700	.600	.650	.850	.700	.650	.700	.650	.700	.700	.700
Web burn, t_b	1.030	1.034	1.057	1.046	1.150	1.048	1.161	1.026	1.145	1.148	1.180
Action, t_a	1.208	1.216	1.242	1.265	1.321	1.245	1.333	1.211	1.335	1.343	1.370
Tailoff, t_{tail}	.688	.766	.743	.709	.591	.717	.639	.735	.605	.595	.590
Total, t_t	(c)	1.788	1.788	(c)	1.780	1.774	1.770	1.764	1.766	1.746	1.790
Chamber pressure, P, psia:											
Maximum, $P_{max.}$	1496	1490	1430	1470	1340	1467	1315	1460	1295	1298	1317
Average web burn time, $\bar{P}_b$	1433	1402	1366	1401	1274	1394	1256	1397	1235	1241	1249
Average action time, $\bar{P}_a$	1297	1262	1236	1243	1163	1252	1152	1264	1134	1131	1140
Average tailoff time, $\bar{P}_{tail}$	143	125	137	165	132	150	134	150	181	173	162
Average total time, $\bar{P}_t$	910	864	864	894	867	884	872	875	863	875	877
Chamber pressure integral, $\int P\,dt$, psia-sec:											
Web burn time, $\int_{t_b} P\,dt$	1476	1450	1444	1465	1465	1461	1458	1433	1414	1425	1474
Action time, $\int_{t_a} P\,dt$	1567	1535	1535	1573	1536	1559	1535	1531	1514	1519	1562
Tailoff time, $\int_{t_{tail}} P\,dt$	99	96	102	117	78	107	86	110	109	103	96
Total time, $\int_{t_t} P\,dt$	1575	1546	1546	1582	1543	1568	1544	1543	1523	1528	1570

[b]Not applicable.

[c]Motors SN AQ-V-1, SN AQ-VIII-1, and SN AQ-X-1 experienced unusually long igniter ignition times, which resulted in prolonged ignition-delay, thrust-rise, and total times for these motors; therefore, all the static-performance data are deleted from this evaluation. The justification for deletion of these data is presented in the section entitled "Failure Analysis."

TABLE III. - SUMMARY OF MOTOR PERFORMANCE DATA - Concluded

Parameter	Motor SN and date static test fired										
	AQ-V-1 Jan. 15, 1965	AQ-I-3 Jan. 19, 1965	AQ-IX-3 Jan. 29, 1965	AQ-VIII-1 Feb. 2, 1965	AQ-VII-1 Feb. 9, 1965	AQ-IV-1 Mar. 25, 1965	AQ-IV-2 Apr. 13, 1965	AQ-VI-1 Apr. 19, 1965	AQ-VI-2 Apr. 23, 1965	AQ-V-2 May 19, 1965	AQ-IX-1 May 25, 1965
Prefire-conditioning temperature, °F	140	140	140	140	20	140	20	140	20	20	20
Ambient pressure, psia	14.9	14.9	14.6	14.7	14.9	14.9	14.6	14.8	14.7	14.7	14.7
Ambient temperature, °F	14	24	27	30	49	34	54	44	61	81	72
Number of igniter cartridges energized . . .	2	1	2	1	1	2	2	2	2	1	2
Prefire cavity pressure, psia	.077	14.7	14.7	.048	.029	.029	.034	.050	.038	.029	14.7
Environmental test group	C	NA[b]	A	A	A	D	D	D	D	C	A
Resultant thrust, F, lb_f:											
Maximum, $F_{max.}$	35400	35500	34250	34600	31700	34700	31500	35300	31400	31100	31400
Average web burn time, $\bar{F}_b$	33767	33557	32570	33192	30037	33057	29903	33645	29740	29814	29614
Average action time, $\bar{F}_a$	30531	30133	29404	29415	27366	29658	27389	30449	27287	27123	26945
Average tailoff time, $\bar{F}_{tail}$	3317	2864	3152	3801	3002	3485	3127	3592	4298	4064	3644
Average total time, $\bar{F}_t$	21424	20634	20566	21138	20403	20937	20743	21066	20755	20988	20726
Resultant impulse, I, lb_f-sec:											
Web burn time, I_b	34780	34698	34427	34719	34543	34644	34717	34520	34052	34226	34945
Action time, I_a	36881	36642	36520	37210	36150	36924	36509	36874	36428	36426	36914
Tailoff time, I_{tail}	2282	2194	2342	2695	1774	2499	1998	2640	2600	2418	2150
Total time, I_t	37063	36894	36772	37415	36318	37143	36715	37160	36653	36645	37099
Resultant average propellant specific impulse, $\bar{I}_{sp}$, lb_f-sec/lb_m:											
Web burn time, $\bar{I}_{sp,b}$	182	181	179	182	177	181	179	182	178	178	181
Action time, $\bar{I}_{sp,a}$	181	181	179	181	177	181	178	182	177	178	180
Tailoff time, $\bar{I}_{sp,tail}$	178	174	173	177	170	178	175	181	175	174	171
Total time, $\bar{I}_{sp,t}$	181	181	179	181	177	181	178	182	177	178	180
Average characteristic exhaust velocity $\bar{C}^*$, ft/sec (based on total time, t_t) . . .	4702	4612	4589	4668	4571	4658	4572	4603	4494	4524	4645
Average burning rate, $\bar{r}_b$, in/sec (based on web burn time, t_b	0.971	0.967	0.946	0.956	0.870	0.954	0.861	0.975	0.873	0.871	0.848

[b]Not applicable.

TABLE IV. - STATIC TEST INSTRUMENTATION

Parameter	One sigma estimated system accuracy		Measuring device	Range of measuring device	Recording device	Method of system calibration
	Steady state at operating level	Integral, percent				
Axial force, lb_f	[a]± 0.25	--	Bonded strain-gage-type load cell	0 to 50 000 lb_f	Multiinput high-speed analog-to-digital converter	Hydraulically actuated at nominal loads of 0, 10 000, 20 000, 30 000, and 40 000 lb_f
Total impulse, lb_f-sec	--	± 0.33				
Forward side force, lb_f	[a]± 0.24	--	Bonded strain-gage-type load cell	0 to 2000 lb_f	Multiinput high-speed analog-to-digital converter	Hydraulically actuated at nominal loads of 0, 500, 1000, 1500, and 2000 lb_f
Motor chamber pressure, psia	[a]± 0.16	--	Bonded strain-gage-type transducers	0 to 2000 psia	Multiinput high-speed analog-to-digital converter	Electrical calibration at nominal levels of 0, 500, 1000, 1500, and 2000 psia
Chamber pressure integral, psia-sec	--	± 0.33				
Aft side force, lb_f	[a]± 3.3	--	Bonded strain gage-type load cell	0 to 500 lb_f	Multiinput high-speed analog-to-digital converter	Hydraulically activated at nominal loads of 0, 125, 250, 375, and 500 lb_f
Time intervals	[b]± 0.1	--	Synchronous timing line generator	--	Photographically recording galvanometer-type oscillograph	Compared with 60 amps

[a]Percent.

[b]Milliseconds.

TABLE V. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 20° F AND THE TWO-SIDED TOLERANCE LIMITS

(a) Chamber pressure

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES, SEC			TRANSFORMED CHAMBER PRESSURE, PSIA		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
.00	0	.00000	.00000	.00000	100.5387	.0000	105.7746
.78	0	.00910	.00864	.00956	260.1556	.0000	682.2802
1.56	0	.01820	.01728	.01912	438.7600	.0000	1088.8585
2.34	0	.02730	.02592	.02868	622.0118	.0000	1348.0400
3.12	0	.03640	.03456	.03824	797.8036	130.7186	1464.8886
3.91	0	.04550	.04320	.04781	950.0211	414.9410	1485.1012
4.69	0	.05460	.05184	.05737	1066.8119	693.7573	1439.8665
5.47	0	.06370	.06048	.06693	1151.0452	893.8762	1408.2142
6.25	0	.07280	.06912	.07649	1207.9601	1033.5293	1382.3909
7.03	0	.08190	.07776	.08605	1246.0335	1127.5799	1364.4871
7.81	0	.09101	.08640	.09561	1270.1988	1187.2790	1353.1185
8.59	0	.10011	.09504	.10517	1285.1707	1212.0604	1358.2810
9.37	0	.10921	.10368	.11473	1293.0780	1225.4984	1360.6575
10.16	0	.11831	.11232	.12429	1296.9331	1230.5453	1363.3209
10.94	0	.12741	.12096	.13386	1299.0141	1230.6908	1367.3374
11.72	0	.13651	.12960	.14342	1299.7598	1229.7833	1369.7364
12.50	0	.14561	.13824	.15298	1298.8957	1228.9051	1368.8862
13.28	0	.15471	.14688	.16254	1297.3366	1229.6935	1364.9797
14.06	0	.16381	.15552	.17210	1295.5245	1230.5075	1360.5415
14.84	0	.17291	.16416	.18166	1293.7579	1229.7957	1357.7202
15.62	0	.18201	.17280	.19122	1293.2178	1231.4355	1355.0001
16.41	0	.19111	.18144	.20078	1292.5854	1231.9616	1353.2091
17.19	0	.20021	.19008	.21034	1292.7520	1234.5594	1350.9447
17.97	0	.20931	.19872	.21991	1292.3065	1235.9403	1348.6727
18.75	0	.21841	.20736	.22947	1291.7836	1235.8681	1347.6991
19.53	0	.22751	.21600	.23903	1291.5652	1234.3448	1348.7856
20.31	0	.23661	.22464	.24859	1291.2913	1233.6114	1348.9712
21.09	0	.24571	.23328	.25815	1289.3441	1229.4687	1349.2196
21.87	0	.25481	.24192	.26771	1286.0201	1223.6637	1348.3766
22.66	0	.26391	.25056	.27727	1281.5866	1216.7290	1346.4443
23.44	0	.27302	.25920	.28683	1276.9963	1210.7647	1343.2278
24.22	0	.28212	.26784	.29639	1273.0168	1207.3114	1338.7221
25.00	0	.29122	.27648	.30595	1269.4044	1205.3310	1333.4777
25.78	0	.30032	.28512	.31552	1266.7651	1203.2972	1330.2330
26.56	0	.30942	.29376	.32508	1265.4667	1202.1809	1328.7524
27.34	0	.31852	.30240	.33464	1265.7402	1202.6303	1328.8502
28.12	0	.32762	.31104	.34420	1266.5205	1205.3909	1327.6501
28.91	0	.33672	.31968	.35376	1267.8264	1207.5357	1328.1172
29.69	0	.34582	.32832	.36332	1269.2173	1209.2736	1329.1610
30.47	0	.35492	.33696	.37288	1270.4855	1210.8620	1330.1091
31.25	0	.36402	.34560	.38244	1272.4281	1211.2104	1333.6457
32.03	0	.37312	.35424	.39200	1274.8783	1213.2131	1336.5436
32.81	0	.38222	.36288	.40157	1277.8542	1215.6812	1340.0273

TABLE V. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 20° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(a) Chamber pressure - Continued

PERCENT	PERCENT	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
WEB BURN	TAILOFF	TRANSFORMED TIMES, SEC			TRANSFORMED CHAMBER PRESSURE, PSIA		
TIME	TIME	MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
33.59	0	.39132	.37152	.41113	1281.2023	1219.1267	1343.2779
34.37	0	.40042	.38016	.42069	1283.2086	1222.7862	1343.6310
35.16	0	.40952	.38880	.43025	1285.1621	1225.2864	1345.0378
35.94	0	.41862	.39744	.43981	1286.7979	1226.0971	1347.4986
36.72	0	.42772	.40608	.44937	1288.1375	1225.8440	1350.4311
37.50	0	.43682	.41472	.45893	1290.0101	1227.3560	1352.6641
38.28	0	.44592	.42336	.46849	1291.7837	1228.3551	1355.2122
39.06	0	.45503	.43200	.47805	1293.1782	1229.8381	1356.5183
39.84	0	.46413	.44064	.48762	1294.5604	1231.5777	1357.5432
40.62	0	.47323	.44928	.49718	1296.3459	1234.5005	1358.1912
41.41	0	.48233	.45792	.50674	1298.5411	1238.5143	1358.5679
42.19	0	.49143	.46656	.51630	1301.3178	1241.7166	1360.9189
42.97	0	.50053	.47520	.52586	1303.1592	1243.0361	1363.2823
43.75	0	.50963	.48384	.53542	1304.7572	1244.1114	1365.4029
44.53	0	.51873	.49248	.54498	1305.7540	1243.1798	1368.3282
45.31	0	.52783	.50112	.55454	1306.4705	1242.6382	1370.3029
46.09	0	.53693	.50976	.56410	1306.9264	1242.7332	1371.1196
46.87	0	.54603	.51840	.57367	1307.2694	1243.5425	1370.9963
47.66	0	.55513	.52704	.58323	1308.1952	1245.1964	1371.1940
48.44	0	.56423	.53568	.59279	1309.1229	1244.7250	1373.5208
49.22	0	.57333	.54432	.60235	1309.8002	1244.8187	1374.7818
50.00	0	.58243	.55296	.61191	1310.3484	1242.0571	1378.6397
50.78	0	.59153	.56160	.62147	1310.9831	1239.6822	1382.2840
51.56	0	.60063	.57024	.63103	1312.1069	1238.2922	1385.9216
52.34	0	.60973	.57888	.64059	1312.9969	1238.7439	1387.2499
53.12	0	.61883	.58752	.65015	1313.8391	1240.6802	1386.9980
53.91	0	.62794	.59615	.65972	1314.3905	1241.4012	1387.3799
54.69	0	.63704	.60479	.66928	1314.5561	1241.5358	1387.5764
55.47	0	.64614	.61343	.67884	1314.3612	1241.5096	1387.2128
56.25	0	.65524	.62207	.68840	1313.7700	1240.6687	1386.8712
57.03	0	.66434	.63071	.69796	1313.4662	1240.5655	1386.3669
57.81	0	.67344	.63935	.70752	1313.2609	1240.6983	1385.8236
58.59	0	.68254	.64799	.71708	1312.6576	1240.4308	1384.8843
59.37	0	.69164	.65663	.72664	1311.6071	1239.9160	1383.2982
60.16	0	.70074	.66527	.73620	1310.6645	1238.3113	1383.0177
60.94	0	.70984	.67391	.74577	1309.7586	1236.9912	1382.5260
61.72	0	.71894	.68255	.75533	1308.7632	1237.1440	1380.3824
62.50	0	.72804	.69119	.76489	1307.4344	1237.9881	1376.8806
63.28	0	.73714	.69983	.77445	1306.6095	1237.7771	1375.4419
64.06	0	.74624	.70847	.78401	1305.6657	1235.2857	1376.0457
64.84	0	.75534	.71711	.79357	1304.4885	1229.9820	1378.9950
65.62	0	.76444	.72575	.80313	1302.7181	1224.5060	1380.9303
66.41	0	.77354	.73439	.81269	1300.6338	1218.6883	1382.5794

TABLE V. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 20° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(a) Chamber pressure - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES,SEC			TRANSFORMED CHAMBER PRESSURE,PSIA		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
67.19	0	.78264	.74303	.82225	1299.1453	1216.1517	1382.1389
67.97	0	.79174	.75167	.83182	1297.4807	1214.0634	1380.8980
68.75	0	.80084	.76031	.84138	1295.5401	1213.1064	1377.9739
69.53	0	.80995	.76895	.85094	1293.2724	1212.3549	1374.1898
70.31	0	.81905	.77759	.86050	1290.3102	1210.9258	1369.6947
71.09	0	.82815	.78623	.87006	1286.8952	1209.0929	1364.6975
71.87	0	.83725	.79487	.87962	1284.0423	1206.6556	1361.4289
72.66	0	.84635	.80351	.88918	1282.0157	1205.2216	1358.8099
73.44	0	.85545	.81215	.89874	1280.1104	1203.7539	1356.4668
74.22	0	.86455	.82079	.90830	1278.3071	1203.2745	1353.3397
75.00	0	.87365	.82943	.91786	1275.5859	1202.1175	1349.0542
75.78	0	.88275	.83807	.92743	1272.8113	1200.8006	1344.8220
76.56	0	.89185	.84671	.93699	1270.6462	1200.0990	1341.1935
77.34	0	.90095	.85535	.94655	1268.7613	1201.2694	1336.2532
78.12	0	.91005	.86399	.95611	1268.2457	1202.6043	1333.8871
78.91	0	.91915	.87263	.96567	1267.2703	1202.1534	1332.3871
79.69	0	.92825	.88127	.97523	1265.6018	1199.9683	1331.3352
80.47	0	.93735	.88991	.98479	1263.8106	1195.7817	1331.8395
81.25	0	.94645	.89855	.99435	1262.4671	1194.3079	1330.6264
82.03	0	.95555	.90719	1.00391	1261.3537	1193.7425	1328.9648
82.81	0	.96465	.91583	1.01348	1260.6257	1193.6292	1327.6223
83.59	0	.97375	.92447	1.02304	1259.9646	1193.0873	1326.8418
84.37	0	.98285	.93311	1.03260	1259.2528	1190.8889	1327.6167
85.16	0	.99196	.94175	1.04216	1258.9931	1190.6099	1327.3763
85.94	0	1.00106	.95039	1.05172	1258.3453	1189.9380	1326.7525
86.72	0	1.01016	.95903	1.06128	1257.9148	1191.2984	1324.5313
87.50	0	1.01926	.96767	1.07084	1257.4661	1191.2014	1323.7309
88.28	0	1.02836	.97631	1.08040	1256.7870	1189.0688	1324.5051
89.06	0	1.03746	.98495	1.08996	1255.4688	1185.4881	1325.4495
89.84	0	1.04656	.99359	1.09953	1254.1424	1182.6768	1325.6079
90.62	0	1.05566	1.00223	1.10909	1253.2960	1181.0251	1325.5669
91.41	0	1.06476	1.01087	1.11865	1253.2731	1180.9055	1325.6407
92.19	0	1.07386	1.01951	1.12821	1253.3827	1180.2370	1326.5283
92.97	0	1.08296	1.02815	1.13777	1252.8392	1177.0161	1328.6624
93.75	0	1.09206	1.03679	1.14733	1252.6177	1173.4844	1331.7510
94.53	0	1.10116	1.04543	1.15689	1252.3433	1170.6768	1334.0097
95.31	0	1.11026	1.05407	1.16645	1251.8798	1168.3751	1335.3846
96.09	0	1.11936	1.06271	1.17601	1251.0725	1165.8632	1336.2818
96.87	0	1.12846	1.07135	1.18558	1249.9153	1159.8296	1340.0010
97.66	0	1.13756	1.07999	1.19514	1248.5027	1152.1721	1344.8333
98.44	0	1.14666	1.08863	1.20470	1243.5671	1139.4232	1347.7110
99.22	0	1.15576	1.09727	1.21426	1227.0648	1116.1310	1337.9986
100.00	0	1.16487	1.10591	1.22382	1189.6236	1067.4869	1311.7603

TABLE V. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 20° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(a) Chamber pressure - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES, SEC			TRANSFORMED CHAMBER PRESSURE, PSIA		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
0	1.45	1.16761	1.10833	1.22690	1173.1091	1048.4345	1297.7837
0	2.90	1.17036	1.11074	1.22999	1154.0990	1027.3495	1280.8485
0	4.35	1.17311	1.11312	1.23310	1132.2906	1003.4920	1261.0892
0	5.80	1.17586	1.11550	1.23623	1108.2760	977.9973	1238.5546
0	7.25	1.17861	1.11786	1.23937	1081.6438	949.3469	1213.9408
0	8.70	1.18136	1.12020	1.24252	1052.4747	917.1226	1187.8268
0	10.14	1.18411	1.12252	1.24569	1021.3997	881.3486	1161.4507
0	11.59	1.18686	1.12484	1.24888	988.6352	843.3428	1133.9276
0	13.04	1.18961	1.12714	1.25208	955.0525	804.9058	1105.1992
0	14.49	1.19236	1.12942	1.25529	919.8061	762.8062	1076.8061
0	15.94	1.19510	1.13169	1.25852	883.9310	718.8001	1049.0619
0	17.39	1.19785	1.13395	1.26176	847.6161	674.6546	1020.5777
0	18.84	1.20060	1.13619	1.26501	811.4154	630.9524	991.8784
0	20.29	1.20335	1.13843	1.26828	775.4313	587.7444	963.1182
0	21.74	1.20610	1.14065	1.27156	740.3729	544.5980	936.1477
0	23.19	1.20885	1.14285	1.27485	706.0741	503.6092	908.5389
0	24.64	1.21160	1.14505	1.27815	673.0166	465.1025	880.9308
0	26.09	1.21435	1.14723	1.28147	641.1414	428.7281	853.5547
0	27.54	1.21710	1.14940	1.28479	610.5435	394.7643	826.3227
0	28.99	1.21985	1.15157	1.28813	581.3595	363.2859	799.4332
0	30.43	1.22260	1.15372	1.29147	553.4519	333.8213	773.0825
0	31.88	1.22534	1.15586	1.29483	526.8169	307.5250	746.1087
0	33.33	1.22809	1.15799	1.29820	501.9629	283.2932	720.6326
0	34.78	1.23084	1.16011	1.30158	478.4255	261.4843	695.3667
0	36.23	1.23359	1.16222	1.30496	456.2211	241.9997	670.4426
0	37.68	1.23634	1.16432	1.30836	434.9340	223.7874	646.0806
0	39.13	1.23909	1.16641	1.31177	414.7693	208.0269	621.5118
0	40.58	1.24184	1.16850	1.31518	395.6135	194.0778	597.1491
0	42.03	1.24459	1.17057	1.31860	377.4544	181.5066	573.4023
0	43.48	1.24734	1.17264	1.32203	360.3006	171.3171	549.2841
0	44.93	1.25009	1.17470	1.32547	344.0857	161.3066	526.8647
0	46.38	1.25284	1.17675	1.32892	328.5536	152.5380	504.5693
0	47.83	1.25558	1.17879	1.33238	314.1749	144.9038	483.4460
0	49.28	1.25833	1.18083	1.33584	300.3235	138.2854	462.3615
0	50.72	1.26108	1.18286	1.33931	287.3198	132.7102	441.9294
0	52.17	1.26383	1.18488	1.34279	274.8250	127.4850	422.1650
0	53.62	1.26658	1.18689	1.34627	263.5730	123.2092	403.9369
0	55.07	1.26933	1.18890	1.34976	252.8784	119.2342	386.5225
0	56.52	1.27208	1.19090	1.35326	242.7309	116.0579	369.4039
0	57.97	1.27483	1.19289	1.35676	233.3791	113.4331	353.3250
0	59.42	1.27758	1.19488	1.36027	224.3977	111.4645	337.3310
0	60.87	1.28033	1.19686	1.36379	216.2832	109.2433	323.3230
0	62.32	1.28308	1.19884	1.36731	208.8284	107.4328	310.2239

TABLE V. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 20° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(a) Chamber pressure - Concluded

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES,SEC			TRANSFORMED CHAMBER PRESSURE,PSIA		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
0	63.77	1.28582	1.20081	1.37084	201.5840	105.2110	297.9570
0	65.22	1.28857	1.20278	1.37437	194.7686	103.0940	286.4432
0	66.67	1.29132	1.20474	1.37791	188.2488	101.1679	275.3298
0	68.12	1.29407	1.20669	1.38145	182.0337	99.4124	264.6550
0	69.57	1.29682	1.20864	1.38500	176.2727	98.0505	254.4950
0	71.01	1.29957	1.21058	1.38855	170.6605	96.3591	244.9619
0	72.46	1.30232	1.21252	1.39211	165.6717	96.2447	235.0986
0	73.91	1.30507	1.21446	1.39568	160.4844	95.5236	225.4452
0	75.36	1.30782	1.21639	1.39924	155.5116	95.1455	215.8777
0	76.81	1.31057	1.21832	1.40282	150.5256	94.6498	206.4014
0	78.26	1.31332	1.22024	1.40639	146.0654	96.1108	196.0200
0	79.71	1.31606	1.22215	1.40997	141.9074	96.4834	187.3313
0	81.16	1.31881	1.22407	1.41356	137.9316	96.8144	179.0488
0	82.61	1.32156	1.22598	1.41715	134.2118	97.4869	170.9366
0	84.06	1.32431	1.22788	1.42074	130.7535	98.1445	163.3625
0	85.51	1.32706	1.22978	1.42434	127.4212	99.2133	155.6291
0	86.96	1.32981	1.23168	1.42794	124.2571	100.1290	148.3853
0	88.41	1.33256	1.23358	1.43154	121.1870	100.7230	141.6509
0	89.86	1.33531	1.23547	1.43515	118.2528	100.8751	135.6306
0	91.30	1.33806	1.23736	1.43876	115.5991	101.2699	129.9284
0	92.75	1.34081	1.23924	1.44237	112.9523	101.2681	124.6365
0	94.20	1.34355	1.24112	1.44599	110.3170	102.5167	118.1174
0	95.65	1.34630	1.24300	1.44961	107.5746	101.3832	113.7659
0	97.10	1.34905	1.24487	1.45323	105.0054	101.2494	108.7615
0	98.55	1.35180	1.24674	1.45686	102.4855	100.5814	104.3896
0	100.00	1.35455	1.24861	1.46049	100.0049	100.0049	100.0049

TABLE V. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 20° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(b) Thrust corrected to sea-level pressure altitude (PA)

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
.00	0	.00000	.00000	.00000	554.7539	.0000	2515.1621
.78	0	.00910	.00864	.00956	5148.3337	.0000	19973.9880
1.56	0	.01820	.01728	.01912	9692.1997	.0000	30003.8418
2.34	0	.02730	.02592	.02868	14031.1770	.0000	34313.3135
3.12	0	.03640	.03456	.03824	18044.9502	1331.2754	34758.6250
3.91	0	.04550	.04320	.04781	21627.9663	9145.4687	34110.4639
4.69	0	.05460	.05184	.05737	24349.1724	15929.4338	32768.9106
5.47	0	.06370	.06048	.06693	26428.3047	20797.7380	32058.8713
6.25	0	.07280	.06912	.07649	27851.6973	23730.5781	31972.8164
7.03	0	.08190	.07776	.08605	28871.3391	25898.1575	31844.5208
7.81	0	.09101	.08640	.09561	29603.6497	27327.4302	31879.8691
8.59	0	.10011	.09504	.10517	30122.3662	28326.3325	31918.3999
9.37	0	.10921	.10368	.11473	30454.4233	28926.9468	31981.8999
10.16	0	.11831	.11232	.12429	30628.0525	29125.7405	32130.3645
10.94	0	.12741	.12096	.13386	30718.4448	29248.9543	32187.9353
11.72	0	.13651	.12960	.14342	30781.1016	29323.6399	32238.5632
12.50	0	.14561	.13824	.15298	30799.1714	29280.6165	32317.7263
13.28	0	.15471	.14688	.16254	30794.0806	29242.2791	32345.8821
14.06	0	.16381	.15552	.17210	30760.8499	29272.0386	32249.6611
14.84	0	.17291	.16416	.18166	30700.3264	29265.8230	32134.8298
15.62	0	.18201	.17280	.19122	30648.1108	29183.3486	32112.8730
16.41	0	.19111	.18144	.20078	30622.4382	29090.5505	32154.3259
17.19	0	.20021	.19008	.21034	30635.9929	29060.9656	32211.0203
17.97	0	.20931	.19872	.21991	30637.6697	28941.7717	32333.5676
18.75	0	.21841	.20736	.22947	30624.5146	28842.5603	32406.4690
19.53	0	.22751	.21600	.23903	30596.4180	28736.5596	32456.2764
20.31	0	.23661	.22464	.24859	30587.3203	28699.9705	32474.6702
21.09	0	.24571	.23328	.25815	30567.0854	28682.1848	32451.9861
21.87	0	.25481	.24192	.26771	30531.5771	28610.2412	32452.9131
22.66	0	.26391	.25056	.27727	30473.4204	28553.6438	32393.1970
23.44	0	.27302	.25920	.28683	30406.8477	28546.1306	32267.5647
24.22	0	.28212	.26784	.29639	30341.2742	28606.7605	32075.7878
25.00	0	.29122	.27648	.30595	30271.2639	28625.1423	31917.3855
25.78	0	.30032	.28512	.31552	30230.4053	28630.7056	31830.1050
26.56	0	.30942	.29376	.32508	30198.2031	28611.6182	31784.7881
27.34	0	.31852	.30240	.33464	30191.7659	28629.2620	31754.2698
28.12	0	.32762	.31104	.34420	30191.5127	28670.4016	31712.6238
28.91	0	.33672	.31968	.35376	30224.8423	28724.3030	31725.3816
29.69	0	.34582	.32832	.36332	30281.0923	28757.1709	31805.0137
30.47	0	.35492	.33696	.37288	30324.4390	28795.5515	31853.3264
31.25	0	.36402	.34560	.38244	30347.3477	28761.2068	31933.4885
32.03	0	.37312	.35424	.39200	30364.3618	28793.6133	31935.1104
32.81	0	.38222	.36288	.40157	30381.1667	28838.3994	31923.9341

TABLE V. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 20° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(b) Thrust corrected to sea-level pressure altitude (PA) - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
33.59	0	.39132	.37152	.41113	30437.6438	28913.4424	31961.8452
34.37	0	.40042	.38016	.42069	30487.0796	28994.9841	31979.1750
35.16	0	.40952	.38880	.43025	30542.6973	29052.5198	32032.8748
35.94	0	.41862	.39744	.43981	30597.6462	29059.9895	32135.3030
36.72	0	.42772	.40608	.44937	30665.6611	29117.7068	32213.6155
37.50	0	.43682	.41472	.45893	30730.9661	29172.7209	32289.2112
38.28	0	.44592	.42336	.46849	30802.9414	29272.0100	32333.8728
39.06	0	.45503	.43200	.47805	30840.8289	29248.2676	32433.3901
39.84	0	.46413	.44064	.48762	30851.5447	29157.4480	32545.6414
40.62	0	.47323	.44928	.49718	30871.4990	29049.5630	32693.4351
41.41	0	.48233	.45792	.50674	30917.9851	29046.7583	32789.2119
42.19	0	.49143	.46656	.51630	30987.2026	29070.1467	32904.2583
42.97	0	.50053	.47520	.52586	31029.9756	29157.7253	32902.2256
43.75	0	.50963	.48384	.53542	31050.7031	29310.2175	32791.1885
44.53	0	.51873	.49248	.54498	31058.8223	29451.0381	32666.6064
45.31	0	.52783	.50112	.55454	31088.9009	29555.4858	32622.3159
46.09	0	.53693	.50976	.56410	31123.6919	29590.6895	32656.6943
46.87	0	.54603	.51840	.57367	31139.7659	29648.1155	32631.4163
47.66	0	.55513	.52704	.58323	31128.9604	29608.8848	32649.0361
48.44	0	.56423	.53568	.59279	31130.5999	29526.1890	32735.0107
49.22	0	.57333	.54432	.60235	31125.3909	29433.9536	32816.8281
50.00	0	.58243	.55296	.61191	31118.8018	29334.7905	32902.8130
50.78	0	.59153	.56160	.62147	31116.1450	29342.2146	32890.0752
51.56	0	.60063	.57024	.63103	31123.3667	29399.8059	32846.9272
52.34	0	.60973	.57888	.64059	31134.1262	29440.8127	32827.4395
53.12	0	.61883	.58752	.65015	31162.9712	29468.3521	32857.5903
53.91	0	.62794	.59615	.65972	31194.7754	29474.8347	32914.7158
54.69	0	.63704	.60479	.66928	31206.1907	29587.1646	32825.2169
55.47	0	.64614	.61343	.67884	31198.0044	29682.1030	32713.9058
56.25	0	.65524	.62207	.68840	31188.8865	29737.4448	32640.3281
57.03	0	.66434	.63071	.69796	31188.1331	29756.2820	32619.9841
57.81	0	.67344	.63935	.70752	31206.8625	29756.6763	32657.0488
58.59	0	.68254	.64799	.71708	31220.2646	29735.8945	32704.6348
59.37	0	.69164	.65663	.72664	31209.2273	29768.5601	32649.8945
60.16	0	.70074	.66527	.73620	31162.6228	29681.0879	32644.1577
60.94	0	.70984	.67391	.74577	31130.4912	29583.3730	32677.6094
61.72	0	.71894	.68255	.75533	31111.2930	29466.5210	32756.0649
62.50	0	.72804	.69119	.76489	31076.8806	29399.9976	32753.7637
63.28	0	.73714	.69983	.77445	31040.4707	29421.4644	32659.4771
64.06	0	.74624	.70847	.78401	30980.7664	29417.4111	32544.1216
64.84	0	.75534	.71711	.79357	30919.5391	29388.9243	32450.1538
65.62	0	.76444	.72575	.80313	30889.9011	29320.4636	32459.3386
66.41	0	.77354	.73439	.81269	30863.4587	29282.2566	32444.6609

TABLE V. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 20° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(b) Thrust corrected to sea-level pressure altitude (PA) - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS: TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
67.19	0	.78264	.74303	.82225	30850.4297	29232.7344	32468.1250
67.97	0	.79174	.75167	.83182	30827.3728	29156.7249	32498.0208
68.75	0	.80084	.76031	.84138	30788.0398	29090.9668	32485.1128
69.53	0	.80995	.76895	.85094	30741.8774	29067.4380	32416.3169
70.31	0	.81905	.77759	.86050	30680.8831	29098.9319	32262.8342
71.09	0	.82815	.78623	.87006	30603.5886	29124.7217	32082.4556
71.87	0	.83725	.79487	.87962	30530.1824	29092.3259	31968.0388
72.66	0	.84635	.80351	.88918	30465.8164	29043.4121	31888.2207
73.44	0	.85545	.81215	.89874	30409.7317	28944.2830	31875.1804
74.22	0	.86455	.82079	.90830	30372.7935	28898.3391	31847.2478
75.00	0	.87365	.82943	.91786	30325.9727	28902.3516	31749.5937
75.78	0	.88275	.83807	.92743	30269.3164	28861.4397	31677.1931
76.56	0	.89185	.84671	.93699	30222.5627	28804.5830	31640.5425
77.34	0	.90095	.85535	.94655	30191.8218	28757.3247	31626.3188
78.12	0	.91005	.86399	.95611	30200.2017	28797.5479	31602.8555
78.91	0	.91915	.87263	.96567	30193.7251	28846.6116	31540.8386
79.69	0	.92825	.88127	.97523	30172.8320	28801.1711	31544.4929
80.47	0	.93735	.88991	.98479	30129.0327	28755.7056	31502.3599
81.25	0	.94645	.89855	.99435	30096.1328	28747.4236	31444.8420
82.03	0	.95555	.90719	1.00391	30073.1853	28767.6294	31378.7412
82.81	0	.96465	.91583	1.01348	30044.6577	28749.3828	31339.9326
83.59	0	.97375	.92447	1.02304	30002.1130	28670.6294	31333.5967
84.37	0	.98285	.93311	1.03260	29960.3984	28579.7078	31341.0891
85.16	0	.99196	.94175	1.04216	29932.5813	28472.9741	31392.1885
85.94	0	1.00106	.95039	1.05172	29918.8188	28436.5193	31401.1184
86.72	0	1.01016	.95903	1.06128	29919.6719	28355.0908	31484.2529
87.50	0	1.01926	.96767	1.07084	29930.1042	28242.3960	31617.8125
88.28	0	1.02836	.97631	1.08040	29923.4365	28218.9146	31627.9585
89.06	0	1.03746	.98495	1.08996	29887.0417	28240.5425	31533.5410
89.84	0	1.04656	.99359	1.09953	29853.2688	28242.3276	31464.2100
90.62	0	1.05566	1.00223	1.10909	29832.6653	28216.5432	31448.7874
91.41	0	1.06476	1.01087	1.11865	29853.3630	28136.7705	31569.9556
92.19	0	1.07386	1.01951	1.12821	29888.6980	28030.8547	31746.5413
92.97	0	1.08296	1.02815	1.13777	29895.8608	27946.1982	31845.5234
93.75	0	1.09206	1.03679	1.14733	29882.2026	27913.4619	31850.9434
94.53	0	1.10116	1.04543	1.15689	29850.2043	27912.6240	31787.7847
95.31	0	1.11026	1.05407	1.16645	29815.9790	27887.9568	31744.0012
96.09	0	1.11936	1.06271	1.17601	29777.5916	27799.9087	31755.2744
96.87	0	1.12846	1.07135	1.18558	29725.1157	27671.7461	31778.4854
97.66	0	1.13756	1.07999	1.19514	29628.2266	27419.4819	31836.9712
98.44	0	1.14666	1.08863	1.20470	29368.6846	26889.0061	31848.3630
99.22	0	1.15576	1.09727	1.21426	28786.1938	25888.3892	31683.9985
100.00	0	1.16487	1.10591	1.22382	27729.8345	24361.7292	31097.9397

TABLE V. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 20° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(b) Thrust corrected to sea-level pressure altitude (PA) - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS: TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
0	1.45	1.16761	1.10833	1.22690	27300.1926	23843.1047	30757.2805
0	2.90	1.17036	1.11074	1.22999	26824.0029	23298.1802	30349.8257
0	4.35	1.17311	1.11312	1.23310	26296.1689	22739.6050	29852.7320
0	5.80	1.17586	1.11550	1.23623	25728.6177	22141.0291	29316.2063
0	7.25	1.17861	1.11786	1.23937	25107.7856	21473.2451	28742.3262
0	8.70	1.18136	1.12020	1.24252	24443.1155	20753.4863	28132.7446
0	10.14	1.18411	1.12252	1.24569	23738.3738	19991.7468	27485.0007
0	11.59	1.18686	1.12484	1.24888	23010.7578	19201.8330	26819.6826
0	13.04	1.18961	1.12714	1.25208	22256.3225	18372.2998	26140.3452
0	14.49	1.19236	1.12942	1.25529	21469.4348	17446.5937	25492.2759
0	15.94	1.19510	1.13169	1.25852	20661.1165	16465.6909	24856.5420
0	17.39	1.19785	1.13395	1.26176	19846.3376	15451.2524	24241.4229
0	18.84	1.20060	1.13619	1.26501	19020.3486	14379.1995	23661.4978
0	20.29	1.20335	1.13843	1.26828	18193.6499	13266.1318	23121.1680
0	21.74	1.20610	1.14065	1.27156	17377.1187	12194.8254	22559.4119
0	23.19	1.20885	1.14285	1.27485	16565.7727	11117.4170	22014.1284
0	24.64	1.21160	1.14505	1.27815	15779.1981	10093.7900	21464.6062
0	26.09	1.21435	1.14723	1.28147	15016.0491	9141.5663	20890.5317
0	27.54	1.21710	1.14940	1.28479	14279.0247	8222.2717	20335.7776
0	28.99	1.21985	1.15157	1.28813	13571.0221	7364.0474	19777.9968
0	30.43	1.22260	1.15372	1.29147	12889.7819	6571.4308	19208.1328
0	31.88	1.22534	1.15586	1.29483	12233.2859	5866.7810	18599.7908
0	33.33	1.22809	1.15799	1.29820	11622.0443	5251.4377	17992.6509
0	34.78	1.23084	1.16011	1.30158	11037.9036	4661.4856	17414.3215
0	36.23	1.23359	1.16222	1.30496	10488.2601	4130.1418	16846.3784
0	37.68	1.23634	1.16432	1.30836	9958.2744	3652.6642	16263.8846
0	39.13	1.23909	1.16641	1.31177	9465.1268	3236.3336	15693.9200
0	40.58	1.24184	1.16850	1.31518	8997.0082	2853.3386	15140.6777
0	42.03	1.24459	1.17057	1.31860	8560.5341	2514.9202	14606.1479
0	43.48	1.24734	1.17264	1.32203	8147.9925	2215.3487	14080.6362
0	44.93	1.25009	1.17470	1.32547	7757.2770	1966.0593	13548.4946
0	46.38	1.25284	1.17675	1.32892	7381.5624	1749.6258	13013.4989
0	47.83	1.25558	1.17879	1.33238	7024.8708	1591.1302	12458.6115
0	49.28	1.25833	1.18083	1.33584	6686.4565	1450.3326	11922.5803
0	50.72	1.26108	1.18286	1.33931	6371.1387	1334.4229	11407.8545
0	52.17	1.26383	1.18488	1.34279	6066.4326	1235.0472	10897.8180
0	53.62	1.26658	1.18689	1.34627	5786.9419	1151.7660	10422.1178
0	55.07	1.26933	1.18890	1.34976	5516.6368	1094.6217	9938.6519
0	56.52	1.27208	1.19090	1.35326	5256.6125	1032.2178	9481.0071
0	57.97	1.27483	1.19289	1.35676	5012.2625	958.2487	9066.2764
0	59.42	1.27758	1.19488	1.36027	4773.7626	872.7996	8674.7256
0	60.87	1.28033	1.19686	1.36379	4554.8772	800.8790	8308.8754
0	62.32	1.28308	1.19884	1.36731	4349.8299	746.8156	7952.8442

TABLE V. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 20° F AND THE TWO-SIDED TOLERANCE LIMITS - Concluded

(b) Thrust corrected to sea-level pressure altitude (PA) - Concluded

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
0	63.77	1.28582	1.20081	1.37084	4148.9938	683.5098	7614.4777
0	65.22	1.28857	1.20278	1.37437	3959.1447	609.5856	7308.7039
0	66.67	1.29132	1.20474	1.37791	3781.9048	518.6768	7045.1327
0	68.12	1.29407	1.20669	1.38145	3614.4293	443.8415	6785.0170
0	69.57	1.29682	1.20864	1.38500	3467.0403	378.5117	6555.5689
0	71.01	1.29957	1.21058	1.38855	3321.1856	341.7373	6300.6339
0	72.46	1.30232	1.21252	1.39211	3185.9037	326.0447	6045.7626
0	73.91	1.30507	1.21446	1.39568	3057.9306	308.7873	5807.0739
0	75.36	1.30782	1.21639	1.39924	2933.4988	308.9398	5558.0579
0	76.81	1.31057	1.21832	1.40282	2818.2462	312.7150	5323.7773
0	78.26	1.31332	1.22024	1.40639	2715.3181	339.1031	5091.5330
0	79.71	1.31606	1.22215	1.40997	2608.9593	329.8938	4888.0247
0	81.16	1.31881	1.22407	1.41356	2508.1811	320.0096	4696.3525
0	82.61	1.32156	1.22598	1.41715	2418.3867	337.1912	4499.5822
0	84.06	1.32431	1.22788	1.42074	2336.1451	372.5615	4299.7288
0	85.51	1.32706	1.22978	1.42434	2255.8889	377.5249	4134.2528
0	86.96	1.32981	1.23168	1.42794	2174.4805	382.8271	3966.1339
0	88.41	1.33256	1.23358	1.43154	2095.9744	375.6129	3816.3360
0	89.86	1.33531	1.23547	1.43515	2020.9644	369.3210	3672.6078
0	91.30	1.33806	1.23736	1.43876	1953.0846	362.2395	3543.9296
0	92.75	1.34081	1.23924	1.44237	1893.3728	355.5204	3431.2252
0	94.20	1.34355	1.24112	1.44599	1833.9030	350.8985	3316.9074
0	95.65	1.34630	1.24300	1.44961	1774.4390	366.7974	3182.0807
0	97.10	1.34905	1.24487	1.45323	1718.6741	369.9616	3067.3865
0	98.55	1.35180	1.24674	1.45686	1663.0090	382.6674	2943.3507
0	100.00	1.35455	1.24861	1.46049	1613.7450	398.5517	2828.9384

TABLE VI. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 70° F AND THE TWO-SIDED TOLERANCE LIMITS

(a) Chamber pressure

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES, SEC			TRANSFORMED CHAMBER PRESSURE, PSIA		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
.00	0	.00000	.00000	.00000	102.3278	.0000	107.6568
.78	0	.00860	.00816	.00903	220.1002	.0000	577.2314
1.56	0	.01719	.01632	.01806	373.0252	.0000	925.7263
2.34	0	.02579	.02448	.02709	554.6963	.0000	1202.1521
3.12	0	.03438	.03264	.03612	748.8180	122.6924	1374.9436
3.91	0	.04298	.04080	.04515	925.0452	404.0323	1446.0581
4.69	0	.05157	.04896	.05418	1077.4023	700.6443	1454.1602
5.47	0	.06017	.05712	.06321	1181.0626	917.1871	1444.9382
6.25	0	.06876	.06528	.07224	1255.2375	1073.9798	1436.4952
7.03	0	.07736	.07344	.08127	1300.8000	1177.1400	1424.4590
7.81	0	.08595	.08160	.09030	1328.4001	1241.6809	1415.1193
8.59	0	.09455	.08976	.09933	1334.6575	1258.7320	1410.5830
9.37	0	.10315	.09792	.10837	1338.4813	1268.5289	1408.4338
10.16	0	.11174	.10609	.11740	1341.3081	1272.6488	1409.9674
10.94	0	.12034	.11425	.12643	1344.3085	1273.6028	1415.0141
11.72	0	.12893	.12241	.13546	1344.8793	1272.4736	1417.2850
12.50	0	.13753	.13057	.14449	1343.7869	1271.3774	1416.1964
13.28	0	.14612	.13873	.15352	1342.1557	1272.1758	1412.1356
14.06	0	.15472	.14689	.16255	1341.1328	1273.8269	1408.4387
14.84	0	.16331	.15505	.17158	1342.0986	1275.7463	1409.4508
15.62	0	.17191	.16321	.18061	1344.9060	1280.6543	1409.1577
16.41	0	.18050	.17137	.18964	1348.2205	1284.9874	1411.4537
17.19	0	.18910	.17953	.19867	1351.8894	1291.0347	1412.7441
17.97	0	.19769	.18769	.20770	1355.1700	1296.0618	1414.2782
18.75	0	.20629	.19585	.21673	1357.3824	1298.6275	1416.1373
19.53	0	.21489	.20401	.22576	1359.1901	1298.9737	1419.4065
20.31	0	.22348	.21217	.23479	1360.8507	1300.0637	1421.6377
21.09	0	.23208	.22033	.24382	1361.4526	1298.2285	1424.6767
21.87	0	.24067	.22849	.25285	1361.4421	1295.4287	1427.4556
22.66	0	.24927	.23665	.26188	1359.1781	1290.3938	1427.9625
23.44	0	.25786	.24481	.27091	1356.3334	1285.9870	1426.6797
24.22	0	.26646	.25297	.27994	1353.0174	1283.1829	1422.8519
25.00	0	.27505	.26113	.28897	1350.6526	1282.4783	1418.8270
25.78	0	.28365	.26929	.29800	1349.1986	1281.6005	1416.7966
26.56	0	.29224	.27745	.30704	1348.1986	1280.7754	1415.6217
27.34	0	.30084	.28561	.31607	1347.2496	1280.0756	1414.4236
28.12	0	.30944	.29377	.32510	1346.7984	1281.7941	1411.8027
28.91	0	.31803	.30194	.33413	1345.6979	1281.7040	1409.6918
29.69	0	.32663	.31010	.34316	1345.1435	1281.6139	1408.6731
30.47	0	.33522	.31826	.35219	1345.4537	1282.3119	1408.5955
31.25	0	.34382	.32642	.36122	1349.6215	1284.6899	1414.5530
32.03	0	.35241	.33458	.37025	1352.4148	1286.9991	1417.8305
32.81	0	.36101	.34274	.37928	1354.5825	1288.6763	1420.4888

TABLE VI. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 70° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(a) Chamber pressure - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES, SEC			TRANSFORMED CHAMBER PRESSURE, PSIA		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
33.59	0	.36960	.35090	.38831	1354.4272	1288.8038	1420.0506
34.37	0	.37820	.35906	.39734	1352.9169	1289.2122	1416.6216
35.16	0	.38679	.36722	.40637	1352.6316	1289.6125	1415.6507
35.94	0	.39539	.37538	.41540	1352.9006	1289.0817	1416.7196
36.72	0	.40399	.38354	.42443	1353.8014	1288.3324	1419.2704
37.50	0	.41258	.39170	.43346	1355.8377	1289.9865	1421.6889
38.28	0	.42119	.39986	.44249	1358.6297	1291.9189	1425.3405
39.06	0	.42977	.40802	.45152	1363.2802	1296.5064	1430.0539
39.84	0	.43837	.41618	.46055	1367.7746	1301.2298	1434.3194
40.62	0	.44696	.42434	.46958	1371.8687	1306.4204	1437.3171
41.41	0	.45556	.43250	.47861	1373.3512	1309.8663	1436.8362
42.19	0	.46415	.44066	.48764	1374.9897	1312.0143	1437.9650
42.97	0	.47275	.44882	.49667	1375.9500	1312.4686	1439.4315
43.75	0	.48134	.45698	.50571	1377.0241	1313.0194	1441.0288
44.53	0	.48994	.46514	.51474	1377.5431	1311.5286	1443.5575
45.31	0	.49853	.47330	.52377	1377.2190	1309.9300	1444.5081
46.09	0	.50713	.48146	.53280	1377.9263	1310.2458	1445.6068
46.87	0	.51573	.48962	.54183	1379.8391	1312.5746	1447.1037
47.66	0	.52432	.49778	.55086	1383.0102	1316.4085	1449.6118
48.44	0	.53292	.50595	.55989	1387.0111	1318.7818	1455.2404
49.22	0	.54151	.51411	.56892	1391.5359	1322.4993	1460.5725
50.00	0	.55011	.52227	.57795	1395.8729	1323.1244	1468.6215
50.78	0	.55870	.53043	.58698	1400.2332	1324.0782	1476.3882
51.56	0	.56730	.53859	.59601	1403.0473	1324.1167	1481.9780
52.34	0	.57589	.54675	.60504	1404.5834	1325.1510	1484.0157
53.12	0	.58449	.55491	.61407	1404.6977	1326.4796	1482.9159
53.91	0	.59308	.56307	.62310	1404.3999	1326.4122	1482.3875
54.69	0	.60168	.57123	.63213	1404.5057	1326.4889	1482.5224
55.47	0	.61028	.57939	.64116	1405.7907	1327.8714	1483.7100
56.25	0	.61887	.58755	.65019	1406.0304	1327.7956	1484.2652
57.03	0	.62747	.59571	.65922	1405.8661	1327.8370	1483.8952
57.81	0	.63606	.60387	.66825	1404.5714	1326.9635	1482.1792
58.59	0	.64466	.61203	.67728	1403.1511	1325.9452	1480.3571
59.37	0	.65325	.62019	.68631	1403.0172	1326.3297	1479.7047
60.16	0	.66185	.62835	.69534	1402.9550	1325.5071	1480.4029
60.94	0	.67044	.63651	.70438	1401.6688	1323.7951	1479.5425
61.72	0	.67904	.64467	.71341	1399.4053	1322.8260	1475.9847
62.50	0	.68763	.65283	.72244	1396.9731	1322.7709	1471.1754
63.28	0	.69623	.66099	.73147	1396.0577	1322.5132	1469.6022
64.06	0	.70483	.66915	.74050	1397.0319	1321.7269	1472.3369
64.84	0	.71342	.67731	.74953	1398.9925	1319.0883	1478.8966
65.62	0	.72202	.68547	.75856	1398.8250	1314.8428	1482.8072
66.41	0	.73061	.69363	.76759	1397.1182	1309.0937	1485.1427

TABLE VI. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 70° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(a) Chamber pressure - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES, SEC			TRANSFORMED CHAMBER PRESSURE, PSIA		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
67.19	0	.73921	.70180	.77662	1394.2316	1305.1636	1483.2996
67.97	0	.74780	.70996	.78565	1391.9155	1302.4268	1481.4041
68.75	0	.75640	.71812	.79468	1389.9899	1301.5464	1478.4334
69.53	0	.76499	.72628	.80371	1388.1328	1301.2802	1474.9854
70.31	0	.77359	.73444	.81274	1385.4268	1300.1905	1470.6631
71.09	0	.78218	.74260	.82177	1382.4180	1298.8406	1465.9953
71.87	0	.79078	.75076	.83080	1378.8213	1295.7225	1461.9201
72.66	0	.79937	.75892	.83983	1375.8689	1293.4528	1458.2849
73.44	0	.80797	.76708	.84886	1373.0275	1291.1286	1454.9263
74.22	0	.81657	.77524	.85789	1370.2698	1289.8393	1450.7004
75.00	0	.82516	.78340	.86692	1368.0463	1289.2526	1446.8400
75.78	0	.83376	.79156	.87595	1365.7366	1288.4686	1443.0046
76.56	0	.84235	.79972	.88498	1363.7230	1288.0081	1439.4379
77.34	0	.85095	.80788	.89401	1360.8661	1288.4747	1433.2575
78.12	0	.85954	.81604	.90304	1357.7881	1287.5122	1428.0641
78.91	0	.86814	.82420	.91208	1354.9932	1285.3689	1424.6176
79.69	0	.87673	.83236	.92111	1353.0300	1282.7556	1423.3044
80.47	0	.88533	.84052	.93014	1352.6273	1279.8176	1425.4371
81.25	0	.89392	.84868	.93917	1351.2900	1278.3353	1424.2448
82.03	0	.90252	.85684	.94820	1349.4854	1277.1502	1421.8206
82.81	0	.91112	.86500	.95723	1349.4386	1277.7221	1421.1552
83.59	0	.91971	.87316	.96626	1349.7848	1278.1400	1421.4296
84.37	0	.92831	.88132	.97529	1350.6629	1277.3364	1423.9895
85.16	0	.93690	.88948	.98432	1350.2709	1276.9299	1423.6119
85.94	0	.94550	.89764	.99335	1349.1147	1275.7730	1422.4564
86.72	0	.95409	.90581	1.00238	1349.2118	1277.7604	1420.6631
87.50	0	.96269	.91397	1.01141	1350.5958	1279.4234	1421.7682
88.28	0	.97128	.92213	1.02044	1352.5815	1279.7017	1425.4612
89.06	0	.97988	.93029	1.02947	1354.3829	1278.8887	1429.8772
89.84	0	.98847	.93845	1.03850	1355.1887	1277.9651	1432.4123
90.62	0	.99707	.94661	1.04753	1355.0040	1276.8681	1433.1399
91.41	0	1.00567	.95477	1.05656	1354.3009	1276.0997	1432.5021
92.19	0	1.01426	.96293	1.06559	1351.9687	1273.0697	1430.8677
92.97	0	1.02286	.97109	1.07462	1350.3420	1268.6179	1432.0662
93.75	0	1.03145	.97925	1.08365	1349.3449	1264.1009	1434.5889
94.53	0	1.04005	.98741	1.09268	1349.5828	1261.5753	1437.5904
95.31	0	1.04864	.99557	1.10171	1351.3294	1261.1910	1441.4678
96.09	0	1.05724	1.00373	1.11075	1353.1933	1261.0287	1445.3580
96.87	0	1.06583	1.01189	1.11978	1354.0519	1256.4607	1451.6431
97.66	0	1.07443	1.02005	1.12881	1353.0242	1248.6291	1457.4194
98.44	0	1.08302	1.02821	1.13784	1346.4695	1233.7079	1459.2311
99.22	0	1.09162	1.03637	1.14687	1326.4564	1206.5371	1446.3758
100.00	0	1.10021	1.04453	1.15590	1284.8251	1152.9142	1416.7361

TABLE VI. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 70° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(a) Chamber pressure - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS: TRANSFORMED TIMES, SEC			TRANSFORMED CHAMBER PRESSURE, PSIA		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
0	1.45	1.10296	1.04696	1.15896	1265.7986	1131.2732	1400.3239
0	2.90	1.10571	1.04937	1.16205	1243.1051	1106.5804	1379.6298
0	4.35	1.10846	1.05177	1.16514	1217.7949	1079.2702	1356.3197
0	5.80	1.11121	1.05415	1.16826	1189.4209	1049.6035	1329.2382
0	7.25	1.11395	1.05652	1.17139	1157.4960	1015.9215	1299.0705
0	8.70	1.11670	1.05887	1.17453	1122.7321	978.3447	1267.1196
0	10.14	1.11945	1.06121	1.17768	1085.9039	937.0083	1234.7995
0	11.59	1.12220	1.06354	1.18085	1047.3192	893.4024	1201.2360
0	13.04	1.12494	1.06585	1.18404	1007.3941	849.0187	1165.7696
0	14.49	1.12769	1.06815	1.18724	965.7292	800.8908	1130.5677
0	15.94	1.13044	1.07043	1.19045	923.4629	750.9469	1095.9789
0	17.39	1.13319	1.07271	1.19367	881.8421	701.8965	1061.7876
0	18.84	1.13594	1.07497	1.19690	839.8980	653.1003	1026.6958
0	20.29	1.13869	1.07721	1.20015	798.2981	605.0764	991.5197
0	21.74	1.14143	1.07945	1.20341	758.2781	557.7686	958.7876
0	23.19	1.14418	1.08167	1.20668	720.1224	513.6292	926.6155
0	24.64	1.14693	1.08389	1.20997	683.3024	472.2107	894.3941
0	26.09	1.14967	1.08609	1.21326	647.9922	433.3092	862.6752
0	27.54	1.15242	1.08828	1.21656	614.4187	397.2699	831.5674
0	28.99	1.15517	1.09046	1.21988	583.1350	364.3954	801.8746
0	30.43	1.15792	1.09263	1.22320	553.6779	333.9576	773.3982
0	31.88	1.16066	1.09479	1.22654	525.9922	307.0436	744.9408
0	33.33	1.16341	1.09694	1.22988	499.8270	282.0877	717.5663
0	34.78	1.16616	1.09909	1.23323	475.5800	259.9291	691.2309
0	36.23	1.16891	1.10122	1.23660	452.6584	240.1099	665.2070
0	37.68	1.17166	1.10334	1.23997	431.5551	222.0489	641.0614
0	39.13	1.17440	1.10546	1.24335	411.5653	206.4199	616.7107
0	40.58	1.17715	1.10756	1.24674	392.7843	192.6899	592.8786
0	42.03	1.17990	1.10966	1.25013	375.0380	180.3447	569.7314
0	43.48	1.18265	1.11175	1.25354	358.0860	170.2641	545.9079
0	44.93	1.18539	1.11384	1.25695	342.4953	160.5611	524.4296
0	46.38	1.18814	1.11591	1.26037	327.7593	152.1692	503.3493
0	47.83	1.19089	1.11798	1.26380	313.2042	144.4561	481.9523
0	49.28	1.19364	1.12004	1.26723	299.2865	137.8080	460.7651
0	50.72	1.19638	1.12210	1.27067	286.1387	132.1646	440.1127
0	52.17	1.19913	1.12414	1.27412	274.0485	127.1248	420.9722
0	53.62	1.20188	1.12619	1.27757	262.4770	122.6969	402.2572
0	55.07	1.20463	1.12822	1.28103	251.5889	118.6262	384.5516
0	56.52	1.20738	1.13025	1.28450	241.9559	115.6874	368.2245
0	57.97	1.21012	1.13227	1.28797	232.9614	113.2302	352.6927
0	59.42	1.21287	1.13429	1.29145	224.8413	111.6848	337.9978
0	60.87	1.21562	1.13630	1.29494	217.5334	109.8748	325.1920
0	62.32	1.21837	1.13830	1.29843	210.9290	108.5135	313.3446

TABLE VI. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 70° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(a) Chamber pressure - Concluded

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES, SEC			TRANSFORMED CHAMBER PRESSURE, PSIA		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
0	63.77	1.22111	1.14031	1.30192	205.3926	107.1989	303.5865
0	65.22	1.22386	1.14230	1.30542	200.2245	105.9819	294.4672
0	66.67	1.22661	1.14429	1.30893	194.8297	104.7045	284.9548
0	68.12	1.22936	1.14627	1.31244	189.2692	103.3638	275.1745
0	69.57	1.23210	1.14826	1.31595	183.5415	102.0937	264.9893
0	71.01	1.23485	1.15023	1.31947	178.6698	100.8813	256.4583
0	72.46	1.23760	1.15220	1.32300	173.3576	100.7098	246.0055
0	73.91	1.24035	1.15417	1.32653	168.1004	100.0568	236.1440
0	75.36	1.24310	1.15613	1.33006	163.1774	99.8356	226.5191
0	76.81	1.24584	1.15809	1.33360	158.0718	99.3949	216.7488
0	78.26	1.24859	1.16004	1.33714	152.3476	100.2445	204.4507
0	79.71	1.25134	1.16199	1.34068	148.0095	100.6323	195.3867
0	81.16	1.25409	1.16394	1.34423	143.6990	100.8626	186.5355
0	82.61	1.25683	1.16588	1.34779	139.6407	101.4303	177.8511
0	84.06	1.25959	1.16782	1.35134	135.5900	101.7748	169.4052
0	85.51	1.26233	1.16976	1.35490	131.8003	102.6230	160.9777
0	86.96	1.26508	1.17169	1.35847	128.1277	103.2479	153.0075
0	88.41	1.26782	1.17362	1.36203	124.6389	103.5920	145.6858
0	89.86	1.27057	1.17554	1.36560	121.0047	103.2226	138.7869
0	91.30	1.27332	1.17746	1.36918	117.6831	103.0955	132.2707
0	92.75	1.27607	1.17938	1.37275	114.4622	102.6218	126.3026
0	94.20	1.27882	1.18130	1.37633	110.7097	102.8816	118.5379
0	95.65	1.28156	1.18321	1.37992	107.7608	101.5587	113.9628
0	97.10	1.28431	1.18512	1.38350	105.0197	101.2631	108.7763
0	98.55	1.28706	1.18703	1.38709	102.4289	100.5259	104.3319
0	100.00	1.28981	1.18893	1.39068	100.0028	100.0028	100.0028

TABLE VI. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 70° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(b) Thrust corrected to sea-level pressure altitude (PA)

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
.00	0	.00000	.00000	.00000	564.6254	.0000	2559.9178
.78	0	.00860	.00816	.00903	4355.6593	.0000	16898.6494
1.56	0	.01719	.01632	.01806	8240.1194	.0000	25508.6819
2.34	0	.02579	.02448	.02709	12512.6915	.0000	30599.8490
3.12	0	.03438	.03264	.03612	16936.9797	1249.5339	32624.4255
3.91	0	.04293	.04080	.04515	21059.3711	8905.0359	33213.7061
4.69	0	.05157	.04896	.05418	24590.8894	16087.5669	33094.2119
5.47	0	.06017	.05712	.06321	27117.5125	21340.1091	32894.9155
6.25	0	.06876	.06528	.07224	28941.7629	24659.3499	33224.1758
7.03	0	.07736	.07344	.08127	30140.3108	27036.4487	33244.1720
7.81	0	.08595	.08160	.09030	30960.1077	28579.5884	33340.6270
8.59	0	.09455	.08976	.09933	31282.2568	29417.0632	33147.4502
9.37	0	.10315	.09792	.10837	31523.7578	29942.6465	33104.8691
10.16	0	.11174	.10609	.11740	31676.0020	30122.2874	33229.7163
10.94	0	.12034	.11425	.12643	31789.5442	30268.8154	33310.2720
11.72	0	.12893	.12241	.13546	31849.6270	30341.5715	33357.6821
12.50	0	.13753	.13057	.14449	31863.6233	30292.5862	33434.6602
13.28	0	.14612	.13873	.15352	31857.9233	30252.5125	33463.3340
14.06	0	.15472	.14689	.16255	31843.7705	30302.5464	33384.9946
14.84	0	.16331	.15505	.17158	31847.4275	30359.3257	33335.5293
15.62	0	.17191	.16321	.18061	31873.0759	30349.7698	33396.3818
16.41	0	.18050	.17137	.18964	31940.4822	30342.6599	33538.3042
17.19	0	.18910	.17953	.19867	32037.4465	30390.3704	33684.5225
17.97	0	.19769	.18769	.20770	32128.0205	30349.6267	33906.4141
18.75	0	.20629	.19585	.21673	32179.6755	30307.2317	34052.1191
19.53	0	.21489	.20401	.22576	32198.4124	30241.1743	34155.6504
20.31	0	.22348	.21217	.23479	32235.0012	30245.9836	34224.0186
21.09	0	.23208	.22033	.24382	32276.5945	30286.2786	34266.9102
21.87	0	.24067	.22849	.25285	32322.1812	30288.1643	34356.1978
22.66	0	.24927	.23665	.26188	32318.3831	30282.3777	34354.3892
23.44	0	.25786	.24481	.27091	32295.9609	30319.6423	34272.2793
24.22	0	.26646	.25297	.27994	32248.0217	30404.5054	34091.5381
25.00	0	.27505	.26113	.28897	32208.7761	30457.2942	33960.2578
25.78	0	.28365	.26929	.29800	32197.6172	30493.8186	33901.4155
26.56	0	.29224	.27745	.30704	32172.4583	30482.1479	33862.7686
27.34	0	.30084	.28561	.31607	32136.0129	30472.8889	33799.1367
28.12	0	.30944	.29377	.32510	32105.1899	30487.6638	33722.7158
28.91	0	.31803	.30194	.33413	32081.2891	30488.5847	33673.9932
29.69	0	.32663	.31010	.34316	32092.5454	30477.4609	33707.6299
30.47	0	.33522	.31826	.35219	32113.8079	30494.7048	33732.9106
31.25	0	.34382	.32642	.36122	32188.4062	30506.0400	33870.7725
32.03	0	.35241	.33458	.37025	32211.0842	30544.8042	33877.3643
32.81	0	.36101	.34274	.37928	32205.3926	30569.9897	33840.7954

TABLE VI. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 70° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(b) Thrust corrected to sea-level pressure altitude (PA) - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS: TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
33.59	0	.36960	.35090	.38831	32177.2544	30565.9399	33788.5688
34.37	0	.37820	.35906	.39734	32143.2429	30570.0916	33716.3940
35.16	0	.38679	.36722	.40637	32146.1511	30577.7407	33714.5615
35.94	0	.39539	.37538	.41540	32169.4460	30552.7998	33786.0923
36.72	0	.40399	.38354	.42443	32228.8679	30602.0051	33855.7305
37.50	0	.41258	.39170	.43346	32209.1311	30661.3711	33936.8911
38.28	0	.42118	.39986	.44249	32396.9041	30786.7515	34007.0566
39.06	0	.42977	.40802	.45152	32512.6809	30833.7891	34191.5728
39.84	0	.43837	.41618	.46055	32596.3621	30806.4558	34386.2681
40.62	0	.44696	.42434	.46958	32670.0200	30741.9417	34598.0981
41.41	0	.45556	.43250	.47861	32699.1980	30720.1682	34678.2275
42.19	0	.46415	.44066	.48764	32741.4803	30715.9028	34767.0757
42.97	0	.47275	.44882	.49667	32763.2231	30786.3945	34740.0519
43.75	0	.48134	.45698	.50571	32770.5171	30933.6309	34607.4033
44.53	0	.48994	.46514	.51474	32766.4062	31070.2280	34462.5845
45.31	0	.49853	.47330	.52377	32772.4385	31155.9858	34388.8911
46.09	0	.50713	.48146	.53280	32814.5142	31198.2310	34430.7974
46.87	0	.51573	.48962	.54183	32868.4111	31293.9561	34442.8662
47.66	0	.52432	.49778	.55086	32909.2070	31302.1997	34516.2144
48.44	0	.53292	.50595	.55989	32982.7607	31282.8940	34682.6274
49.22	0	.54151	.51411	.56892	33067.7148	31270.7266	34864.7031
50.00	0	.55011	.52227	.57795	33149.8799	31249.4297	35050.3301
50.78	0	.55870	.53043	.58698	33234.4941	31339.7979	35129.1904
51.56	0	.56730	.53859	.59601	33280.4873	31437.4692	35123.5054
52.34	0	.57589	.54675	.60504	33305.8486	31494.4209	35117.2764
53.12	0	.58449	.55491	.61407	33318.0493	31506.2388	35129.8590
53.91	0	.59308	.56307	.62310	33330.9907	31493.2686	35168.7129
54.69	0	.60168	.57123	.63213	33341.5000	31611.6904	35071.3096
55.47	0	.61028	.57939	.64116	33368.1992	31746.8486	34989.5498
56.25	0	.61887	.58755	.65019	33379.1475	31825.7773	34932.5176
57.03	0	.62747	.59571	.65922	33382.1602	31849.5815	34914.7388
57.81	0	.63606	.60387	.66825	33376.6611	31825.6445	34927.6777
58.59	0	.64466	.61203	.67728	33372.5635	31785.8623	34959.2646
59.37	0	.65325	.62019	.68631	33384.2974	31843.2256	34925.3691
60.16	0	.66185	.62835	.69534	33356.9399	31771.0830	34942.7969
60.94	0	.67044	.63651	.70438	33315.0234	31659.3394	34970.7075
61.72	0	.67904	.64467	.71341	33265.9946	31507.3101	35024.6792
62.50	0	.68763	.65283	.72244	33205.1606	31413.4385	34996.8828
63.28	0	.69623	.66099	.73147	33165.4482	31435.6079	34895.2886
64.06	0	.70483	.66915	.74050	33148.6978	31475.9443	34821.4512
64.84	0	.71342	.67731	.74953	33159.5122	31518.0122	34801.0122
65.62	0	.72202	.68547	.75856	33168.7759	31483.5547	34853.9971
66.41	0	.73061	.69363	.76759	33152.9893	31454.4897	34851.4888

TABLE VI. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 70° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(b) Thrust corrected to sea-level pressure altitude (PA) - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
67.19	0	.73921	.70180	.77662	33108.4165	31372.3198	34844.5132
67.97	0	.74780	.70996	.78565	33071.0859	31278.8433	34863.3286
68.75	0	.75640	.71812	.79468	33032.6045	31211.8091	34853.3999
69.53	0	.76499	.72628	.80371	32996.7686	31199.5107	34794.0264
70.31	0	.77359	.73444	.81274	32942.5571	31243.9912	34641.1230
71.09	0	.78218	.74260	.82177	32875.2090	31286.5703	34463.8477
71.87	0	.79078	.75076	.83080	32783.7075	31239.7187	34327.6963
72.66	0	.79937	.75892	.83983	32696.1418	31169.6062	34222.6772
73.44	0	.80797	.76708	.84886	32617.0295	31045.2102	34188.8486
74.22	0	.81657	.77524	.85789	32557.8428	30977.3137	34138.3716
75.00	0	.82516	.78340	.86692	32524.1414	30997.3289	34050.9536
75.78	0	.83376	.79156	.87595	32479.2153	30968.5527	33989.8779
76.56	0	.84235	.79972	.88498	32436.4089	30914.5596	33958.2583
77.34	0	.85095	.80788	.89401	32383.5747	30844.9417	33922.2075
78.12	0	.85954	.81604	.90304	32332.4375	30830.7524	33834.1226
78.91	0	.86814	.82420	.91208	32283.7952	30843.4329	33724.1572
79.69	0	.87673	.83236	.92111	32257.1812	30790.7664	33723.5957
80.47	0	.88533	.84052	.93014	32246.4087	30776.5691	33716.2480
81.25	0	.89392	.84868	.93917	32213.5950	30769.9958	33657.1938
82.03	0	.90252	.85684	.94820	32174.4219	30777.6465	33571.1973
82.81	0	.91112	.86500	.95723	32161.3462	30774.8179	33547.8745
83.59	0	.91971	.87316	.96626	32140.9009	30714.4985	33567.3032
84.37	0	.92831	.88132	.97529	32135.2454	30654.3293	33616.1611
85.16	0	.93690	.88948	.98432	32102.7129	30537.2834	33668.1421
85.94	0	.94550	.89764	.99335	32076.9814	30487.7576	33666.2051
86.72	0	.95409	.90581	1.00238	32091.1824	30413.0471	33769.3174
87.50	0	.96269	.91397	1.01141	32146.7683	30334.0657	33959.4707
88.28	0	.97128	.92213	1.02044	32204.2524	30369.8083	34038.6963
89.06	0	.97988	.93029	1.02947	32241.7407	30465.5195	34017.9619
89.84	0	.98847	.93845	1.03850	32258.5493	30517.8145	33999.2842
90.62	0	.99707	.94661	1.04753	32253.6577	30506.3840	34000.9312
91.41	0	1.00567	.95477	1.05656	32259.8752	30404.9065	34114.8437
92.19	0	1.01426	.96293	1.06559	32239.6223	30235.6479	34243.5967
92.97	0	1.02286	.97109	1.07462	32222.5195	30121.1245	34323.9146
93.75	0	1.03145	.97925	1.08365	32189.7083	30068.9417	34310.4746
94.53	0	1.04005	.98741	1.09268	32167.9563	30079.9309	34255.9814
95.31	0	1.04864	.99557	1.10171	32184.5662	30103.3821	34265.7500
96.09	0	1.05724	1.00373	1.11075	32208.2380	30069.1238	34347.3521
96.87	0	1.06583	1.01189	1.11978	32201.6636	29977.2173	34426.1099
97.66	0	1.07443	1.02005	1.12881	32108.6282	29714.9731	34502.2832
98.44	0	1.08302	1.02821	1.13784	31798.8787	29114.0127	34483.7446
99.22	0	1.09162	1.03637	1.14687	31117.8608	27985.3357	34250.3857
100.00	0	1.10021	1.04453	1.15590	29948.9587	26311.3162	33586.6011

TABLE VI. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 70° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(b) Thrust corrected to sea-level pressure altitude (PA) - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
0	1.45	1.10296	1.04696	1.15896	29457.2317	25726.9932	33187.4702
0	2.90	1.10571	1.04937	1.16205	28892.7153	25094.9749	32690.4558
0	4.35	1.10846	1.05177	1.16514	28281.9094	24456.7737	32107.0452
0	5.80	1.11121	1.05415	1.16826	27612.3962	23762.1343	31462.6582
0	7.25	1.11395	1.05652	1.17139	26868.5129	22979.0940	30757.9319
0	8.70	1.11670	1.05887	1.17453	26074.8035	22138.8752	30010.7317
0	10.14	1.11945	1.06121	1.17768	25237.5176	21254.2812	29220.7539
0	11.59	1.12220	1.06354	1.18085	24376.6443	20341.6270	28411.6615
0	13.04	1.12494	1.06585	1.18404	23476.0786	19379.1914	27572.9658
0	14.49	1.12769	1.06815	1.18724	22541.3374	18317.6479	26765.0269
0	15.94	1.13044	1.07043	1.19045	21585.1404	17202.0833	25968.1975
0	17.39	1.13319	1.07271	1.19367	20647.7144	16075.1594	25220.2693
0	18.84	1.13594	1.07497	1.19690	19688.0090	14883.9441	24492.0740
0	20.29	1.13868	1.07721	1.20015	18730.1641	13657.3379	23802.9902
0	21.74	1.14143	1.07945	1.20341	17797.3684	12489.7458	23104.9910
0	23.19	1.14419	1.08167	1.20668	16895.3718	11338.6133	22452.1304
0	24.64	1.14693	1.08389	1.20997	16020.3522	10248.0537	21792.6506
0	26.09	1.14967	1.08609	1.21326	15176.5000	9239.2466	21113.7534
0	27.54	1.15242	1.08828	1.21656	14369.6554	8274.4594	20464.8513
0	28.99	1.15517	1.09046	1.21988	13612.4679	7386.5371	19838.3987
0	30.43	1.15792	1.09263	1.22320	12895.0443	6574.1138	19215.9749
0	31.88	1.16066	1.09479	1.22654	12214.1367	5857.5977	18570.6758
0	33.33	1.16341	1.09694	1.22988	11572.5911	5229.0923	17916.0898
0	34.78	1.16616	1.09909	1.23323	10972.2549	4633.7610	17310.7488
0	36.23	1.16891	1.10122	1.23660	10406.3561	4097.8890	16714.8230
0	37.68	1.17166	1.10334	1.23997	9880.9106	3624.2874	16137.5339
0	39.13	1.17440	1.10546	1.24335	9392.0103	3211.3336	15572.6869
0	40.58	1.17715	1.10756	1.24674	8932.6659	2832.9327	15032.3990
0	42.03	1.17990	1.10966	1.25013	8505.7310	2498.8202	14512.6417
0	43.48	1.18265	1.11175	1.25354	8097.9097	2201.7319	13994.0875
0	44.93	1.18539	1.11384	1.25695	7721.4225	1956.9722	13485.8728
0	46.38	1.18814	1.11591	1.26037	7363.7158	1745.3956	12982.0360
0	47.83	1.19089	1.11798	1.26380	7003.1672	1586.2145	12420.1199
0	49.28	1.19364	1.12004	1.26723	6663.3687	1445.3246	11881.4128
0	50.72	1.19638	1.12210	1.27067	6344.9482	1328.9373	11360.9591
0	52.17	1.19913	1.12414	1.27412	6049.2922	1231.5577	10867.0267
0	53.62	1.20188	1.12619	1.27757	5762.8789	1146.9767	10378.7811
0	55.07	1.20463	1.12822	1.28103	5488.5067	1089.0401	9887.9731
0	56.52	1.20738	1.13025	1.28450	5239.8287	1028.9221	9450.7354
0	57.97	1.21012	1.13227	1.28797	5003.2932	956.5339	9050.0524
0	59.42	1.21287	1.13429	1.29145	4783.1991	874.5250	8691.8732
0	60.87	1.21562	1.13630	1.29494	4581.2064	805.5085	8356.9043
0	62.32	1.21837	1.13830	1.29843	4393.5859	754.3279	8032.8438

TABLE VI. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 70° F AND THE TWO-SIDED TOLERANCE LIMITS - Concluded

(b) Thrust corrected to sea-level pressure altitude (PA) - Concluded

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
0	63.77	1.22111	1.14031	1.30192	4227.3832	696.4238	7758.3426
0	65.22	1.22386	1.14230	1.30542	4070.0492	626.6613	7513.4370
0	66.67	1.22661	1.14429	1.30893	3914.1132	536.8088	7291.4177
0	68.12	1.22936	1.14627	1.31244	3758.0951	461.4833	7054.7070
0	69.57	1.23210	1.14826	1.31595	3610.0066	394.1198	6825.8935
0	71.01	1.23485	1.15023	1.31947	3477.0535	357.7756	6596.3315
0	72.46	1.23760	1.15220	1.32300	3333.7065	341.1709	6326.2419
0	73.91	1.24035	1.15417	1.32653	3203.0496	323.4413	6082.6578
0	75.36	1.24310	1.15613	1.33006	3078.1025	324.1687	5832.0364
0	76.81	1.24584	1.15809	1.33360	2959.5327	328.3924	5590.6730
0	78.26	1.24859	1.16004	1.33714	2832.1033	353.6879	5310.5187
0	79.71	1.25134	1.16199	1.34068	2721.1460	344.0794	5098.2125
0	81.16	1.25409	1.16394	1.34423	2613.0569	333.3904	4892.7235
0	82.61	1.25683	1.16588	1.34779	2516.2124	350.8310	4681.5937
0	84.06	1.25958	1.16782	1.35134	2422.5582	386.3424	4458.7740
0	85.51	1.26233	1.16976	1.35490	2333.4185	390.4996	4276.3373
0	86.96	1.26508	1.17169	1.35847	2242.2148	394.7521	4089.6774
0	88.41	1.26782	1.17362	1.36203	2155.6772	386.3121	3925.0423
0	89.86	1.27057	1.17554	1.36560	2067.9942	377.9156	3758.0729
0	91.30	1.27332	1.17746	1.36918	1988.2938	368.7698	3607.8178
0	92.75	1.27607	1.17938	1.37275	1918.6824	360.2729	3477.0920
0	94.20	1.27882	1.18130	1.37633	1840.4316	352.1477	3328.7156
0	95.65	1.28156	1.18321	1.37992	1777.5100	367.4322	3187.5879
0	97.10	1.28431	1.18512	1.38350	1718.9079	370.0119	3067.8039
0	98.55	1.28706	1.18703	1.38709	1662.0911	382.4562	2941.7260
0	100.00	1.28981	1.18893	1.39068	1613.7115	398.5434	2828.8796

TABLE VII. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 140° F AND THE TWO-SIDED TOLERANCE LIMITS

(a) Chamber pressure

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES, SEC			TRANSFORMED CHAMBER PRESSURE, PSIA		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
.00	0	.00000	.00000	.00000	100.4337	.0000	105.6641
.78	0	.00814	.00773	.00855	295.3759	.0000	774.6484
1.56	0	.01628	.01546	.01711	513.3419	.0000	1273.9463
2.34	0	.02443	.02319	.02566	728.8890	.0000	1579.6671
3.12	0	.03257	.03092	.03422	922.5771	151.1625	1693.9917
3.91	0	.04071	.03865	.04277	1075.6648	469.8184	1681.5112
4.69	0	.04885	.04638	.05132	1198.7382	779.5502	1617.9263
5.47	0	.05699	.05411	.05988	1289.0778	1001.0692	1577.0863
6.25	0	.06514	.06184	.06843	1351.2128	1156.0961	1546.3294
7.03	0	.07328	.06957	.07699	1389.9962	1257.8568	1522.1355
7.81	0	.08142	.07730	.08554	1410.4805	1318.4030	1502.5580
8.59	0	.08956	.08503	.09409	1420.7699	1339.9457	1501.5941
9.37	0	.09770	.09276	.10265	1425.5901	1351.0851	1500.0950
10.16	0	.10585	.10049	.11120	1426.9890	1353.9439	1500.0341
10.94	0	.11399	.10822	.11976	1427.2773	1352.2079	1502.3468
11.72	0	.12213	.11595	.12831	1425.8703	1349.1042	1502.6364
12.50	0	.13027	.12368	.13686	1425.7977	1348.9691	1502.6263
13.28	0	.13641	.13141	.14542	1426.3201	1351.9604	1500.6978
14.06	0	.14656	.13914	.15397	1428.0669	1356.3982	1499.7357
14.84	0	.15470	.14687	.16253	1429.3379	1358.6727	1500.0032
15.62	0	.16284	.15460	.17108	1430.4530	1362.1144	1498.7916
16.41	0	.17098	.16233	.17963	1430.7782	1363.6739	1497.8834
17.19	0	.17912	.17006	.18819	1431.3210	1366.8907	1495.7512
17.97	0	.18727	.17779	.19674	1432.5235	1370.0415	1495.0056
18.75	0	.19541	.18552	.20530	1434.2267	1372.1455	1496.3070
19.53	0	.20355	.19325	.21385	1436.2723	1372.6409	1499.9036
20.31	0	.21169	.20098	.22240	1437.7016	1373.4818	1501.9214
21.09	0	.21983	.20871	.23096	1437.6042	1370.8438	1504.3647
21.87	0	.22798	.21644	.23951	1435.6745	1366.0617	1505.2873
22.66	0	.23612	.22417	.24807	1431.5368	1359.0906	1503.9830
23.44	0	.24426	.23190	.25662	1426.7016	1352.7055	1500.6976
24.22	0	.25240	.23963	.26518	1421.8263	1348.4403	1495.2123
25.00	0	.26054	.24736	.27373	1418.5203	1346.9204	1490.1203
25.78	0	.26868	.25509	.28228	1416.1169	1345.1661	1487.0677
26.56	0	.27683	.26282	.29084	1414.6039	1343.8598	1485.3479
27.34	0	.28497	.27055	.29939	1413.1396	1342.6804	1483.5989
28.12	0	.29311	.27828	.30795	1412.2903	1344.1250	1480.4556
28.91	0	.30125	.28601	.31650	1412.2309	1345.0731	1479.3888
29.69	0	.30939	.29374	.32505	1412.8966	1346.1671	1479.6262
30.47	0	.31754	.30147	.33361	1413.6395	1347.2977	1479.9812
31.25	0	.32568	.30920	.34216	1414.8231	1346.7547	1482.8915
32.03	0	.33382	.31693	.35072	1416.2446	1347.7415	1484.7477
32.81	0	.34196	.32466	.35927	1418.1979	1349.1965	1487.1993

TABLE VII. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 140° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(a) Chamber pressure - Continued

PERCENT	PERCENT	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
WEB BURN	TAILOFF	TRANSFORMED TIMES, SEC			TRANSFORMED CHAMBER PRESSURE, PSIA		
TIME	TIME	MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
33.59	0	.35010	.33239	.36782	1420.0132	1351.2122	1488.8143
34.37	0	.35825	.34012	.37638	1422.4617	1355.4823	1489.4411
35.16	0	.36639	.34785	.38493	1424.7229	1358.3451	1491.1007
35.94	0	.37453	.35558	.39349	1427.6518	1360.3067	1494.9969
36.72	0	.38267	.36331	.40204	1430.5358	1361.3560	1499.7157
37.50	0	.39081	.37103	.41059	1432.9190	1363.3241	1502.5139
38.28	0	.39896	.37876	.41915	1434.7802	1364.3303	1505.2301
39.06	0	.40710	.38649	.42770	1436.8444	1366.4675	1507.2213
39.84	0	.41524	.39422	.43626	1438.9012	1368.8960	1508.9064
40.62	0	.4233[illegible]	.40195	.44481	1441.8523	1373.0652	1510.6394
41.41	0	.43152	.40968	.45336	1444.5722	1377.7949	1511.3494
42.19	0	.43967	.41741	.46192	1446.9669	1380.6950	1513.2380
42.97	0	.44781	.42514	.47047	1449.1724	1382.3127	1516.0320
43.75	0	.45595	.43287	.47903	1451.2944	1383.8280	1518.7407
44.53	0	.4640[illegible]	.44060	.48758	1453.2260	1383.5847	1522.8673
45.31	0	.47223	.44833	.49613	1455.4254	1384.3153	1526.5355
46.09	0	.48038	.45606	.50469	1457.6419	1386.0459	1529.2379
46.87	0	.48652	.46379	.51324	1459.0815	1387.9541	1530.2090
47.66	0	.49666	.47152	.52180	1460.2896	1389.9665	1530.6128
48.44	0	.50480	.47925	.53035	1461.4136	1389.5243	1533.3029
49.22	0	.51294	.48698	.53890	1462.5049	1390.0329	1535.1568
50.00	0	.52109	.49471	.54746	1463.8000	1387.5966	1540.1833
50.78	0	.52923	.50244	.55601	1465.4547	1385.7526	1545.1569
51.56	0	.53737	.51017	.56457	1466.2470	1383.7610	1548.7331
52.34	0	.54551	.51790	.57312	1466.9521	1383.9927	1549.9116
53.12	0	.55365	.52563	.58167	1467.5312	1385.8142	1549.2481
53.91	0	.56180	.53336	.59023	1467.8527	1386.3414	1549.3639
54.69	0	.56994	.54109	.59878	1468.0958	1386.5468	1549.6449
55.47	0	.57808	.54882	.60734	1468.9139	1387.4959	1550.3319
56.25	0	.58622	.55655	.61589	1469.4561	1387.6922	1551.2201
57.03	0	.59436	.56428	.62444	1469.7399	1388.1656	1551.3141
57.81	0	.60251	.57201	.63300	1469.9270	1388.7080	1551.1460
58.59	0	.61065	.57974	.64155	1469.6545	1388.7893	1550.5197
59.37	0	.61879	.58747	.65011	1468.9440	1388.6530	1549.2350
60.16	0	.62693	.59520	.65866	1468.7596	1387.6791	1549.8402
60.94	0	.63507	.60293	.66721	1468.5672	1386.9767	1550.1576
61.72	0	.64322	.61066	.67577	1467.9619	1387.6309	1548.2929
62.50	0	.65136	.61839	.68432	1467.1820	1389.2505	1545.1135
63.28	0	.65950	.62612	.69288	1466.4005	1389.1503	1543.6507
64.06	0	.66764	.63385	.70143	1464.9622	1385.9956	1543.9289
64.84	0	.67578	.64158	.70999	1463.8383	1380.2304	1547.4461
65.62	0	.68393	.64931	.71854	1461.8198	1374.0556	1549.5840
66.41	0	.69207	.65704	.72709	1459.2677	1367.3275	1551.2079

TABLE VII. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 140° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(a) Chamber pressure - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES, SEC			TRANSFORMED CHAMBER PRESSURE, PSIA		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
67.19	0	.70021	.66477	.73565	1456.5565	1363.5070	1549.6060
67.97	0	.70835	.67250	.74420	1454.3248	1360.9238	1547.8258
68.75	0	.71649	.68023	.75276	1452.1519	1359.7531	1544.5506
69.53	0	.72463	.68796	.76131	1450.4388	1359.6978	1541.1898
70.31	0	.73278	.69569	.76986	1447.9036	1358.8235	1536.9836
71.09	0	.74092	.70342	.77842	1445.0010	1357.6401	1532.3619
71.87	0	.74906	.71115	.78697	1442.1234	1355.2095	1529.0372
72.66	0	.75720	.71888	.79553	1439.8217	1353.5748	1526.0685
73.44	0	.76534	.72661	.80408	1437.7971	1352.0349	1523.5593
74.22	0	.77349	.73434	.81263	1435.9080	1351.7095	1520.2866
75.00	0	.78163	.74207	.82119	1434.1466	1351.5458	1516.7474
75.78	0	.78977	.74980	.82974	1431.9759	1350.9603	1512.9915
76.56	0	.79791	.75753	.83830	1430.0538	1350.6562	1509.4515
77.34	0	.80605	.76526	.84685	1428.9775	1352.9629	1504.9920
78.12	0	.81420	.77299	.85540	1427.8405	1353.9389	1501.7422
78.91	0	.82234	.78072	.86396	1427.1032	1353.7736	1500.4328
79.69	0	.83048	.78845	.87251	1426.3542	1352.2715	1500.4369
80.47	0	.83862	.79618	.88107	1425.5981	1348.8604	1502.3358
81.25	0	.84676	.80391	.88962	1425.2075	1348.2621	1502.1530
82.03	0	.85491	.81164	.89817	1424.8855	1348.5087	1501.2623
82.81	0	.86305	.81937	.90673	1424.4041	1348.7035	1500.1047
83.59	0	.87119	.82710	.91528	1423.9770	1348.3942	1499.5598
84.37	0	.87933	.83483	.92384	1423.7354	1346.4418	1501.0289
85.16	0	.88747	.84256	.93239	1423.9886	1346.6436	1501.3337
85.94	0	.89562	.85029	.94094	1423.8817	1346.4755	1501.2880
86.72	0	.90376	.85802	.94950	1423.5669	1348.1778	1498.9559
87.50	0	.91190	.86575	.95805	1422.7561	1347.7811	1497.7312
88.28	0	.92004	.87348	.96661	1421.7859	1345.1773	1498.3945
89.06	0	.92818	.88121	.97516	1421.9458	1342.6855	1501.2060
89.84	0	.93633	.88894	.98371	1422.3754	1341.3233	1503.4274
90.62	0	.94447	.89667	.99227	1422.6106	1340.5762	1504.6450
91.41	0	.95261	.90440	1.00082	1422.5565	1340.4140	1504.6989
92.19	0	.96075	.91213	1.00938	1422.4056	1339.3960	1505.4152
92.97	0	.96889	.91986	1.01793	1422.3544	1336.2720	1508.4368
93.75	0	.97704	.92759	1.02648	1422.6895	1332.8120	1512.5669
94.53	0	.98518	.93532	1.03504	1422.9132	1330.1237	1515.7027
95.31	0	.99332	.94305	1.04359	1422.7706	1327.8668	1517.6743
96.09	0	1.00146	.95078	1.05215	1422.7590	1325.8564	1519.6617
96.87	0	1.00960	.95851	1.06070	1423.0044	1320.4436	1525.5652
97.66	0	1.01775	.96624	1.06925	1422.0135	1312.2954	1531.7317
98.44	0	1.02589	.97397	1.07781	1417.0371	1298.3658	1535.7085
99.22	0	1.03403	.98170	1.08636	1399.2757	1272.7731	1525.7783
100.00	0	1.04217	.98943	1.09492	1361.2664	1221.5074	1501.0254

TABLE VII. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO

A PREFIRE-CONDITIONING TEMPERATURE OF 140° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(a) Chamber pressure - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES, SEC			TRANSFORMED CHAMBER PRESSURE, PSIA		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
0	1.45	1.04504	.99198	1.09810	1342.2156	1199.5688	1484.8624
0	2.90	1.04791	.99451	1.10131	1320.0136	1175.0424	1464.9848
0	4.35	1.05078	.99703	1.10453	1293.9075	1146.7249	1441.0901
0	5.80	1.05365	.99954	1.10776	1264.5977	1115.9433	1413.2522
0	7.25	1.05652	1.00203	1.11101	1232.9754	1082.1689	1383.7819
0	8.70	1.05939	1.00451	1.11427	1198.9454	1044.7567	1353.1342
0	10.14	1.06226	1.00697	1.11754	1162.4666	1003.0730	1321.8603
0	11.59	1.06513	1.00942	1.12083	1123.9962	958.9108	1289.1816
0	13.04	1.06800	1.01186	1.12413	1084.8065	914.2608	1255.3522
0	14.49	1.07087	1.01429	1.12745	1044.5277	866.2392	1222.8161
0	15.94	1.07374	1.01670	1.13078	1003.9811	816.4231	1191.5391
0	17.39	1.07661	1.01910	1.13411	962.9810	766.4785	1159.4835
0	18.84	1.07948	1.02148	1.13747	922.2515	717.1379	1127.3650
0	20.29	1.08234	1.02386	1.14083	882.0282	668.5404	1095.5160
0	21.74	1.08521	1.02622	1.14420	842.5952	619.7899	1065.4004
0	23.19	1.08808	1.02858	1.14759	804.1639	573.5721	1034.7558
0	24.64	1.09095	1.03092	1.15099	766.6470	529.8079	1003.4863
0	26.09	1.09382	1.03325	1.15439	730.4815	488.4694	972.4935
0	27.54	1.09669	1.03557	1.15781	695.5835	449.7494	941.4177
0	28.99	1.09956	1.03788	1.16124	661.8137	413.5609	910.0664
0	30.43	1.10243	1.04019	1.16468	629.6288	379.7683	879.4893
0	31.88	1.10530	1.04248	1.16812	599.0289	349.6782	848.3797
0	33.33	1.10817	1.04476	1.17158	569.9111	321.6411	819.1810
0	34.78	1.11104	1.04703	1.17504	542.1354	296.3051	787.9658
0	36.23	1.11391	1.04930	1.17852	515.9361	273.6751	758.1971
0	37.68	1.11678	1.05156	1.18200	491.1110	252.6923	729.5297
0	39.13	1.11965	1.05381	1.18549	467.5852	234.5165	700.6539
0	40.58	1.12252	1.05605	1.18899	445.2673	218.4367	672.0979
0	42.03	1.12539	1.05828	1.19249	424.0711	203.9232	644.2189
0	43.48	1.12826	1.06050	1.19601	404.0999	192.1430	616.0568
0	44.93	1.13113	1.06272	1.19953	385.0070	180.4905	589.5236
0	46.38	1.13400	1.06493	1.20306	367.1569	170.4604	563.8535
0	47.83	1.13686	1.06714	1.20659	350.3693	161.5973	539.1412
0	49.28	1.13973	1.06934	1.21013	334.4475	153.9980	514.8970
0	50.72	1.14260	1.07153	1.21368	319.1783	147.4253	490.9314
0	52.17	1.14547	1.07371	1.21724	304.6530	141.3215	467.9844
0	53.62	1.14834	1.07589	1.22080	290.9043	135.9854	445.8232
0	55.07	1.15121	1.07806	1.22436	278.1253	131.1383	425.1122
0	56.52	1.15408	1.08023	1.22794	266.0190	127.1928	404.8453
0	57.97	1.15695	1.08239	1.23151	254.7610	123.8257	385.6962
0	59.42	1.15982	1.08454	1.23510	244.0714	121.2369	366.9059
0	60.87	1.16269	1.08669	1.23869	234.1374	118.2614	350.0134
0	62.32	1.16556	1.08884	1.24228	224.7769	115.6376	333.9162

TABLE VII. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 140° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(a) Chamber pressure - Concluded

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLFRANCE LIMITS					
		TRANSFORMED TIMES, SEC			TRANSFORMED CHAMBER PRESSURE, PSIA		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
0	63.77	1.16843	1.09098	1.24588	215.7874	112.6241	318.9508
0	65.22	1.17130	1.09311	1.24948	207.4773	109.8209	305.1337
0	66.67	1.17417	1.09524	1.25309	199.5115	107.2206	291.8024
0	68.12	1.17704	1.09737	1.25671	192.0985	104.9090	279.2879
0	69.57	1.17991	1.09949	1.26033	185.1175	102.9704	267.2647
0	71.01	1.18278	1.10160	1.26395	178.4587	100.7621	256.1552
0	72.46	1.18565	1.10372	1.26758	172.2978	100.0941	244.5014
0	73.91	1.18852	1.10583	1.27121	166.4180	99.0554	233.7805
0	75.36	1.19139	1.10793	1.27484	160.8243	98.3959	223.2527
0	76.81	1.19425	1.11003	1.27848	155.3086	97.6573	212.9599
0	78.26	1.19712	1.11213	1.28212	150.2649	98.8741	201.6557
0	79.71	1.19999	1.11422	1.28577	145.5537	98.9626	192.1448
0	81.16	1.20286	1.11631	1.28942	141.2459	99.1407	183.3511
0	82.61	1.20573	1.11839	1.29307	137.1215	99.6004	174.6425
0	84.06	1.20860	1.12047	1.29673	133.2316	100.0046	166.4586
0	85.51	1.21147	1.12255	1.30039	129.4971	100.8296	158.1645
0	86.96	1.21434	1.12463	1.30405	126.0279	101.5559	150.4999
0	88.41	1.21721	1.12670	1.30772	122.7059	101.9854	143.4263
0	89.86	1.22008	1.12877	1.31139	119.4871	101.9280	137.0462
0	91.30	1.22295	1.13084	1.31506	116.1955	101.7923	130.5987
0	92.75	1.22582	1.13290	1.31874	113.1989	101.4892	124.9086
0	94.20	1.22869	1.13496	1.32242	110.3971	102.5911	118.2031
0	95.65	1.23156	1.13702	1.32610	107.8378	101.6313	114.0443
0	97.10	1.23443	1.13907	1.32978	105.1259	101.3656	108.8863
0	98.55	1.23730	1.14112	1.33347	102.5435	100.6383	104.4487
0	100.00	1.24017	1.14317	1.33716	100.0059	100.0059	100.0059

TABLE VII. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 140° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(b) Thrust corrected to sea-level pressure altitude (PA)

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
.00	0	.00000	.00000	.00000	554.1740	.0000	2512.5333
.78	0	.00814	.00773	.00855	5845.3239	.0000	22678.0998
1.56	0	.01628	.01546	.01711	11339.7123	.0000	35103.9956
2.34	0	.02443	.02319	.02566	16442.0852	.0000	40209.2017
3.12	0	.03257	.03092	.03422	20867.1118	1539.4814	40194.7422
3.91	0	.04071	.03865	.04277	24488.3435	10354.9905	38621.6963
4.69	0	.04885	.04638	.05132	27360.2917	17899.3335	36821.2500
5.47	0	.05699	.05411	.05988	29597.5698	23291.7896	35903.3501
6.25	0	.06514	.06184	.06843	31154.6455	26544.8008	35764.4992
7.03	0	.07328	.06957	.07699	32207.0393	28890.3455	35523.7329
7.81	0	.08142	.07730	.08554	32873.0991	30345.4917	35400.7065
8.59	0	.08956	.08503	.09409	33300.5962	31315.0615	35286.1399
9.37	0	.09770	.09276	.10265	33575.3330	31991.3242	35259.3418
10.16	0	.10585	.10049	.11120	33699.4109	32046.4575	35352.3823
10.94	0	.11399	.10822	.11976	33751.5618	32136.9658	35366.1377
11.72	0	.12213	.11595	.12831	33767.6665	32168.7939	35366.5391
12.50	0	.13027	.12368	.13686	33808.2476	32141.3306	35475.1646
13.28	0	.13841	.13141	.14542	33855.8936	32149.7988	35561.9883
14.06	0	.14656	.13914	.15397	33907.9282	32266.7998	35549.0566
14.84	0	.15470	.14687	.16253	33917.5801	32332.7476	35502.4126
15.62	0	.16284	.15460	.17108	33900.4644	32280.2632	35520.6655
16.41	0	.17098	.16233	.17963	33896.3433	32200.6787	35592.0078
17.19	0	.17912	.17006	.18819	33919.8369	32175.9844	35663.6895
17.97	0	.18727	.17779	.19674	33961.8984	32081.9937	35841.8032
18.75	0	.19541	.18552	.20530	34001.4346	32022.9873	35979.8818
19.53	0	.20355	.19325	.21385	34024.4424	31956.2056	36092.6792
20.31	0	.21169	.20098	.22240	34055.3984	31954.0552	36156.7417
21.09	0	.21983	.20871	.23096	34081.9575	31980.3140	36183.6011
21.87	0	.22798	.21644	.23951	34084.5415	31939.6191	36229.4630
22.66	0	.23612	.22417	.24807	34038.9189	31994.5210	36183.3169
23.44	0	.24426	.23190	.25662	33971.5132	31892.6597	36050.3667
24.22	0	.25240	.23963	.26518	33888.0239	31950.7534	35825.2944
25.00	0	.26054	.24736	.27373	33827.2056	31987.7144	35666.6968
25.78	0	.26868	.25509	.28228	33704.5728	32006.2666	35582.8789
26.56	0	.27683	.26282	.29084	33757.1079	31983.5410	35530.6748
27.34	0	.28497	.27055	.29939	33707.6919	31963.2290	35452.1549
28.12	0	.29311	.27828	.30795	33666.3955	31970.2129	35362.5781
28.91	0	.30125	.28601	.31650	33667.4292	31995.9790	35338.8794
29.69	0	.30939	.29374	.32505	33709.0049	32012.5703	35405.4395
30.47	0	.31754	.30147	.33361	33741.2930	32040.1353	35442.4507
31.25	0	.32568	.30920	.34216	33743.4609	31979.8179	35507.1040
32.03	0	.33382	.31693	.35072	33731.3472	31986.4243	35476.2700
32.81	0	.34196	.32466	.35927	33717.8574	32005.6514	35430.0635

TABLE VII. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 140° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(b) Thrust corrected to sea-level pressure altitude (PA) - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
33.59	0	.35010	.33239	.36782	33735.3877	32046.0483	35424.7271
34.37	0	.35825	.34012	.37638	33795.5220	32141.5054	35449.5386
35.16	0	.36639	.34785	.38493	33859.4482	32207.4469	35511.4497
35.94	0	.37453	.35558	.39349	33946.8692	32240.9194	35652.8589
36.72	0	.38267	.36331	.40204	34055.6226	32336.5483	35774.6958
37.50	0	.39081	.37103	.41059	34135.3823	32404.5137	35866.2510
38.28	0	.39896	.37876	.41915	34212.7319	32512.3315	35913.1323
39.06	0	.40710	.38649	.42770	34267.1045	32497.6177	36036.5913
39.84	0	.41524	.39422	.43626	34301.4272	32408.4424	36174.4121
40.62	0	.42338	.40195	.44481	34336.6260	32310.1895	36363.0625
41.41	0	.43152	.40968	.45336	34394.9526	32313.2915	36476.6138
42.19	0	.43967	.41741	.46192	34455.4238	32323.8027	36597.0440
42.97	0	.44781	.42514	.47047	34506.7461	32424.7187	36588.7734
43.75	0	.45595	.43287	.47903	34537.7686	32601.9223	36473.7140
44.53	0	.46409	.44060	.48758	34566.6094	32777.2422	36355.9766
45.31	0	.47223	.44833	.49613	34633.4453	32925.2017	36341.6890
46.09	0	.48038	.45606	.50469	34712.8936	33003.1050	36422.6821
46.87	0	.48852	.46379	.51324	34756.0020	33091.1284	36420.8755
47.66	0	.49666	.47152	.52180	34748.0986	33051.2954	36444.9019
48.44	0	.50480	.47925	.53035	34752.0317	32960.3795	36543.0840
49.22	0	.51294	.48698	.53890	34756.3218	32867.5698	36645.0737
50.00	0	.52109	.49471	.54746	34765.1826	32772.1279	36758.2373
50.78	0	.52923	.50244	.55601	34782.5234	32799.5732	36765.4736
51.56	0	.53737	.51017	.56457	34779.5933	32853.5566	36705.6299
52.34	0	.54551	.51790	.57312	34784.7529	32892.8906	36676.6152
53.12	0	.55365	.52563	.58167	34808.3955	32915.5410	36701.2500
53.91	0	.56180	.53336	.59023	34836.9321	32916.1792	36757.6851
54.69	0	.56994	.54109	.59878	34851.0635	33042.9355	36659.1914
55.47	0	.57808	.54882	.60734	34866.5063	33172.3540	36560.6597
56.25	0	.58622	.55655	.61589	34894.8745	33261.4321	36508.3169
57.03	0	.59436	.56428	.62444	34898.8369	33296.6274	36501.0464
57.81	0	.60251	.57201	.63300	34929.6997	33306.5127	36552.8867
58.59	0	.61065	.57974	.64155	34954.2798	33292.3755	36616.1841
59.37	0	.61879	.58747	.65011	34953.0034	33339.5176	36566.4893
60.16	0	.62693	.59520	.65866	34921.5244	33261.2837	36581.7651
60.94	0	.63507	.60293	.66721	34905.0703	33170.3643	36639.7764
61.72	0	.64322	.61066	.67577	34895.6875	33050.8447	36740.5303
62.50	0	.65136	.61839	.68432	34873.9800	32992.2080	36755.7520
63.28	0	.65950	.62612	.69288	34836.5474	33019.5454	36653.5493
64.06	0	.66764	.63385	.70143	34760.5444	33006.4531	36514.6357
64.84	0	.67578	.64158	.70999	34696.5142	32978.9263	36414.1021
65.62	0	.68393	.64931	.71854	34662.5020	32901.3872	36423.6167
66.41	0	.69207	.65704	.72709	34627.7686	32853.7124	36401.8247

TABLE VII. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 140° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(b) Thrust corrected to sea-level pressure altitude (PA) - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
67.19	0	.70021	.66477	.73565	34588.4272	32774.7227	36402.1318
67.97	0	.70835	.67250	.74420	34553.8945	32681.2925	36426.4966
68.75	0	.71649	.68023	.75276	34509.8608	32607.6367	36412.0850
69.53	0	.72463	.68796	.76131	34477.8198	32599.8921	36355.7476
70.31	0	.73278	.69569	.76986	34428.1226	32652.9580	36203.2871
71.09	0	.74092	.70342	.77842	34363.4927	32702.9351	36024.0503
71.87	0	.74906	.71115	.78697	34288.8159	32673.9419	35903.6899
72.66	0	.75720	.71888	.79553	34215.9165	32618.4258	35813.4072
73.44	0	.76534	.72661	.80408	34155.6680	32509.7017	35801.6343
74.22	0	.77349	.73434	.81263	34119.5557	32463.2129	35775.8984
75.00	0	.78163	.74207	.82119	34095.6187	32495.0352	35696.2021
75.78	0	.78977	.74980	.82974	34054.4839	32470.5527	35638.4150
76.56	0	.79791	.75753	.83830	34014.1021	32418.2310	35609.9731
77.34	0	.80605	.76526	.84685	34004.3730	32388.7310	35620.0151
78.12	0	.81420	.77299	.85540	34000.5659	32421.4038	35579.7280
78.91	0	.82234	.78072	.86396	34001.8716	32484.8555	35518.8877
79.69	0	.83048	.78845	.87251	34005.2812	32459.3975	35551.1650
80.47	0	.83862	.79618	.88107	33986.0195	32436.8857	35535.1533
81.25	0	.84676	.80391	.88962	33975.7241	32453.1577	35498.2905
82.03	0	.85491	.81164	.89817	33972.1099	32497.2920	35446.9277
82.81	0	.86305	.81937	.90673	33948.0088	32484.4536	35411.5640
83.59	0	.87119	.82710	.91528	33907.5562	32402.7505	35412.3618
84.37	0	.87933	.83483	.92384	33873.7974	32312.7627	35434.8320
85.16	0	.88747	.84256	.93239	33855.3540	32204.4609	35506.2471
85.94	0	.89562	.85029	.94094	33854.6660	32177.3687	35531.9634
86.72	0	.90376	.85802	.94950	33859.7280	32089.1113	35630.3447
87.50	0	.91190	.86575	.95805	33864.3228	31954.7705	35773.8750
88.28	0	.92004	.87348	.96661	33851.9746	31923.6724	35780.2769
89.06	0	.92818	.88121	.97516	33850.1064	31985.2798	35714.9331
89.84	0	.93633	.88894	.98371	33857.8413	32030.8052	35684.8774
90.62	0	.94447	.89667	.99227	33862.9233	32028.4707	35697.3760
91.41	0	.95261	.90440	1.00082	33885.7446	31937.2876	35834.2017
92.19	0	.96075	.91213	1.00938	33919.2900	31810.9106	36027.6694
92.97	0	.96889	.91986	1.01793	33940.9155	31727.4556	36154.3755
93.75	0	.97704	.92759	1.02648	33939.4009	31703.3594	36175.4424
94.53	0	.98518	.93532	1.03504	33915.8203	31714.3418	36117.2988
95.31	0	.99332	.94305	1.04359	33886.0781	31694.8682	36077.2881
96.09	0	1.00146	.95078	1.05215	33864.0161	31614.9336	36113.0986
96.87	0	1.00960	.95851	1.06070	33841.4697	31503.7490	36179.1904
97.66	0	1.01775	.96624	1.06925	33745.8140	31230.1089	36261.5190
98.44	0	1.02589	.97397	1.07781	33465.4365	30639.8584	36291.0146
99.22	0	1.03403	.98170	1.08636	32826.1562	29521.6621	36130.6504
100.00	0	1.04217	.98943	1.09492	31730.7844	27876.7178	35584.8511

TABLE VII. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 140° F AND THE TWO-SIDED TOLERANCE LIMITS - Continued

(b) Thrust corrected to sea-level pressure altitude (PA) - Continued

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS					
		TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
0	1.45	1.04504	.99198	1.09810	31235.5818	27280.1460	35191.0176
0	2.90	1.04791	.99451	1.10131	30680.2527	26647.5525	34712.9526
0	4.35	1.05078	.99703	1.10453	30049.5376	25985.3286	34113.7466
0	5.80	1.05365	.99954	1.10776	29357.6270	25264.0100	33451.2437
0	7.25	1.05652	1.00203	1.11101	28620.5879	24477.5425	32763.6333
0	8.70	1.05939	1.00451	1.11427	27844.8137	23641.7061	32047.9214
0	10.14	1.06226	1.00697	1.11754	27016.9148	22752.8359	31280.9937
0	11.59	1.06513	1.00942	1.12083	26161.3228	21830.8911	30491.7544
0	13.04	1.06800	1.01186	1.12413	25280.0796	20868.3704	29691.7889
0	14.49	1.07087	1.01429	1.12745	24380.5925	19812.2720	28948.9131
0	15.94	1.07374	1.01670	1.13078	23467.1829	18701.9600	28232.4058
0	17.39	1.07661	1.01910	1.13411	22547.5244	17554.2454	27540.8035
0	18.84	1.07948	1.02148	1.13747	21618.4517	16343.3401	26893.5632
0	20.29	1.08234	1.02386	1.14083	20694.6917	15089.7983	26299.5850
0	21.74	1.08521	1.02622	1.14420	19776.3552	13878.5488	25674.1616
0	23.19	1.08808	1.02858	1.14759	18867.1384	12661.8806	25072.3962
0	24.64	1.09095	1.03092	1.15099	17974.4080	11498.0432	24450.7727
0	26.09	1.09382	1.03325	1.15439	17108.4656	10415.4009	23801.5303
0	27.54	1.09669	1.03557	1.15781	16267.8904	9367.5173	23168.2634
0	28.99	1.09956	1.03788	1.16124	15449.1104	8383.1548	22515.0659
0	30.43	1.10243	1.04019	1.16468	14663.9250	7475.9191	21851.9309
0	31.88	1.10530	1.04248	1.16812	13910.1320	6670.9550	21149.3088
0	33.33	1.10817	1.04476	1.17158	13195.2620	5962.2987	20428.2251
0	34.78	1.11104	1.04703	1.17504	12507.7758	5282.2366	19733.3149
0	36.23	1.11391	1.04930	1.17852	11861.0735	4670.7385	19051.4084
0	37.68	1.11678	1.05156	1.18200	11244.5055	4124.4501	18364.5608
0	39.13	1.11965	1.05381	1.18549	10670.3961	3648.4419	17692.3503
0	40.58	1.12252	1.05605	1.18899	10126.2302	3211.4634	17040.9971
0	42.03	1.12539	1.05828	1.19249	9617.7826	2825.5198	16410.0454
0	43.48	1.12826	1.06050	1.19601	9138.4873	2484.6538	15792.3208
0	44.93	1.13113	1.06272	1.19953	8679.8331	2199.8787	15159.7876
0	46.38	1.13400	1.06493	1.20306	8248.8571	1955.1975	14542.5166
0	47.83	1.13686	1.06714	1.20659	7834.1683	1774.4358	13893.9008
0	49.28	1.13973	1.06934	1.21013	7446.1989	1615.1254	13277.2723
0	50.72	1.14260	1.07153	1.21368	7077.5827	1482.3862	12672.7792
0	52.17	1.14547	1.07371	1.21724	6724.8490	1369.0925	12080.6055
0	53.62	1.14834	1.07589	1.22080	6387.0200	1271.1985	11502.8414
0	55.07	1.15121	1.07806	1.22436	6067.4081	1203.9069	10930.9093
0	56.52	1.15408	1.08023	1.22794	5760.9427	1131.2510	10390.6343
0	57.97	1.15695	1.08239	1.23151	5471.4800	1046.0422	9896.9178
0	59.42	1.15982	1.08454	1.23510	5192.2939	949.3207	9435.2672
0	60.87	1.16269	1.08669	1.23869	4930.8828	866.9916	8994.7739
0	62.32	1.16556	1.08884	1.24228	4682.0322	803.8508	8560.2136

TABLE VII. - VARIATION OF MOTOR PERFORMANCE AS A FUNCTION OF MOTOR OPERATING TIME TRANSFORMED TO A PREFIRE-CONDITIONING TEMPERATURE OF 140° F AND THE TWO-SIDED TOLERANCE LIMITS - Concluded

(b) Thrust corrected to sea-level pressure altitude (PA) - Concluded

PERCENT WEB BURN TIME	PERCENT TAILOFF TIME	MEANS WITH TWO-SIDED TOLERANCE LIMITS: TRANSFORMED TIMES			TRANSFORMED THRUST AT PA= 14.70		
		MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM
0	63.77	1.16843	1.09098	1.24588	4441.3284	731.6693	8150.9875
0	65.22	1.17130	1.09311	1.24948	4217.4791	649.3608	7785.5974
0	66.57	1.17417	1.09524	1.25309	4008.1703	549.7083	7466.6323
0	68.12	1.17704	1.09737	1.25671	3914.2729	468.3818	7160.1639
0	69.57	1.17991	1.09949	1.26033	3641.0050	397.5039	6884.5060
0	71.01	1.18279	1.10160	1.26395	3472.9442	357.3528	6589.5356
0	72.46	1.18565	1.10372	1.26758	3313.3249	339.0852	6287.5645
0	73.91	1.18852	1.10583	1.27121	3170.9911	320.2042	6021.7781
0	75.36	1.19139	1.10793	1.27484	3033.7163	319.4942	5747.9385
0	76.81	1.19425	1.11003	1.27848	2907.7974	322.6519	5492.9431
0	78.26	1.19712	1.11213	1.28212	2793.3855	348.8527	5237.9183
0	79.71	1.19999	1.11422	1.28577	2675.9962	338.3705	5013.6219
0	81.16	1.20286	1.11631	1.28942	2568.4487	327.6990	4809.1980
0	82.61	1.20573	1.11839	1.29307	2470.8174	344.5017	4597.1330
0	84.06	1.20860	1.12047	1.29673	2380.4206	379.6224	4381.2187
0	85.51	1.21147	1.12255	1.30039	2292.6406	383.6754	4201.6058
0	86.96	1.21434	1.12463	1.30405	2205.4683	388.2827	4022.6539
0	88.41	1.21721	1.12670	1.30772	2122.2443	380.3206	3864.1679
0	89.86	1.22008	1.12877	1.31139	2042.0580	373.1759	3710.9402
0	91.30	1.22295	1.13084	1.31506	1963.1608	364.1084	3562.2131
0	92.75	1.22582	1.13290	1.31874	1897.5067	356.2967	3438.7166
0	94.20	1.22869	1.13496	1.32242	1835.2335	351.1530	3319.3140
0	95.65	1.23156	1.13702	1.32610	1778.7804	367.6948	3189.8661
0	97.10	1.23443	1.13907	1.32979	1720.6466	370.3861	3070.9071
0	98.55	1.23730	1.14112	1.33347	1663.9508	382.8841	2945.0175
0	100.00	1.24017	1.14317	1.33716	1613.7626	398.5560	2828.9692

TABLE VIII. - SUMMARY OF MOTOR PERFORMANCE DATA TRANSFORMED TO SPECIFIC PREFIRE-CONDITIONING TEMPERATURES AND THE ONE-SIDED AND TWO-SIDED TOLERANCE LIMITS

(a) Transformed to 20° F

Parameter	Mean	Tolerance limits			
		One-sided		Two-sided	
		Minimum	Maximum	Minimum	Maximum
Time, t, sec:					
Ignition delay, t_d					
All 17 motors	0.047	0.015	0.079	0.011	0.083
Ignition category 1 (duplicated only a failed igniter cartridge, 2 motors)	(a)	(a)	(a)	(a)	(a)
Ignition category 2 (simulated only a failed nozzle closure, 7 motors)	.051	.030	.072	.027	.075
Ignition category 3 (duplicated a failed igniter cartridge and simulated a failed nozzle closure, 4 motors)	(a)	(a)	(a)	(a)	(a)
Ignition category 4 (duplicated normal ignition conditions, 5 motors)	.036	.010	.062	.008	.064
Thrust rise, t_f					
All 17 motors	.118	.088	.148	.085	.151
Ignition category 1 (duplicated only a failed igniter cartridge, 2 motors)	(a)	(a)	(a)	(a)	(a)
Ignition category 2 (simulated only a failed nozzle closure, 7 motors)	.114	.083	.145	.079	.149
Ignition category 3 (duplicated a failed igniter cartridge and simulated a failed nozzle closure, 4 motors)	(a)	(a)	(a)	(a)	(a)
Ignition category 4 (duplicated normal ignition conditions, 5 motors)[b]	.119	.085	.153	.079	.159
Maximum thrust, $t_{F_{max.}}$	.701	.537	.866	.521	.882
Web burn, t_b	1.165	1.109	1.221	1.103	1.227
Action, t_a	1.341	1.281	1.402	1.275	1.408
Tailoff, t_{tail}	.606	.512	.699	.503	.709
Total, t_t	1.775	1.729	1.822	1.724	1.827

[a]Insufficient data to perform statistical analysis.

[b]Specifications: 0.075-second minimum and 0.150-second maximum.

TABLE VIII. - SUMMARY OF MOTOR PERFORMANCE DATA TRANSFORMED TO SPECIFIC PREFIRE-CONDITIONING TEMPERATURES AND THE ONE-SIDED AND TWO-SIDED TOLERANCE LIMITS - Continued

(a) Transformed to 20° F - Concluded

Parameter	Mean	Tolerance limits			
		One-sided		Two-sided	
		Minimum	Maximum	Minimum	Maximum
Chamber pressure, P, psia:					
Maximum, $P_{max.}$	1312	1253	1371	1247	1376
Average web burn time, $\overline{P}_b$	1247	1194	1300	1189	1305
Average action time, $\overline{P}_a$	1144	1099	1188	1094	1193
Average tailoff time, $\overline{P}_{tail}$	147	95	199	90	205
Average total time, $\overline{P}_t$	869	829	908	825	912
Chamber pressure integral, $\int P\,dt$, psia-sec:					
Web burn time, $\int_{t_b} P\,dt$	1452	1391	1514	1384	1520
Action time, $\int_{t_a} P\,dt$	1534	1481	1587	1476	1592
Tailoff time, $\int_{t_{tail}} P\,dt$	89	58	121	55	124
Total time, $\int_{t_t} P\,dt$	1542	1490	1594	1485	1599
Resultant thrust, F, lb_f:					
Maximum, $F_{max.}$	31 415	29 915	32 915	29 766	33 064
Average web burn time[c], $\overline{F}_b$	29 708	28 482	30 935	28 360	31 057
Average action time, $\overline{F}_a$	27 186	26 014	28 358	25 898	28 475
Average tailoff time, $\overline{F}_{tail}$	3384	2050	4719	1917	4852
Average total time, $\overline{F}_t$	20 649	19 847	21 451	19 767	21 531
Resultant impulse, I, lb_f-sec:					
Web burn time, I_b	34 601	33 762	35 441	33 679	35 524
Action time[d], I_a	36 460	35 705	37 214	35 630	37 289
Tailoff time, I_{tail}	2049	1226	2872	1144	2954
Total time, I_t	36 654	35 893	37 416	35 817	37 492
Resultant average propellant specific impulse, $\overline{I}_{sp}$, lb_f-sec/lb_m:					
Web burn time, $\overline{I}_{sp,b}$	178.5	174.7	182.2	174.4	182.6
Action time, $\overline{I}_{sp,a}$	178.2	174.5	181.8	174.2	182.1
Tailoff time, $\overline{I}_{sp,tail}$	172.5	158.0	186.9	156.5	188.4
Total time, $\overline{I}_{sp,t}$	178.2	174.5	181.8	174.2	182.1
Average characteristic exhaust velocity, $\overline{C}$*, ft/sec (based on total time, t_t)	4566	4404	4728	4388	4744
Average burning rate, $\overline{r}_b$, in/sec (based on web burn time, t_b)	0.859	0.817	0.900	0.813	0.904

[c]Specifications: 28 000-lb_f minimum and 32 400-lb_f maximum.
[d]Specifications: 35 700-lb_f-sec minimum and 37 500-lb_f-sec maximum.

TABLE VIII. - SUMMARY OF MOTOR PERFORMANCE DATA TRANSFORMED TO SPECIFIC PREFIRE-CONDITIONING TEMPERATURES AND THE ONE-SIDED AND TWO-SIDED TOLERANCE LIMITS - Continued

(b) Transformed to 70° F

Parameter	Mean	Tolerance limits			
		One-sided		Two-sided	
		Minimum	Maximum	Minimum	Maximum
Time, t, sec:					
Ignition delay, t_d					
All 17 motors	0.046	0.014	0.078	0.011	0.081
Ignition category 1 (duplicated only a failed igniter cartridge, 2 motors)	(a)	(a)	(a)	(a)	(a)
Ignition category 2 (simulated only a failed nozzle closure, 7 motors)	.044	.026	.062	.023	.065
Ignition category 3 (duplicated a failed igniter cartridge and simulated a failed nozzle closure, 4 motors)	(a)	(a)	(a)	(a)	(a)
Ignition category 4 (duplicated normal ignition conditions, 5 motors)	.040	.010	.070	.007	.073
Thrust rise, t_f					
All 17 motors	.111	.083	.140	.080	.143
Ignition category 1 (duplicated only a failed igniter cartridge, 2 motors)	(a)	(a)	(a)	(a)	(a)
Ignition category 2 (simulated only a failed nozzle closure, 7 motors)	.110	.080	.140	.076	.144
Ignition category 3 (duplicated a failed igniter cartridge and simulated a failed nozzle closure, 4 motors)	(a)	(a)	(a)	(a)	(a)
Ignition category 4 (duplicated normal ignition conditions, 5 motors)[b]	.113	.080	.145	.075	.150
Maximum thrust, $t_{F_{max}}$	.671	.514	.828	.498	.844
Web burn, t_b	1.095	1.042	1.148	1.037	1.153
Action, t_a	1.281	1.224	1.339	1.218	1.345
Tailoff, t_{tail}	.686	.580	.792	.569	.802
Total, t_t	1.766	1.720	1.813	1.715	1.817

[a]Insufficient data to perform statistical analysis.

[b]Specifications: 0.075-second minimum and 0.150-second maximum.

TABLE VIII. - SUMMARY OF MOTOR PERFORMANCE DATA TRANSFORMED TO SPECIFIC PREFIRE-CONDITIONING TEMPERATURES AND THE ONE-SIDED AND TWO-SIDED TOLERANCE LIMITS - Continued

(b) Transformed to 70° F - Concluded

Parameter	Mean	Tolerance limits			
		One-sided		Two-sided	
		Minimum	Maximum	Minimum	Maximum
Chamber pressure, P, psia:					
Maximum, $P_{max.}$	1397	1335	1460	1328	1466
Average web burn time, $\overline{P}_b$	1329	1273	1385	1267	1390
Average action time, $\overline{P}_a$	1200	1153	1247	1148	1251
Average tailoff time, $\overline{P}_{tail}$	133	86	180	81	184
Average total time, $\overline{P}_t$	875	835	915	831	919
Chamber pressure integral, $\int P\,dt$, psia-sec:					
Web burn time, $\int_{t_b} P\,dt$	1455	1393	1516	1387	1523
Action time, $\int_{t_a} P\,dt$	1537	1484	1590	1479	1596
Tailoff time, $\int_{t_{tail}} P\,dt$	91	59	123	56	126
Total time, $\int_{t_t} P\,dt$	1545	1494	1597	1488	1602
Resultant thrust, F, lb_f:					
Maximum, $F_{max.}$	33 468	31 869	35 066	31 711	35 224
Average web burn time[c], $\overline{F}_b$	31 660	30 353	32 967	30 223	33 097
Average action time, $\overline{F}_a$	28 525	27 295	29 755	27 173	29 877
Average tailoff time, $\overline{F}_{tail}$	3049	1847	4252	1727	4371
Average total time, $\overline{F}_t$	20 803	19 994	21 611	19 914	21 691
Resultant impulse, I, lb_f-sec:					
Web burn time, I_b	34 655	33 814	35 496	33 731	35 579
Action time[d], I_a	36 541	35 785	37 298	35 710	37 373
Tailoff time, I_{tail}	2090	1250	2929	1167	3013
Total time, I_t	36 734	35 971	37 498	35 895	37 574
Resultant average propellant specific impulse, $\overline{I}_{sp}$, lb_f-sec/lb_m:					
Web burn time, $\overline{I}_{sp,b}$	180.0	176.2	182.2	174.4	182.6
Action time, $\overline{I}_{sp,a}$	179.3	175.7	182.9	175.3	183.3
Tailoff time, $\overline{I}_{sp,tail}$	169.2	154.7	183.7	153.3	185.2
Total time, $\overline{I}_{sp,t}$	179.3	175.7	182.9	175.3	183.3
Average characteristic exhaust velocity, $\overline{C}^*$, ft/sec (based on total time, t_t)	4608	4443	4781	4426	4798
Average burning rate, $\overline{r}_b$, in/sec (based on web burn time, t_b)	0.914	0.870	0.958	0.865	0.962

[c]Specifications: 29 400-lb_f minimum and 33 900-lb_f maximum.
[d]Specifications: 35 800-lb_f-sec minimum and 37 600-lb_f-sec maximum.

TABLE VIII. - SUMMARY OF MOTOR PERFORMANCE DATA TRANSFORMED TO SPECIFIC PREFIRE-CONDITIONING TEMPERATURES AND THE ONE-SIDED AND TWO-SIDED TOLERANCE LIMITS - Continued

(c) Transformed to 140° F

Parameter	Mean	Tolerance limits			
		One-sided		Two-sided	
		Minimum	Maximum	Minimum	Maximum
Time, t, sec:					
Ignition delay, t_d					
All 17 motors	0.034	0.011	0.058	0.008	0.061
Ignition category 1 (duplicated only a failed igniter cartridge, 2 motors)	(a)	(a)	(a)	(a)	(a)
Ignition category 2 (simulated only a failed nozzle closure, 7 motors)	.037	.022	.053	.020	.055
Ignition category 3 (duplicated a failed igniter cartridge and simulated a failed nozzle closure, 4 motors)	(a)	(a)	(a)	(a)	(a)
Ignition category 4 (duplicated normal ignition conditions, 5 motors)	.028	.09	.047	.007	.049
Thrust rise, t_f					
All 17 motors	.099	.074	.125	.071	.127
Ignition category 1 (duplicated only a failed igniter cartridge, 2 motors)	(a)	(a)	(a)	(a)	(a)
Ignition category 2 (simulated only a failed nozzle closure, 7 motors)	.089	.065	.113	.062	.116
Ignition category 3 (duplicated a failed igniter cartridge and simulated a failed nozzle closure, 4 motors)	(a)	(a)	(a)	(a)	(a)
Ignition category 4 (duplicated normal ignition conditions, 5 motors)[b]	.113	.080	.146	.075	.151
Maximum thrust, $t_{F_{max.}}$	.683	.523	.844	.508	.859
Web burn, t_b	1.042	.992	1.092	.987	1.097
Action, t_a	1.230	1.175	1.285	1.169	1.291
Tailoff, t_{tail}	.717	.606	.827	.595	.838
Total, t_t	1.779	1.732	1.825	1.727	1.830

[a]Insufficient data to perform statistical analysis.

[b]Specifications: 0.075-second minimum and 0.150-second maximum.

TABLE VIII. - SUMMARY OF MOTOR PERFORMANCE DATA TRANSFORMED TO SPECIFIC PREFIRE-CONDITIONING TEMPERATURES AND THE ONE-SIDED AND TWO-SIDED TOLERANCE LIMITS- Concluded

(c) Transformed to 140° F - Concluded

Parameter	Mean	Tolerance limits			
		One-sided		Two-sided	
		Minimum	Maximum	Minimum	Maximum
Chamber pressure, P, psia:					
Maximum[c], $P_{max.}$	1466	1400	1532	1394	1539
Average web burn time, $\overline{P}_b$	1396	1337	1455	1331	1460
Average action time, $\overline{P}_a$	1259	1209	1308	1205	1313
Average tailoff time, $\overline{P}_{tail}$	144	93	195	88	200
Average total time, $\overline{P}_t$	883	843	924	839	928
Chamber pressure integral, $\int P\,dt$, psia-sec:					
Web burn time, $\int_{t_b} P\,dt$	1454	1392	1516	1386	1522
Action time, $\int_{t_a} P\,dt$	1548	1494	1601	1489	1606
Tailoff time, $\int_{t_{tail}} P\,dt$	103	67	140	63	143
Total time, $\int_{t_t} P\,dt$	1557	1505	1610	1500	1615
Resultant thrust, F, lb_f:					
Maximum, $F_{max.}$	35 114	33 437	36 791	33 271	36 957
Average web burn time[d], $\overline{F}_b$	[c]33 251	[c]31 878	[c]34 624	[c]31 742	[c]34 760
Average action time, $\overline{F}_a$	29 920	28 631	31 210	28 502	31 338
Average tailoff time, $\overline{F}_{tail}$	3315	2008	4622	1878	4752
Average total time, $\overline{F}_t$	20 997	20 181	21 813	20 100	21 894
Resultant impulse, I, lb_f-sec:					
Web burn time, I_b	34 649	33 808	35 490	33 725	35 573
Action time[e], I_a	36 791	36 029	37 553	35 954	37 629
Tailoff time, I_{tail}	2374	1420	3327	1325	3422
Total time, I_t	37 022	36 252	37 792	36 176	37 868
Resultant average propellant specific impulse, $\overline{I}_{sp}$, lb_f-sec/lb_m:					
Web burn time, $\overline{I}_{sp,b}$	181.2	177.4	184.8	177.0	185.4
Action time, $\overline{I}_{sp,a}$	180.9	177.2	184.5	176.9	184.9
Tailoff time, $\overline{I}_{sp,tail}$	176.6	162.0	191.2	160.5	192.7
Total time, $\overline{I}_{sp,t}$	180.9	177 2	184.5	176.9	184.9
Average characteristic exhaust velocity, $\overline{C}$*, ft/sec (based on total time, t_t)	4635	4471	4799	4455	4815
Average burning rate, $\overline{r}_b$, in/sec (based on web burn time, t_b)	0.960	0.914	1.006	0.909	1.010

[c]Specification: 1700-psia maximum.

[d]Specifications: 31 200-lb_f minimum and 36 000-lb_f maximum.

[e]Specifications: 35 900-lb_f-sec minimum and 37 700-lb_f-sec maximum.

TABLE IX. - SUMMARY OF MOTOR PHYSICAL MEASUREMENTS

(a) Motors tested in 1964

Parameter	Motor SN and date static test fired							
	AQ-II-1 Aug. 18	AQ-II-2 Aug. 31	AQ-III-2 Sept. 9 (a)	AQ-III-4 Nov. 10	AQ-IX-2 Nov. 13	AQ-XI-1 Dec. 3	AQ-IX-4 Dec. 14	AQ-III-1 Dec. 22
Weight, lb_m:								
Prefire motor	525.2	526.7	525.7	525.7	523.0	528.7	527.7	525.2
Postfire motor	315.2	317.2	--	317.7	318.7	319.7	319.7	315.2
Expended mass	210.0	209.5	--	208.0	204.3	209.0	208.0	210.0
Propellant	204.0	205.4	205.6	206.8	203.3	205.1	204.5	205.6
Nozzle throat area, in^2:								
Prefire								
Nozzle A	10.184	10.184	10.184	10.184	10.184	10.184	10.184	10.190
Nozzle B	8.767	8.767	8.762	8.762	8.762	8.767	8.767	8.761
Total[b]	18.951	18.951	18.946	18.946	18.946	18.951	18.951	18.951
Postfire								
Nozzle A	10.230	10.207	--	10.094	10.201	10.213	10.207	10.190
Nozzle B	8.804	8.756	--	8.746	8.767	8.735	8.783	8.772
Total[b]	19.034	18.963	--	18.840	18.968	18.948	18.990	18.962
Change from prefire to postfire, percent								
Nozzle A	.45	.23	--	-.88	.17	.29	.23	.00
Nozzle B	.42	-.13	--	-.18	.06	-.37	.18	.13
Total[b]	.87	.10	--	-1.07	.22	-.08	.41	.13
Average resultant thrust-vector excursion angle during web burn time, deg	3.99	4.19	--	3.75	3.78	3.61	3.57	3.74
Average location of resultant thrust vector, in.	22.38	24.50	--	18.60	19.90	19.91	18.37	20.11

[a]Interstage failure caused subsequent destruction of the motor assembly. See the section entitled "Failure Analysis."

[b]Nozzle A plus nozzle B.

TABLE IX. - SUMMARY OF MOTOR PHYSICAL MEASUREMENTS - Concluded

(b) Motors tested in 1965

Parameter	Motor SN and date static test fired												
	AQ-X-1 Jan. 13	AQ-V-1 Jan. 15	AQ-X-2 Jan. 17	AQ-I-3 Jan. 19	AQ-IX-3 Jan. 29	AQ-VIII-1 Feb. 2	AQ-VII-1 Feb. 9	AQ-IV-1 Mar. 25	AQ-IV-2 Apr. 13	AQ-VI-1 Apr. 19	AQ-VI-2 Apr. 23	AQ-V-2 May 19	AQ-IX-1 May 25
Weight, lb_m:													
Prefire motor	528.2	529.2	526.7	528.7	527.2	529.2	527.7	529.2	526.7	527.7	527.7	527.2	527.2
Postfire motor	319.2	319.2	318.2	319.7	318.2	317.7	318.2	318.7	316.7	317.2	316.7	317.2	317.2
Expended mass	209.0	210.0	208.5	209.0	209.0	211.5	209.5	210.5	210.0	210.5	211.0	210.0	210.0
Propellant	204.1	204.2	204.2	204.3	205.4	206.5	205.7	205.2	205.8	204.3	206.6	206.3	206.0
Nozzle throat area, in^2:													
Prefire													
Nozzle A	10.190	10.190	10.184	10.184	10.184	10.184	10.179	10.184	10.179	10.179	10.173	10.190	10.184
Nozzle B	8.772	8.767	8.767	8.762	8.767	8.756	8.762	8.762	8.767	8.767	8.767	8.777	8.762
Total[b]	18.962	18.957	18.951	18.946	18.951	18.940	18.941	18.946	18.946	18.946	18.940	18.967	18.946
Postfire													
Nozzle A	10.230	10.230	10.218	10.224	10.196	10.201	10.196	10.201	10.196	10.213	10.207	10.184	10.196
Nozzle B	8.804	8.793	8.767	8.772	8.783	8.793	8.783	8.772	8.777	8.809	8.793	8.772	8.809
Total[a]	19.034	19.023	18.985	18.996	18.979	18.994	18.979	18.973	18.973	19.022	19.000	18.958	19.005
Change from prefire to postfire, percent													
Nozzle A	.39	.39	.33	.39	.12	.17	.17	.17	.17	.33	.33	-.06	.12
Nozzle B	.37	.30	.00	.11	.18	.42	.24	.11	.11	.48	.30	-.06	.54
Total[a]	.76	.69	.33	.51	.30	.59	.41	.28	.28	.81	.63	-.12	.65
Average resultant thrust-vector excursion angle during web burn time, deg	3.73	4.05	3.66	3.95	3.62	3.62	3.68	3.98	3.81	3.83	3.93	3.62	3.63
Average location of resultant thrust vector, in.	20.41	25.04	19.52	23.87	20.27	19.57	21.12	21.05	21.06	20.34	21.51	20.98	18.23

[a]Nozzle A plus nozzle B.

TABLE X. - SUMMARY OF MOTOR PHYSICAL MEASUREMENTS AND THE ONE-SIDED AND TWO-SIDED TOLERANCE LIMITS

Parameter	Mean	Tolerance limits			
		One-sided		Two-sided	
		Minimum	Maximum	Minimum	Maximum
Weight, lb_m:					
Prefire motor[a]	527.2	522.0	532.5	521.5	533.0
Postfire motor[b]	317.9	313.4	322.3	313.0	322.8
Expended mass	209.4	208.6	210.1	208.5	210.2
Propellant	205.2	201.8	208.5	201.5	208.8
Nozzle throat area, in^2:					
Prefire					
Nozzle A	10.184	10.170	10.198	10.168	10.199
Nozzle B	8.765	8.748	8.782	8.747	8.784
Total[c]	18.949	18.918	18.981	18.915	18.984
Postfire					
Nozzle A	10.202	10.106	10.298	10.096	10.307
Nozzle B	8.779	8.712	8.847	8.706	8.853
Total[c]	18.981	18.818	19.145	18.802	19.161
Change from prefire to postfire, percent					
Nozzle A	.175	.57	.98	.71	1.06
Nozzle B	.161	.41	.73	.47	.79
Total[c]	.336	1.04	1.71	1.18	1.84
Average resultant thrust-vector excursion angle during web burn time, deg[d]	3.787	3.21	4.37	3.15	4.43
Average location of resultant thrust vector, in.	20.84	14.56	27.12	13.94	27.73

[a]Specifications: 512-lb_m minimum and 535-lb_m maximum.
[b]Specifications: 305-lb_m minimum and 325-lb_m maximum.
[c]Nozzle A plus nozzle B.
[d]Specifications: 3.0° minimum and 4.5° maximum.

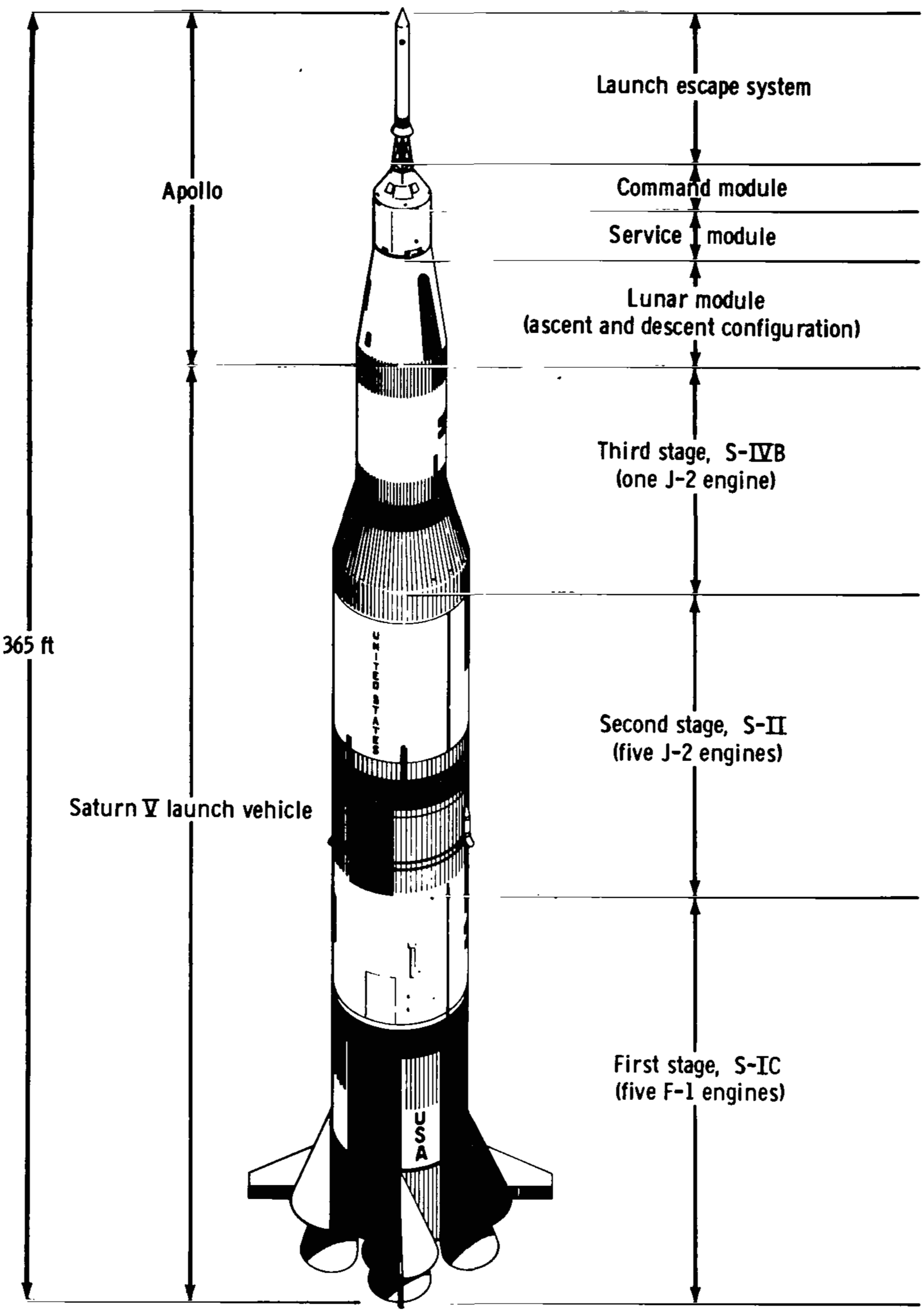


Figure 1. - Saturn V launch vehicle and Apollo spacecraft.

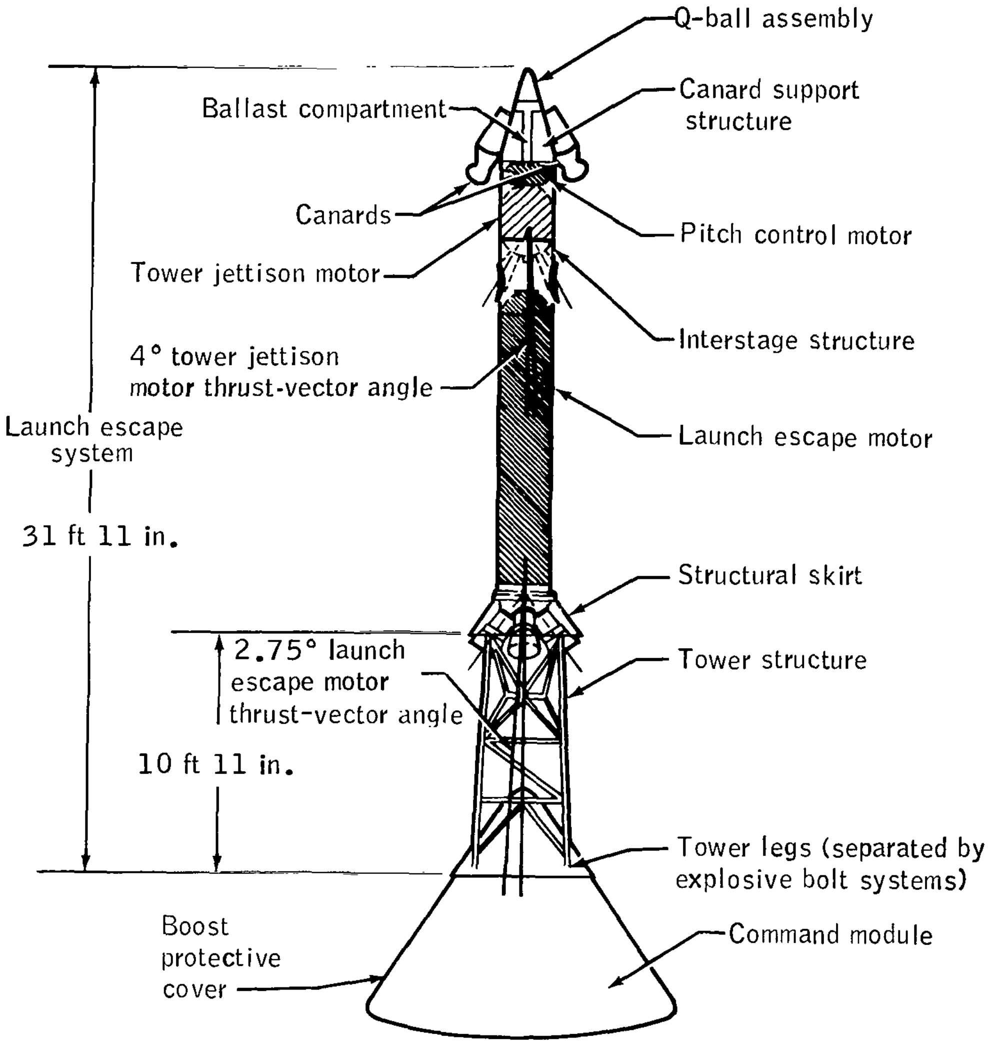
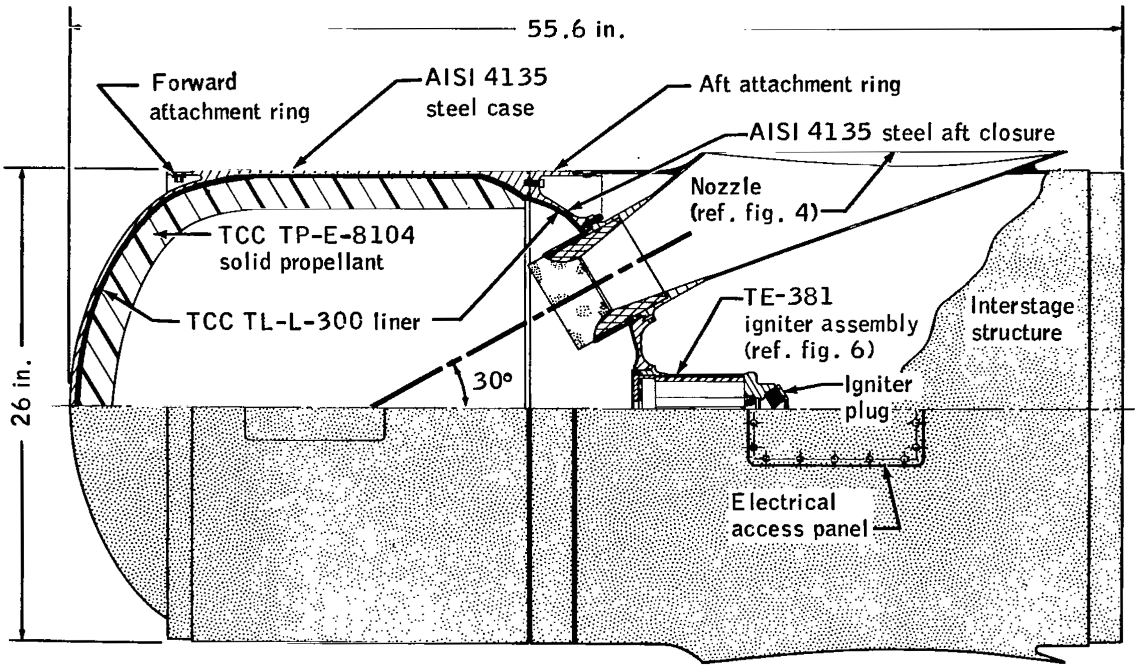
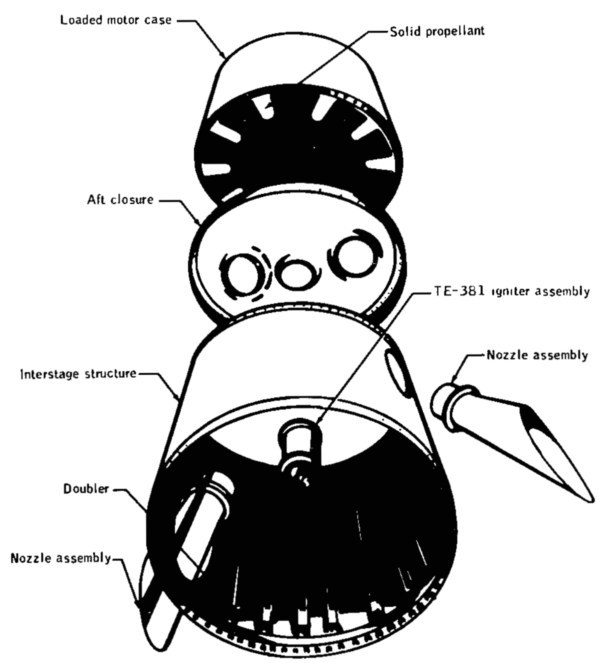


Figure 2. - Apollo launch escape system and command module.

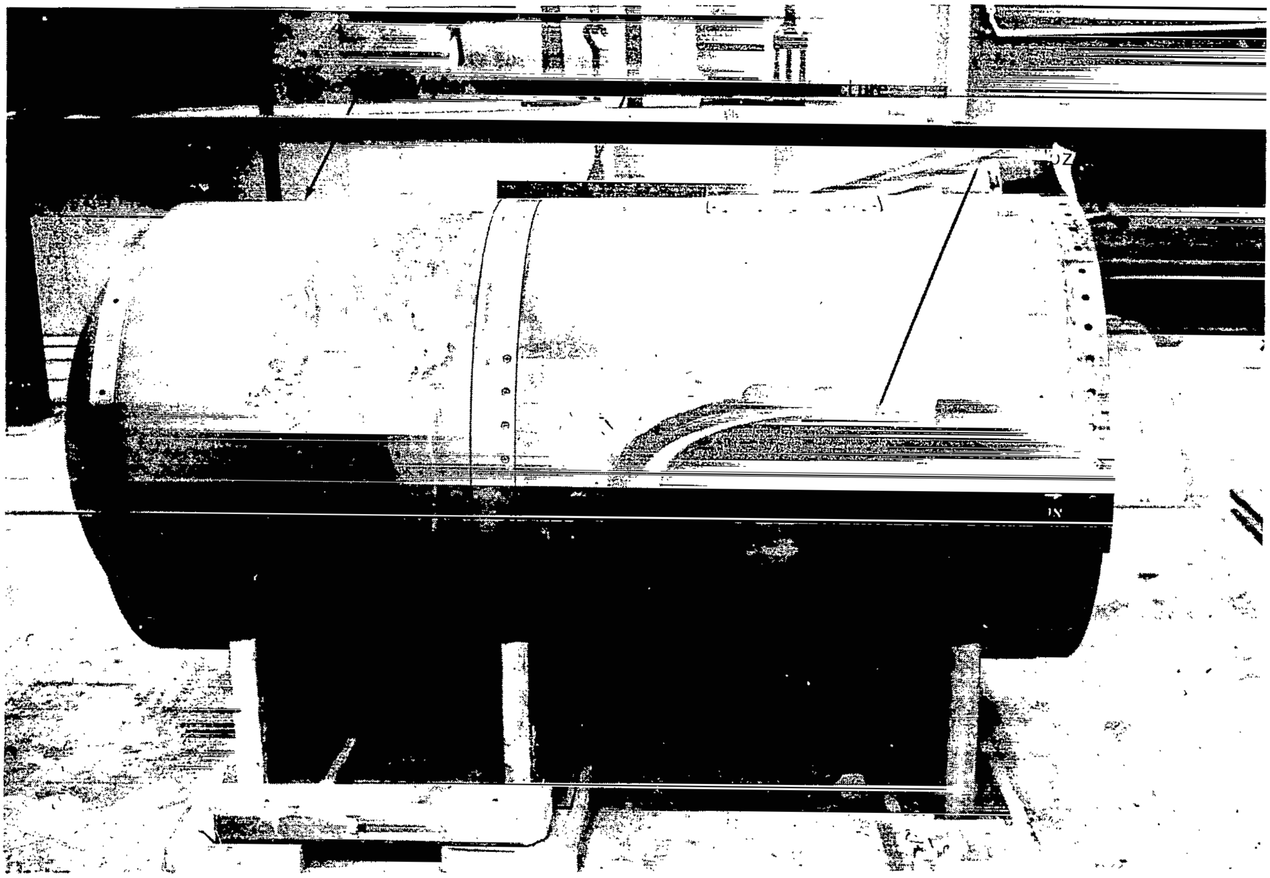


(a) Schematic.



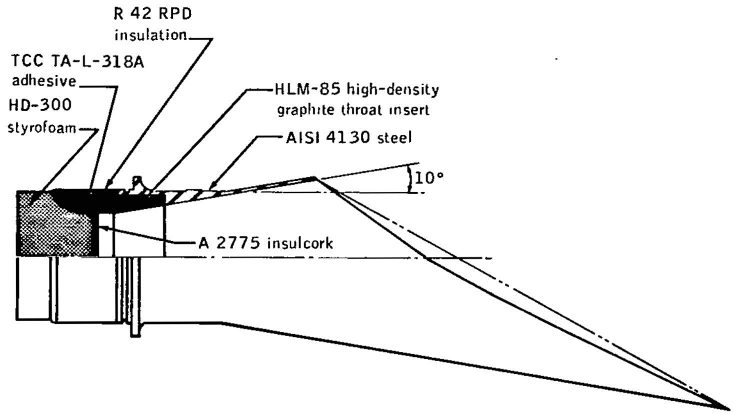
(b) Pictorial view.

Figure 3. - The tower jettison motor for the Apollo launch escape system.

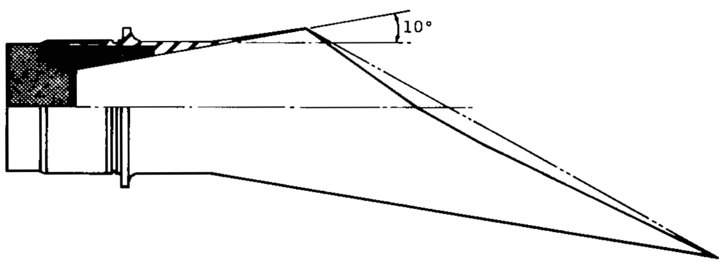


(c) Photograph.

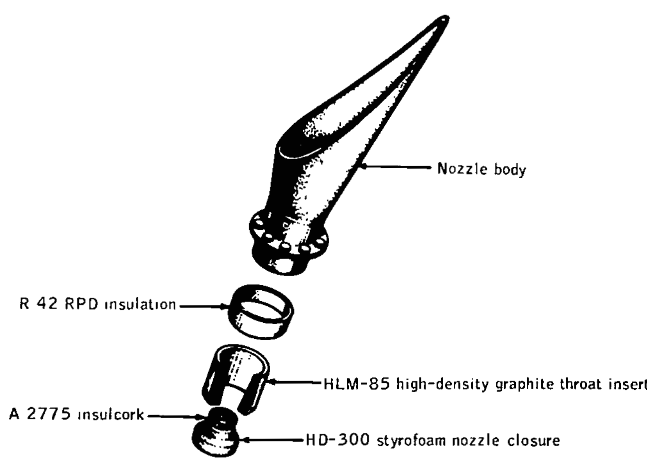
Figure 3. - Concluded.



(a) Schematic of small-throat nozzle.

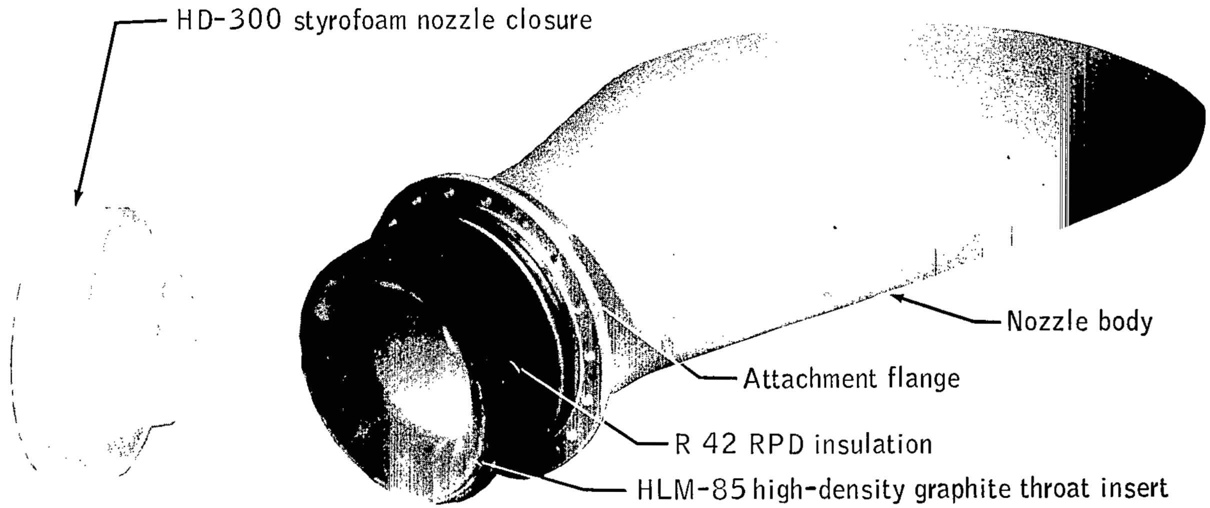


(b) Schematic of large-throat nozzle.



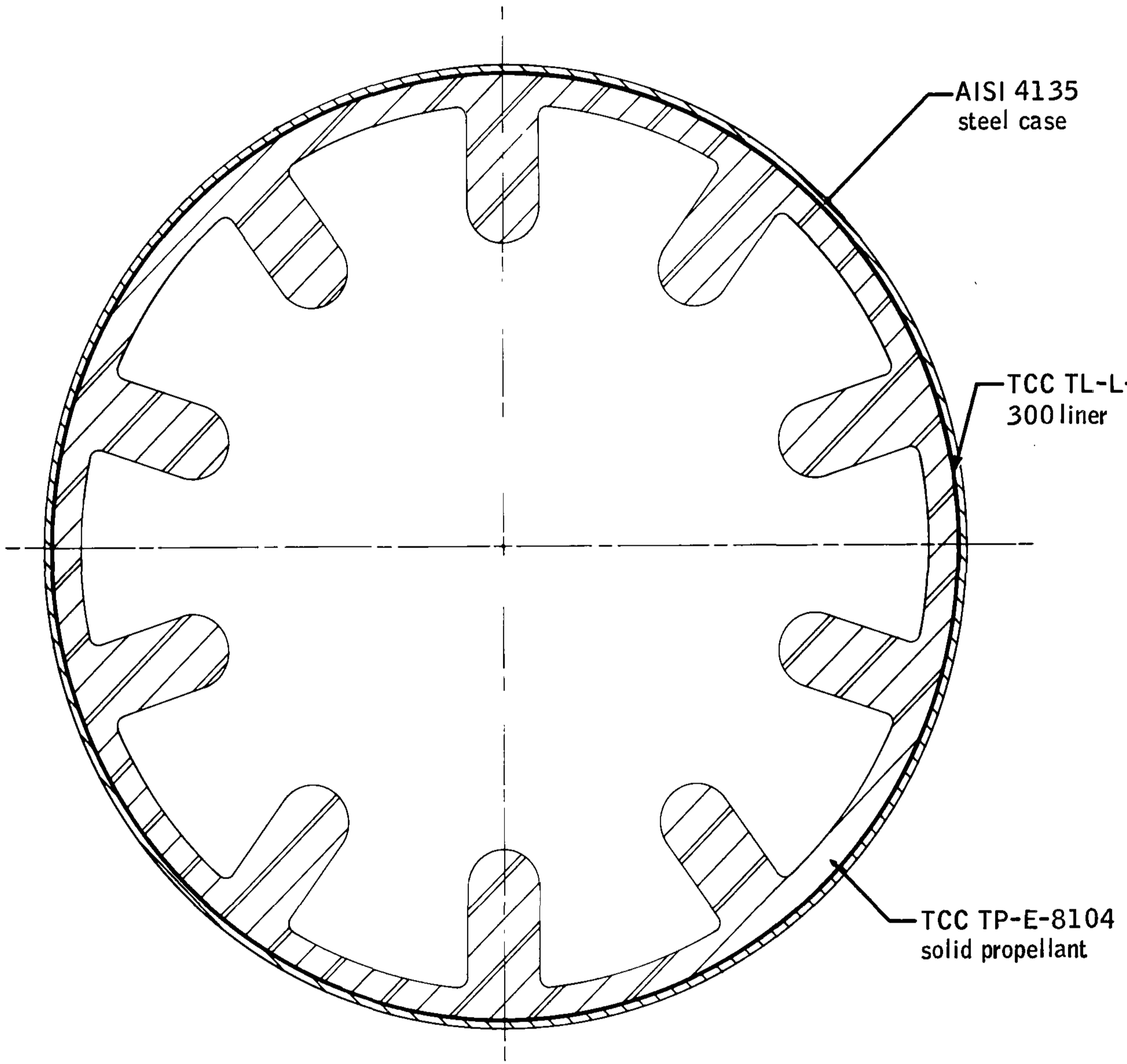
(c) Pictorial view.

Figure 4. - Nozzle assembly.



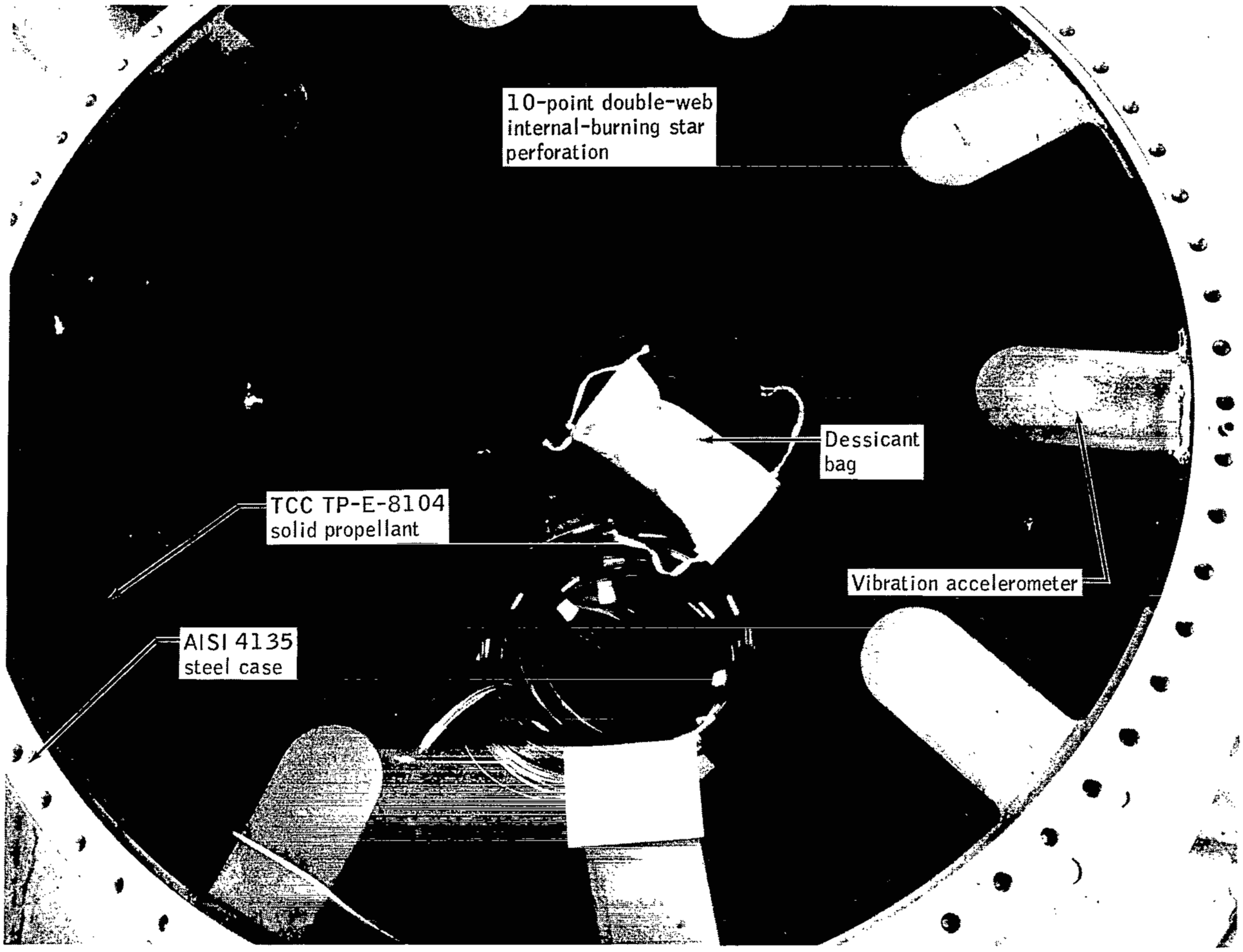
(d) Photograph.

Figure 4. - Concluded.



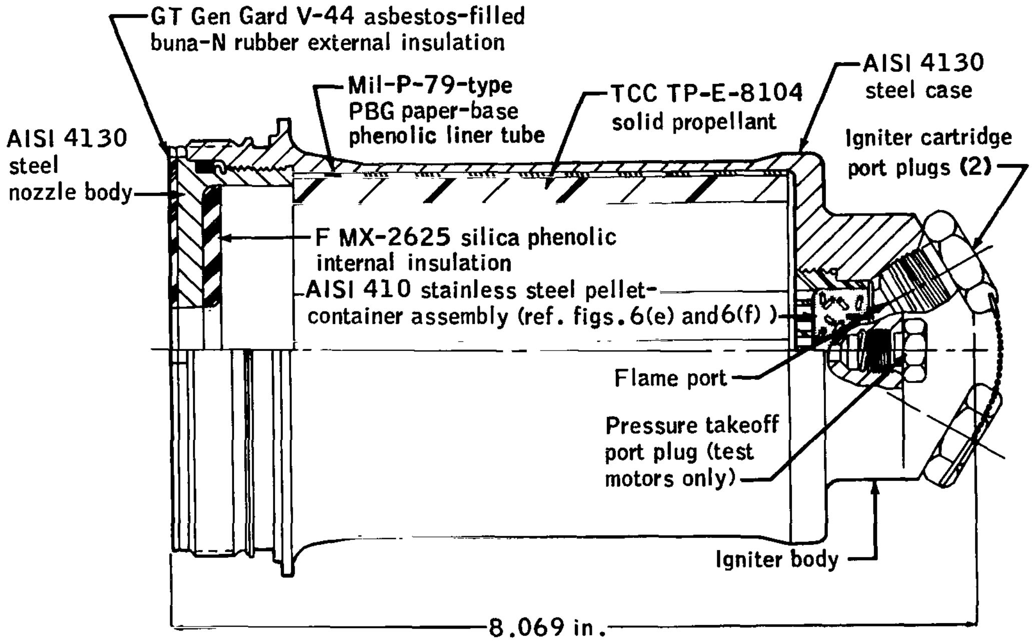
(a) Schematic.

Figure 5. - Propellant grain.

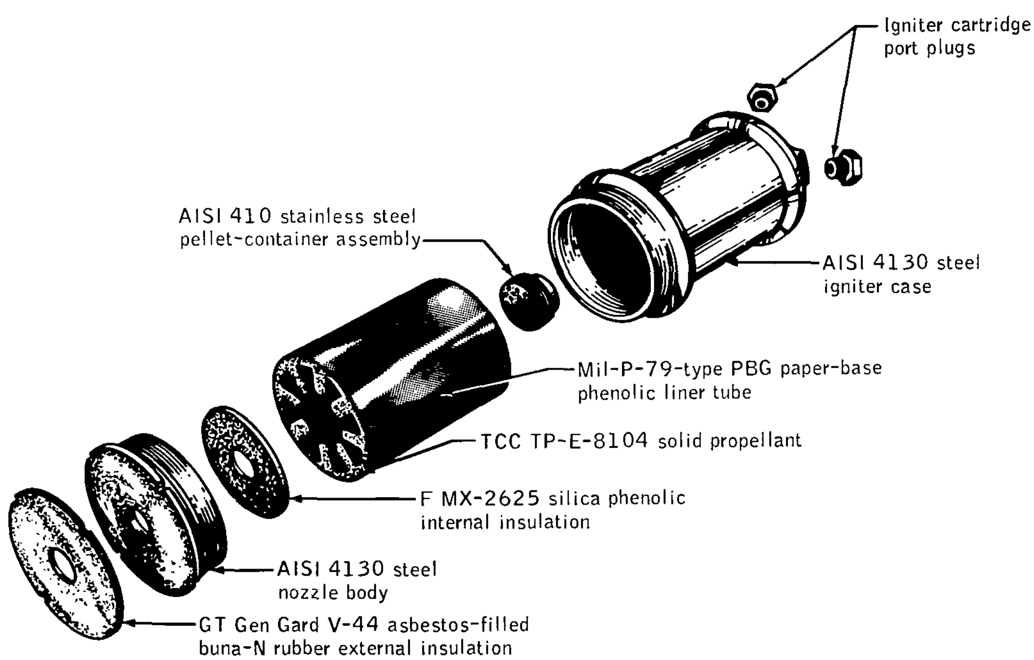


(b) Photograph.

Figure 5. - Concluded.

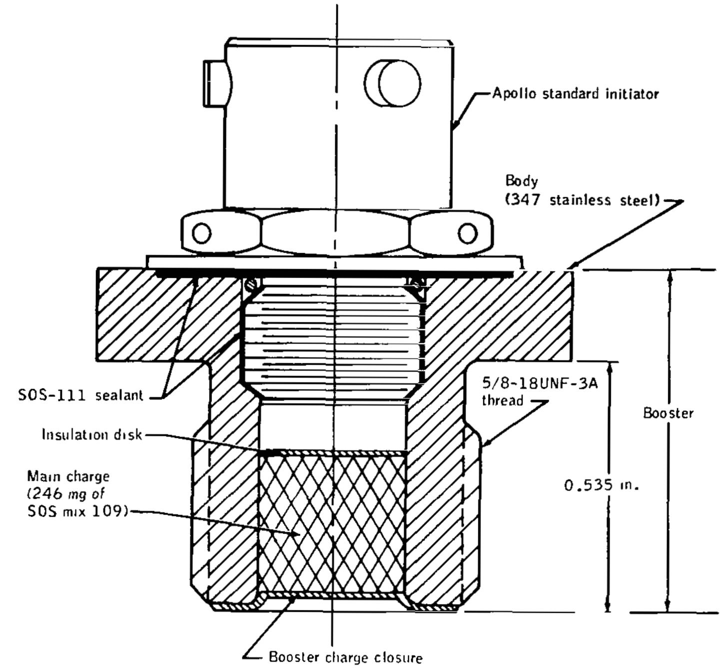


(a) Schematic of the TE-381 igniter assembly.

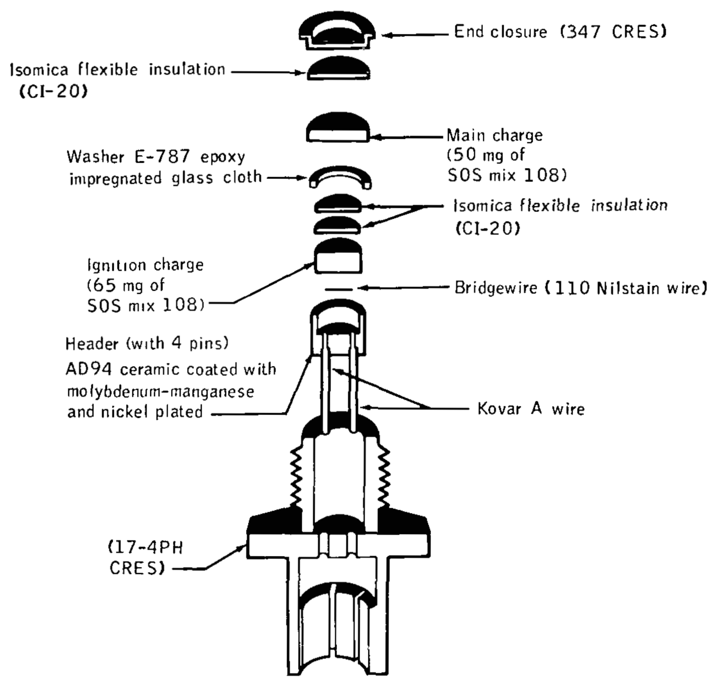


(b) Pictorial view of the TE-381 igniter assembly.

Figure 6. - Motor ignition system.

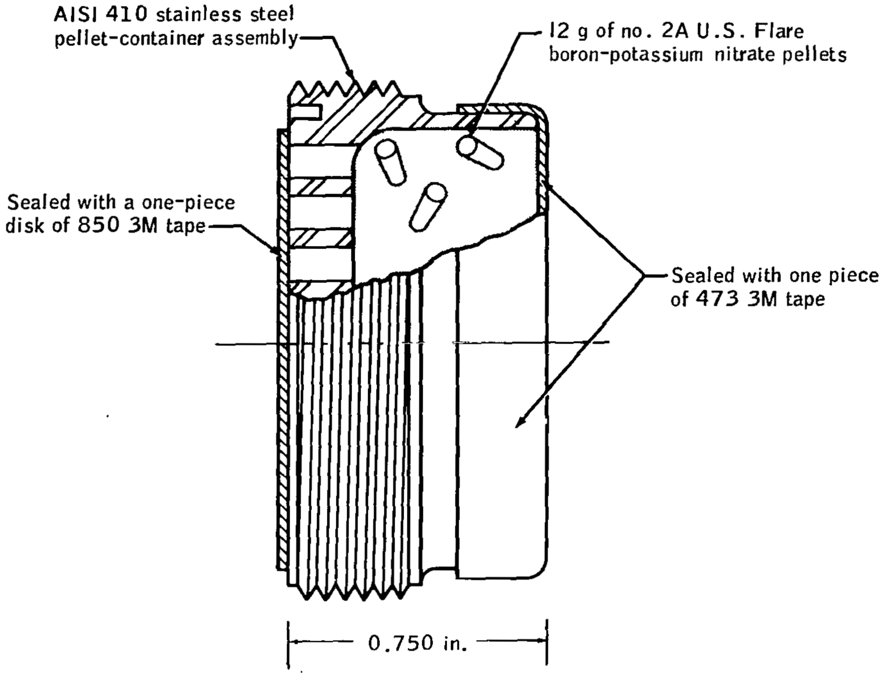


(c) Schematic of pyrotechnic igniter cartridge.

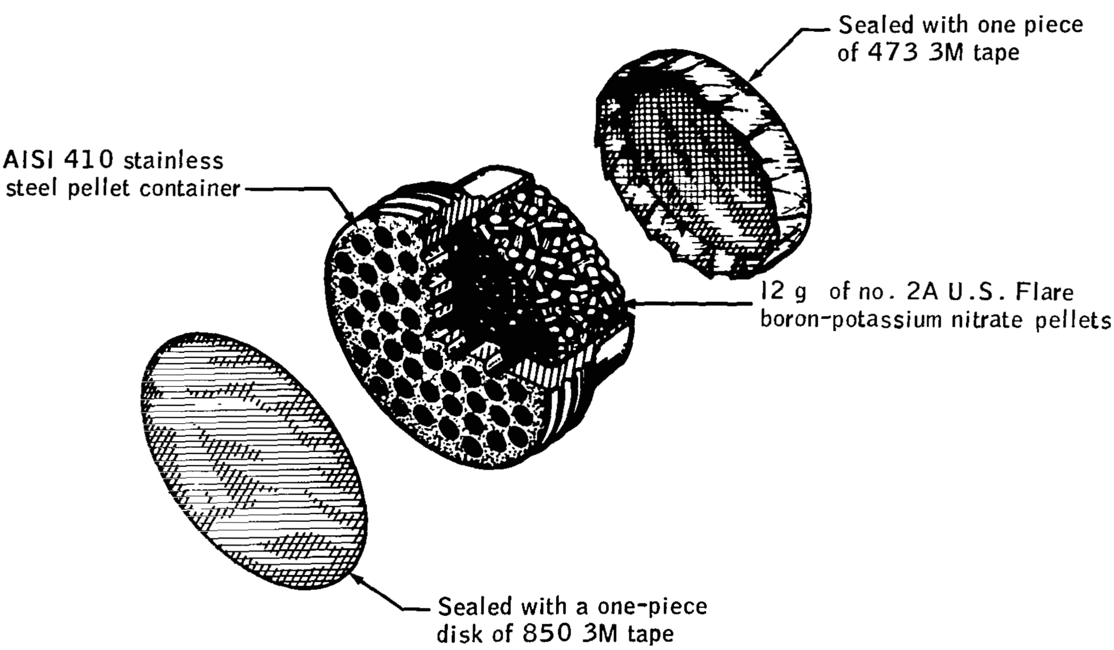


(d) Pictorial view of Apollo standard initiator. Load of main charge and ignition charge vary with lot.

Figure 6. - Continued.

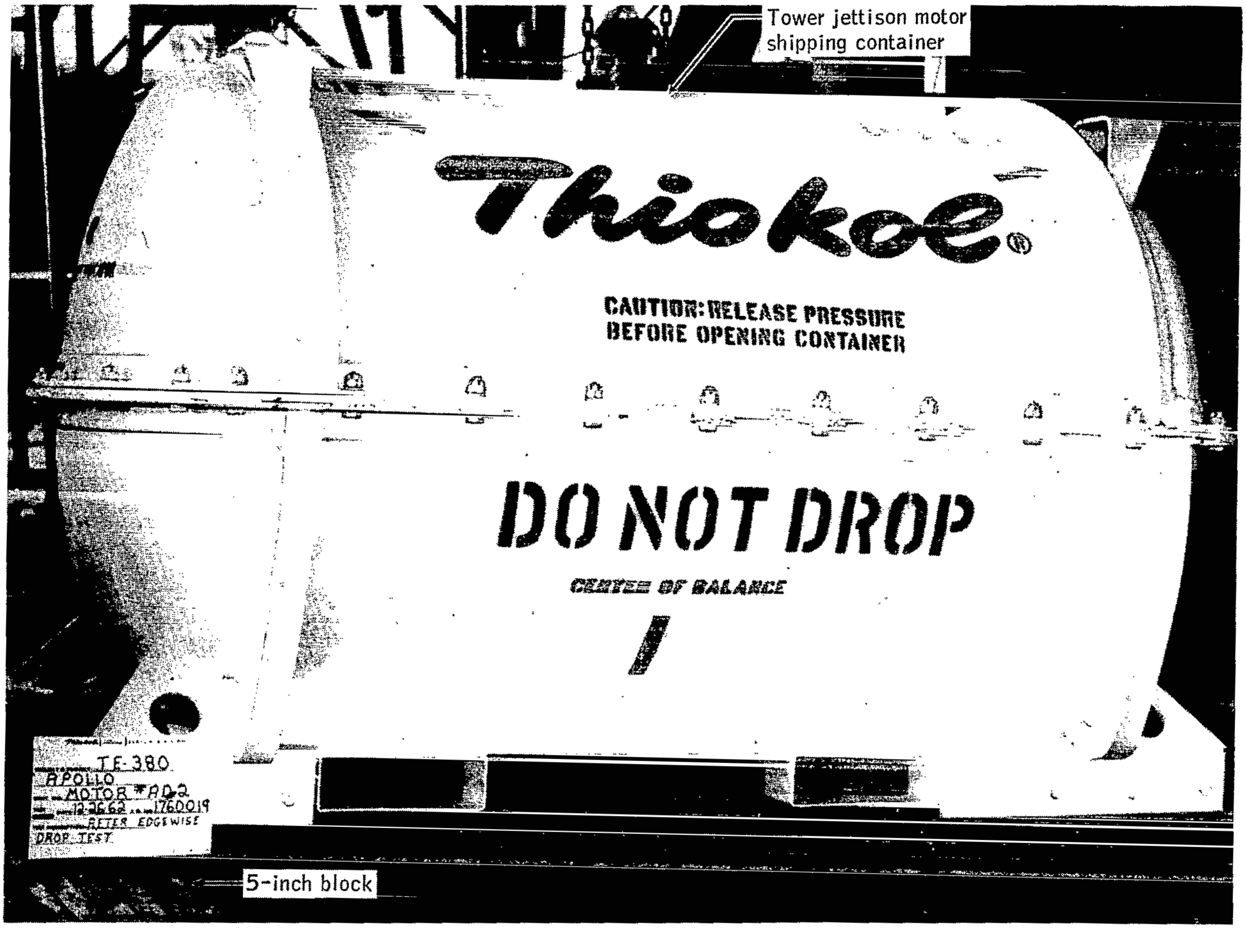


(e) Schematic of igniter pellet container.



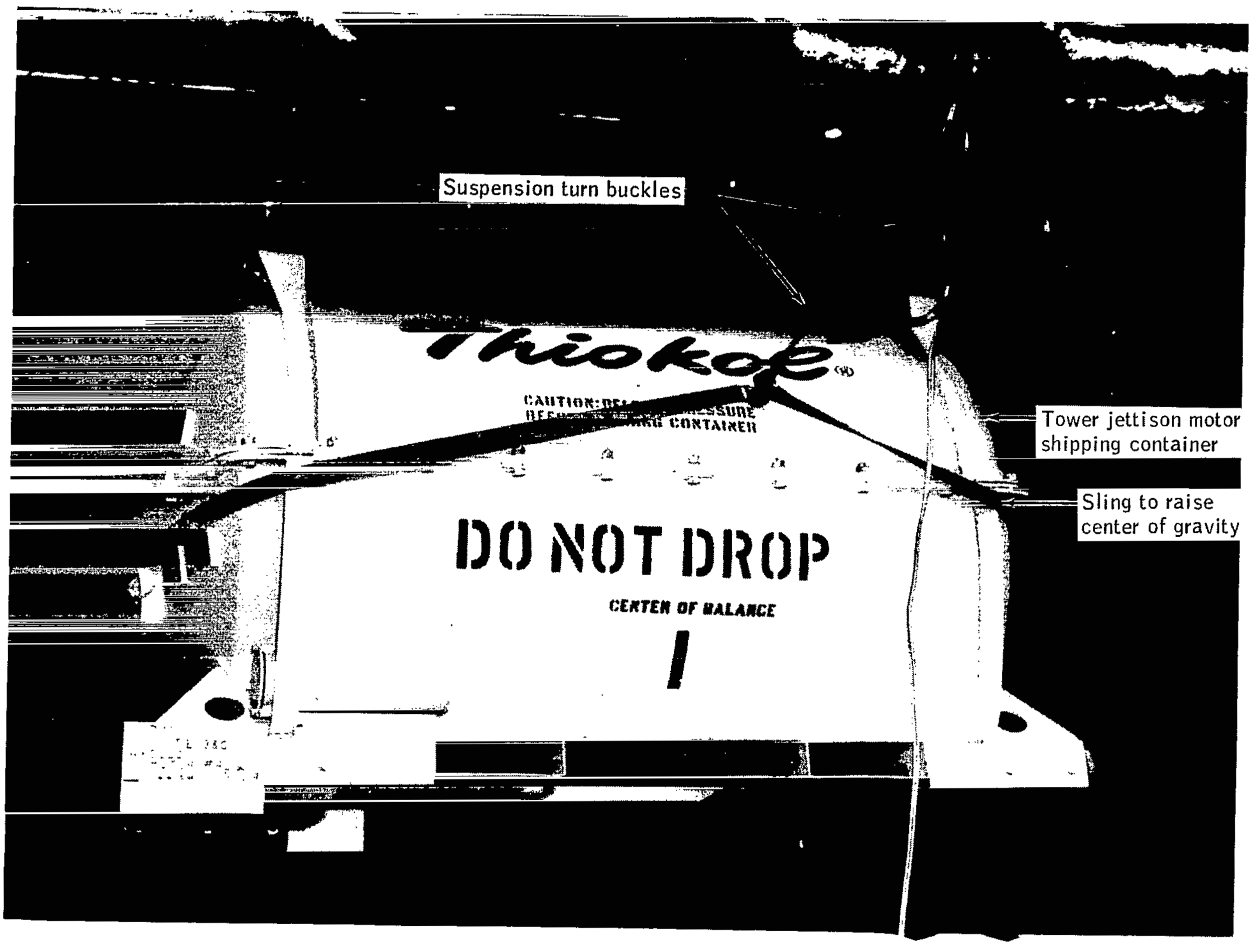
(f) Pictorial view of igniter pellet container.

Figure 6. - Concluded.



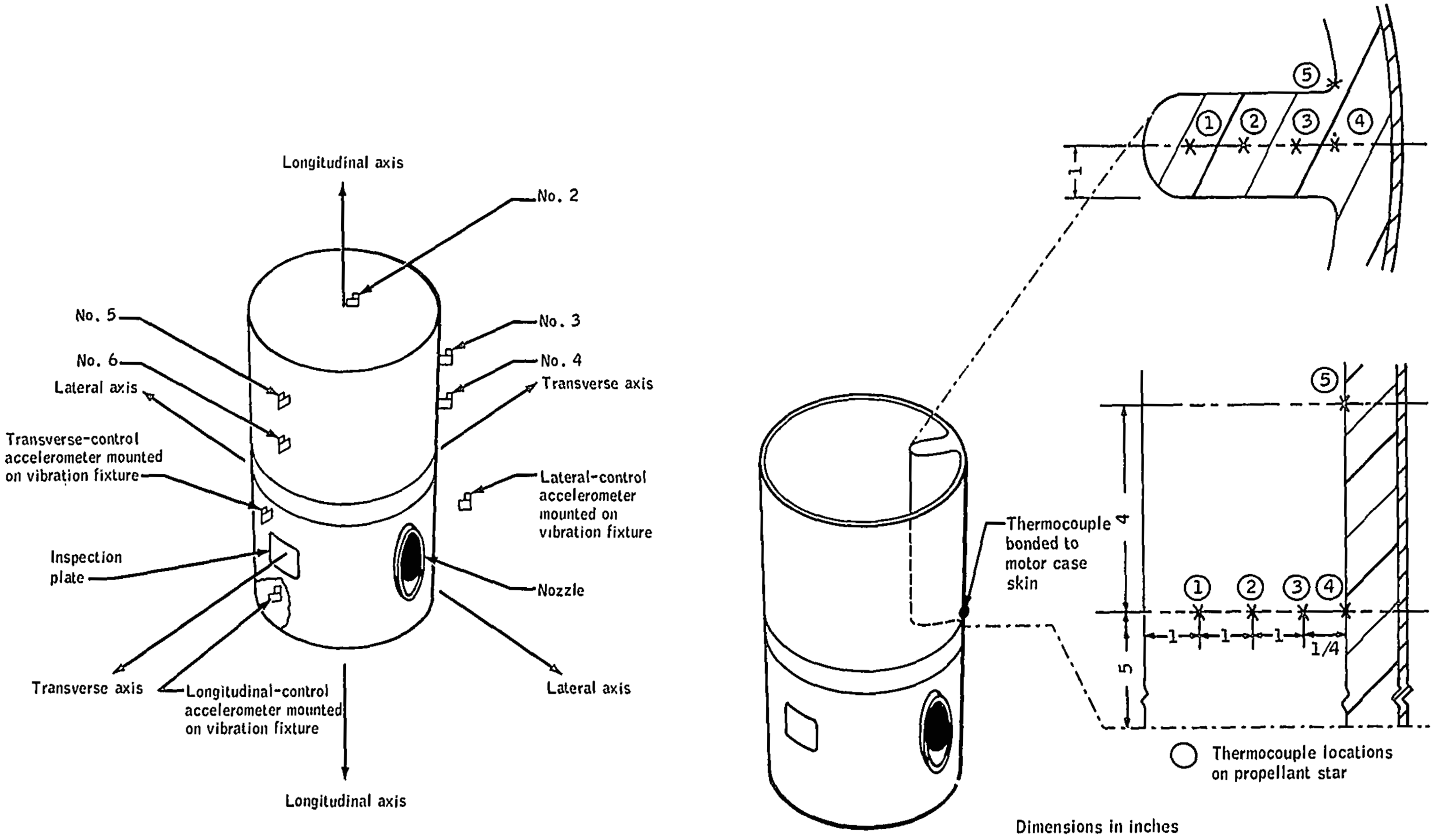
(a) Edgewise drop testing.

Figure 7. - Impact testing.



(b) Pendulum impact testing.

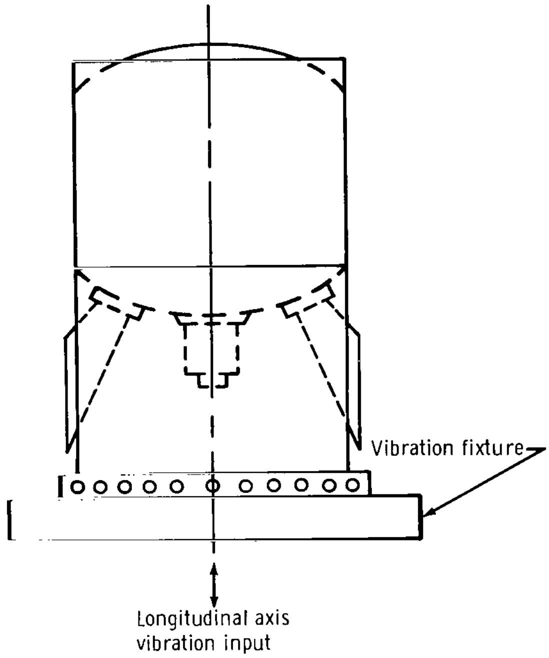
Figure 7. - Concluded.



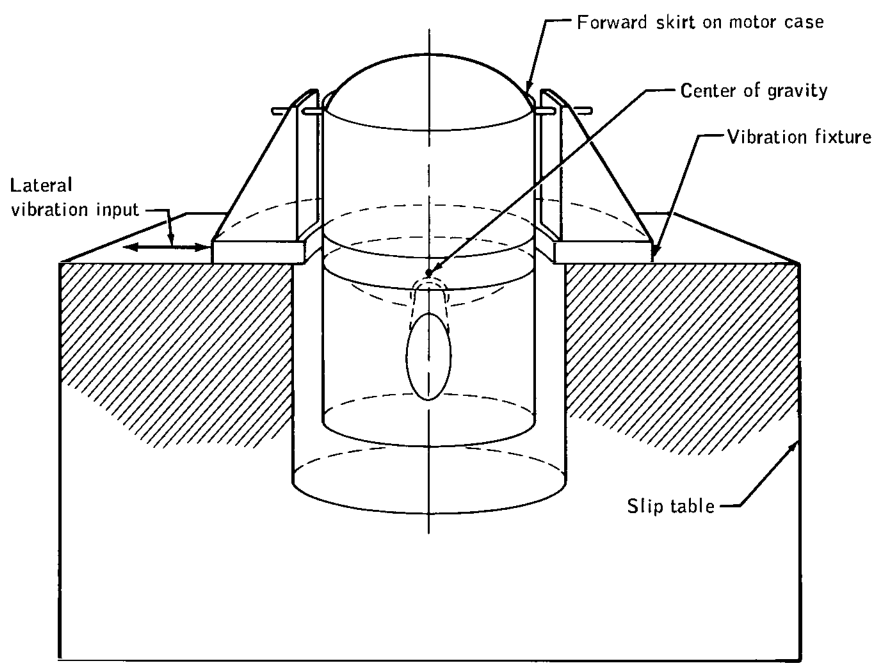
(a) Schematic of accelerometer locations (accelerometers 2 to 6 mounted on motor case).

(b) Schematic of thermocouple locations.

Figure 8. - Accelerometer and thermocouple locations and definition of axes.

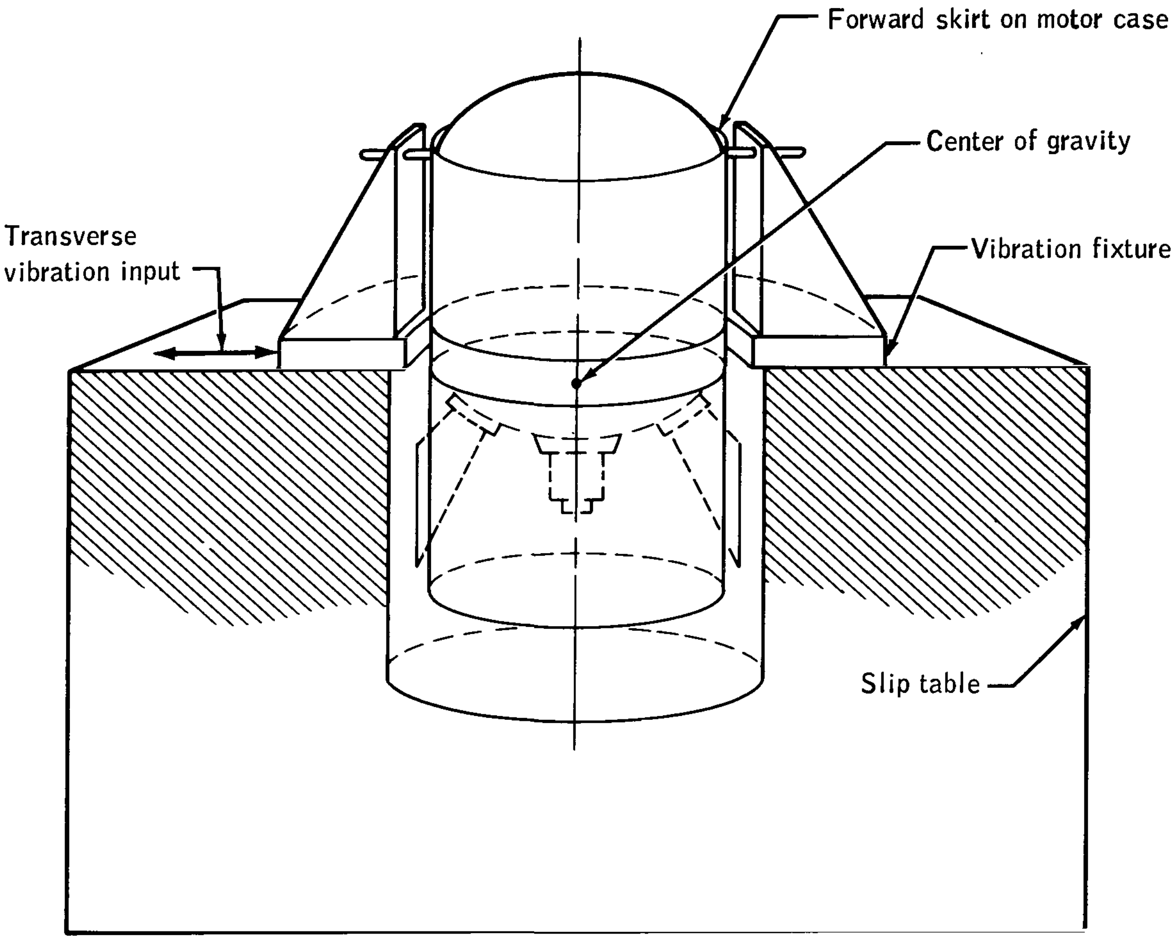


(a) Schematic of longitudinal vibration test fixture.



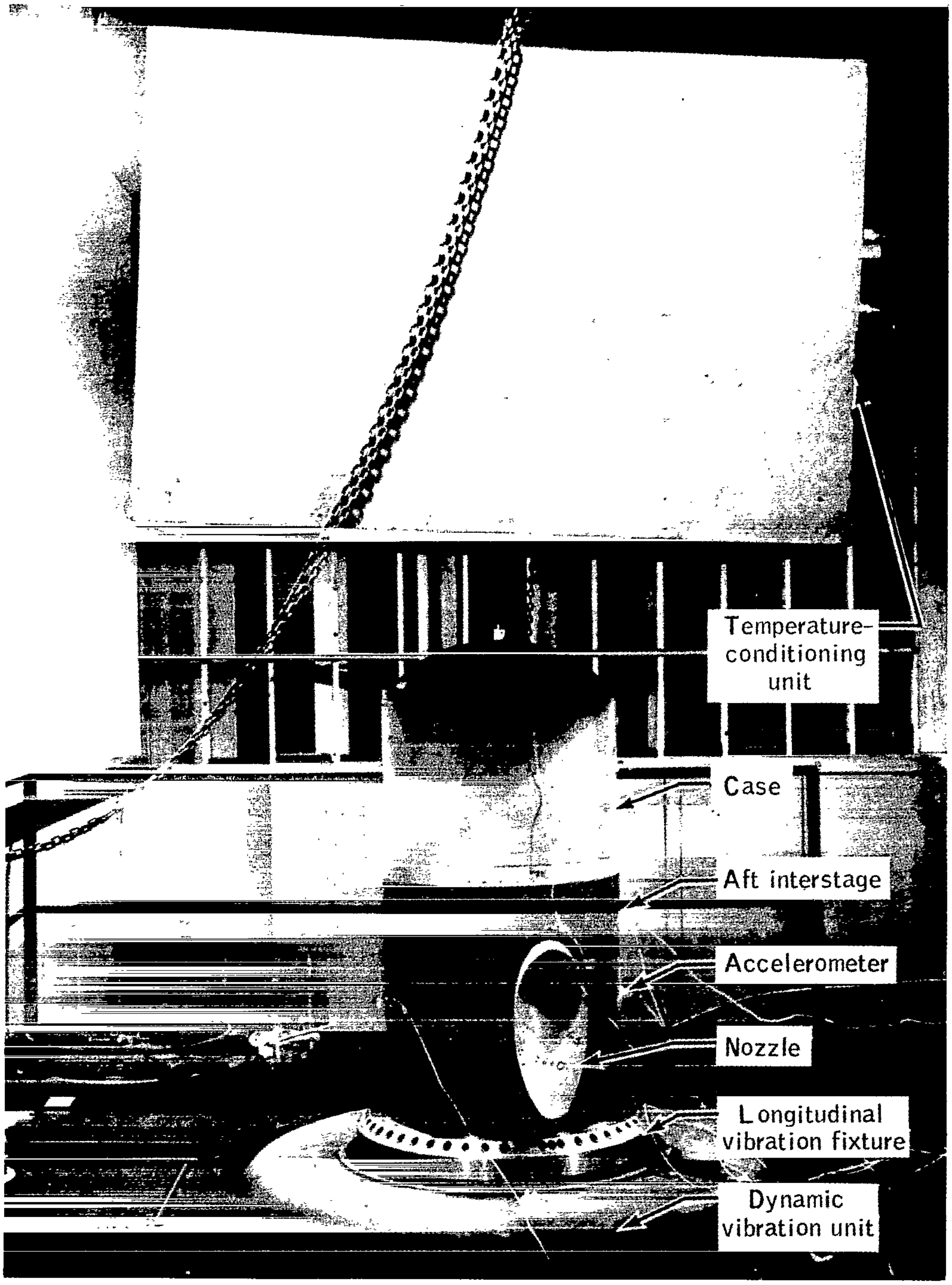
(b) Schematic of lateral vibration test fixture.

Figure 9. - Vibration test fixtures.



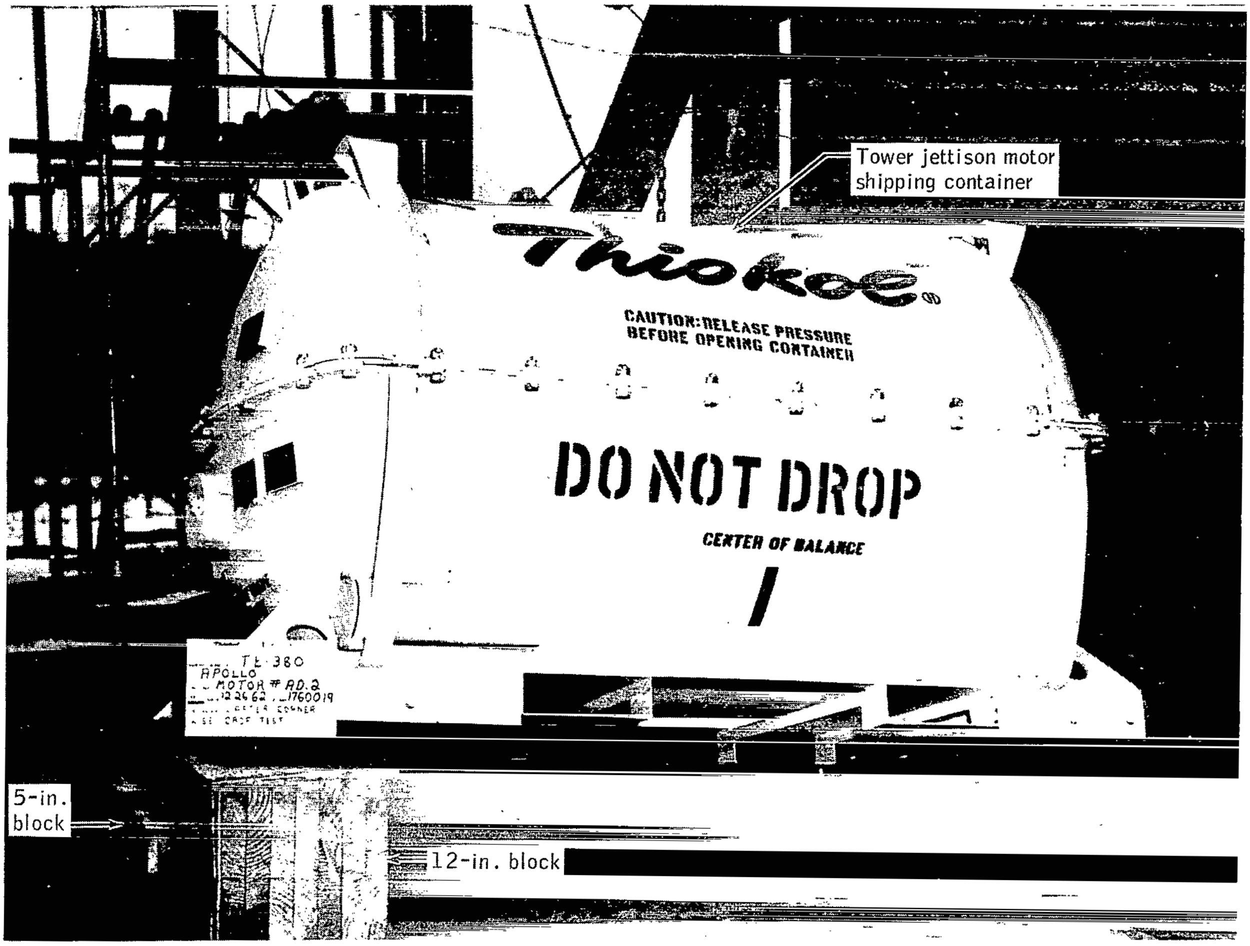
(c) Schematic of transverse vibration test fixture.

Figure 9. - Continued.



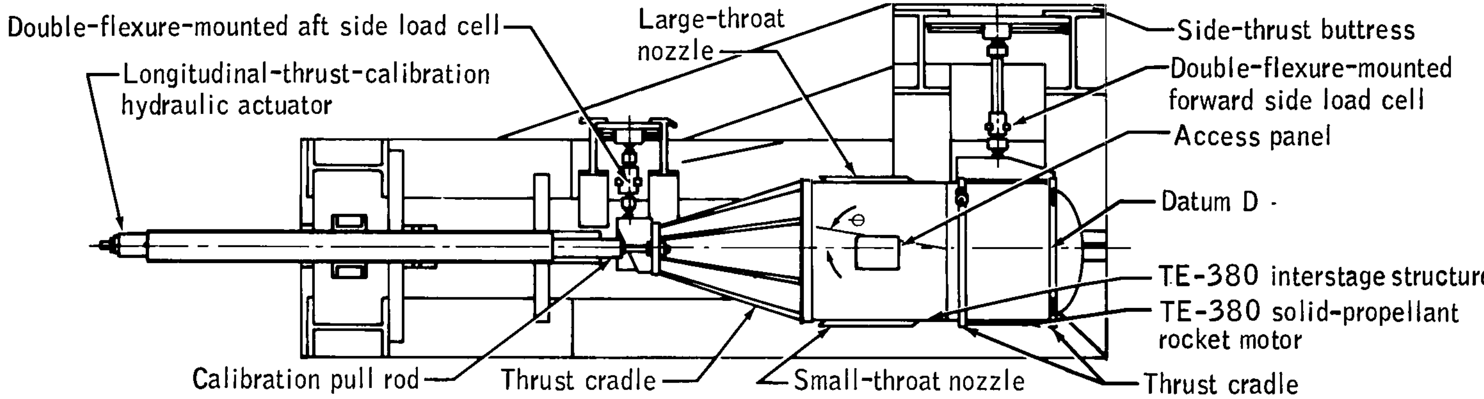
(d) Photograph of longitudinal vibration test fixture with temperature-conditioning unit.

Figure 9. - Continued.

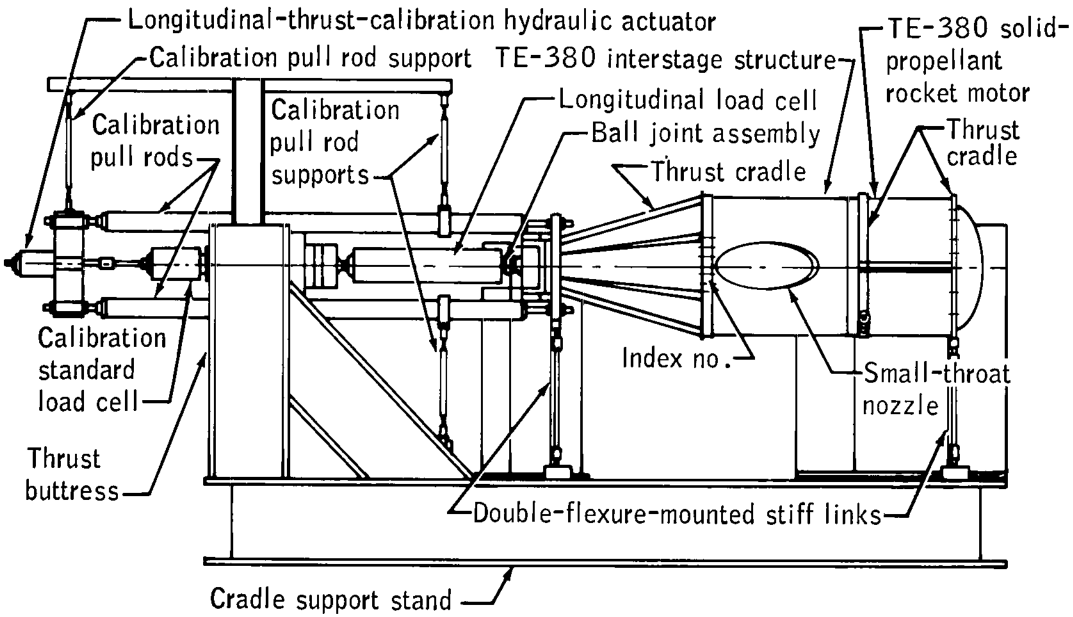


(e) Cornerwise drop testing.

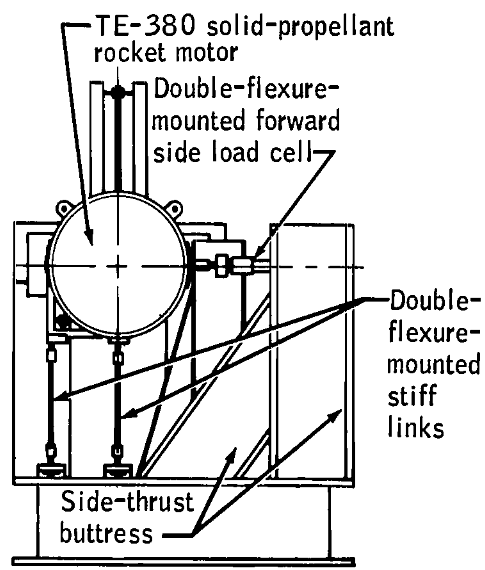
Figure 9. - Concluded.



(a) Schematic of top view.

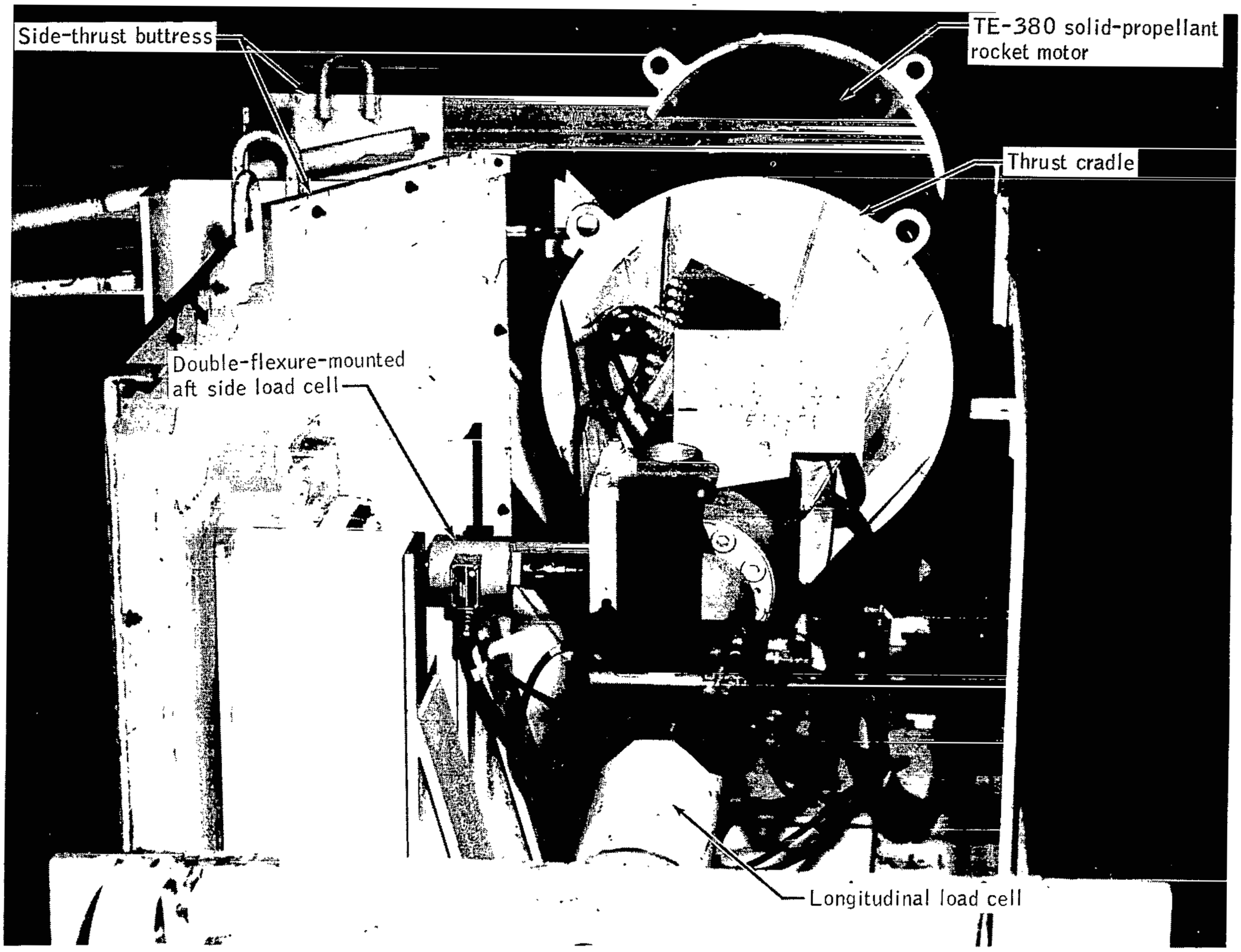


(b) Schematic of side view.



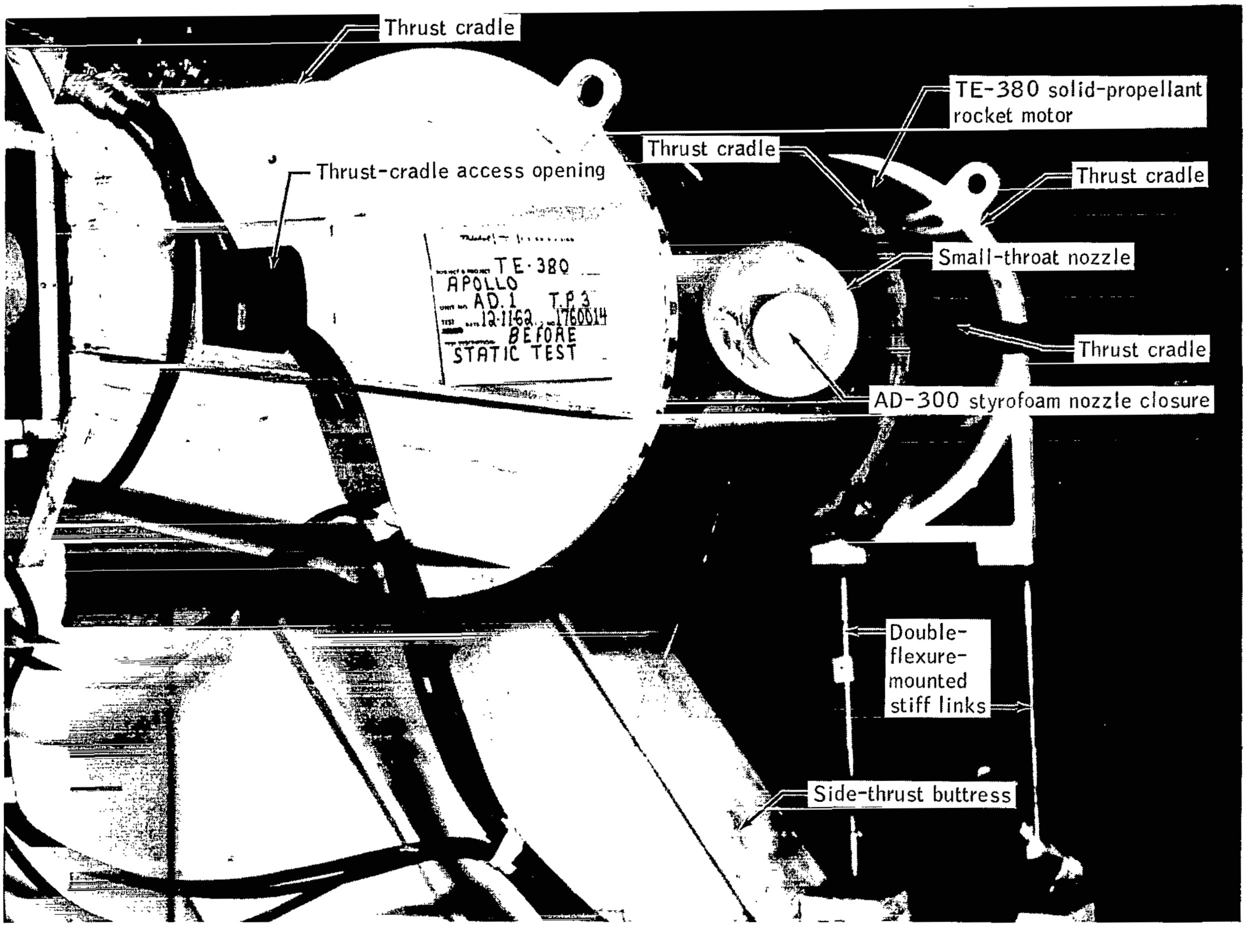
(c) Schematic of end view.

Figure 10. - Static test stand.



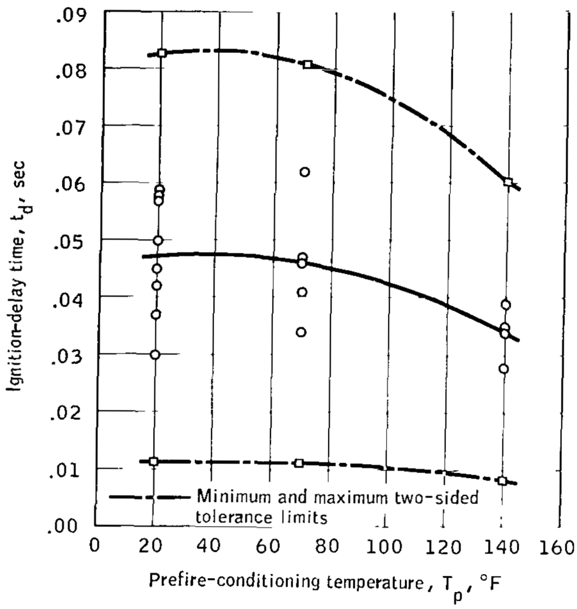
(d) Photograph, end view.

Figure 10. - Continued.

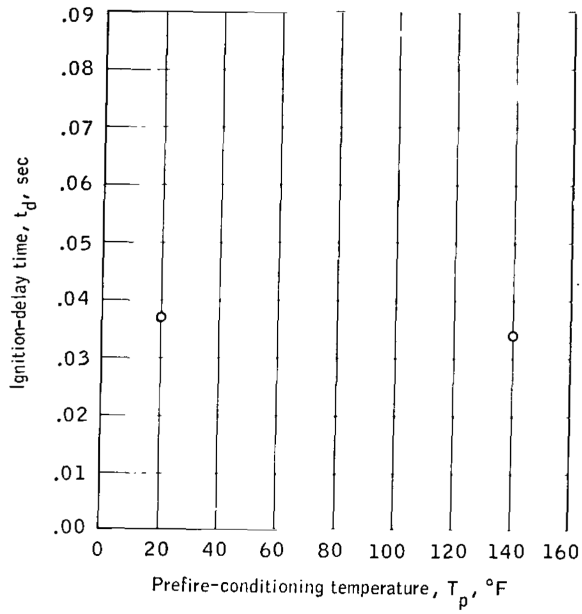


(e) Photograph, side view.

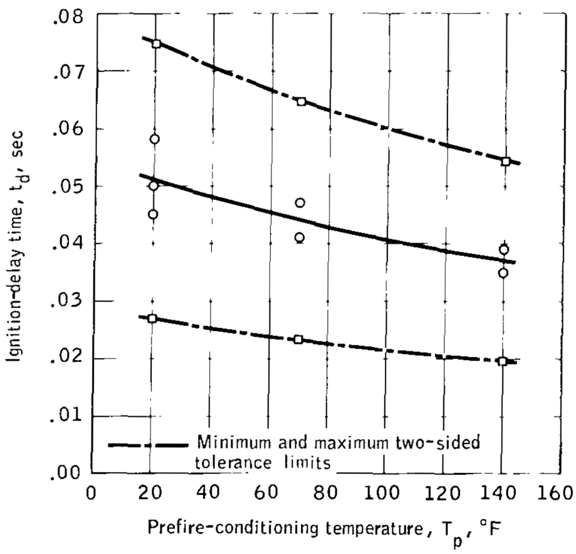
Figure 10. - Concluded.



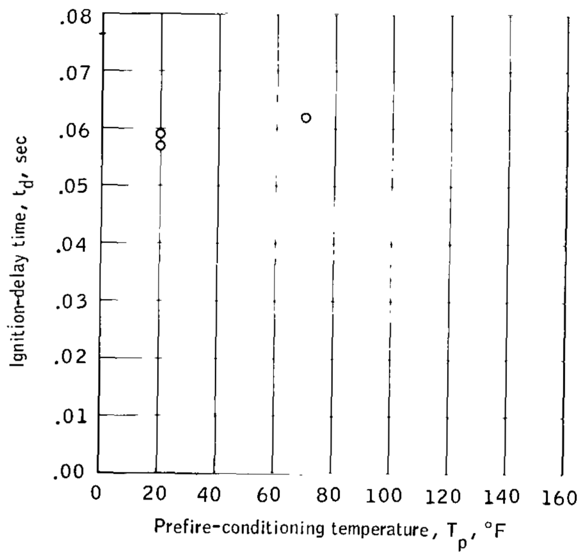
(a) Ignition-delay times independent of prefire cavity pressure and the number of igniter cartridges used.



(b) Ignition-delay times of the two motors in ignition category 1 (duplicated only a failed igniter cartridge).

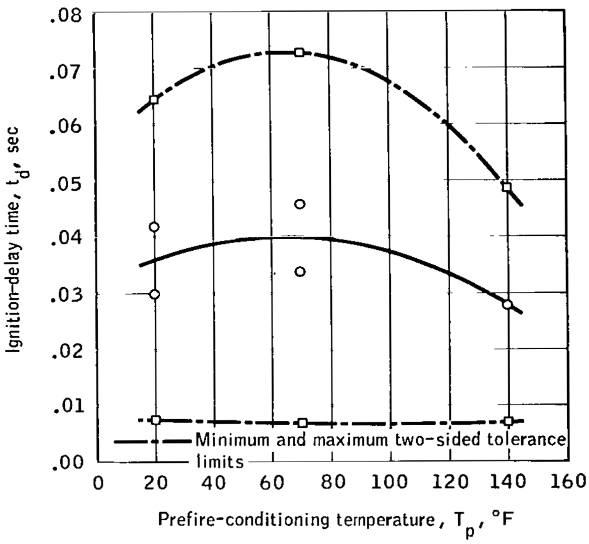


(c) Ignition-delay times of the seven motors in ignition category 2 (simulated only a failed nozzle closure).

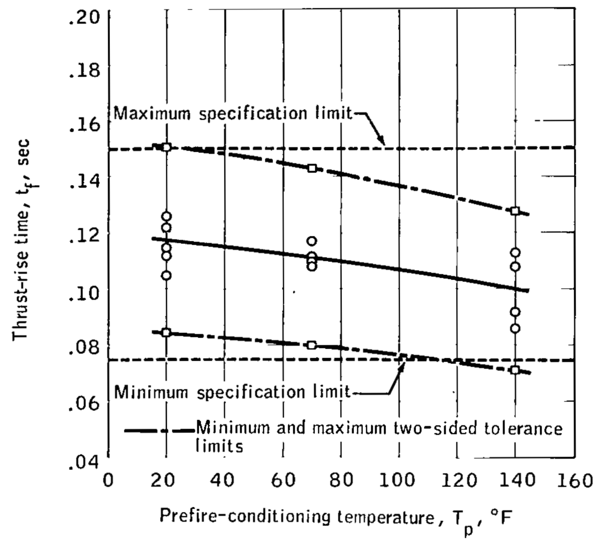


(d) Ignition-delay times of the three motors in ignition category 3 (duplicated a failed igniter cartridge and simulated a failed nozzle closure).

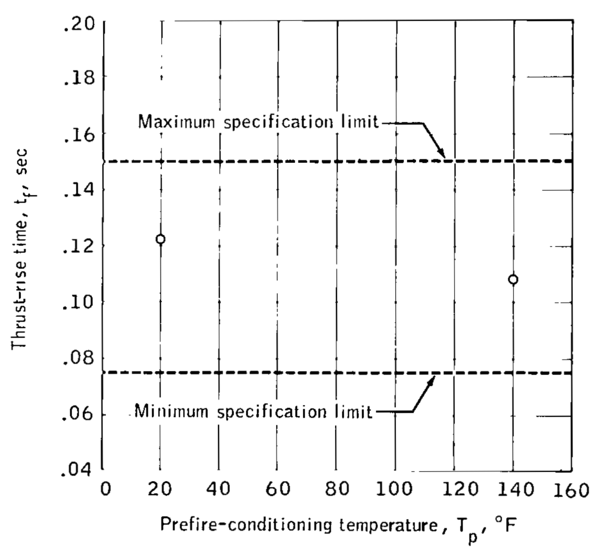
Figure 11. - Variation of motor time characteristics as a function of prefire-conditioning temperature.



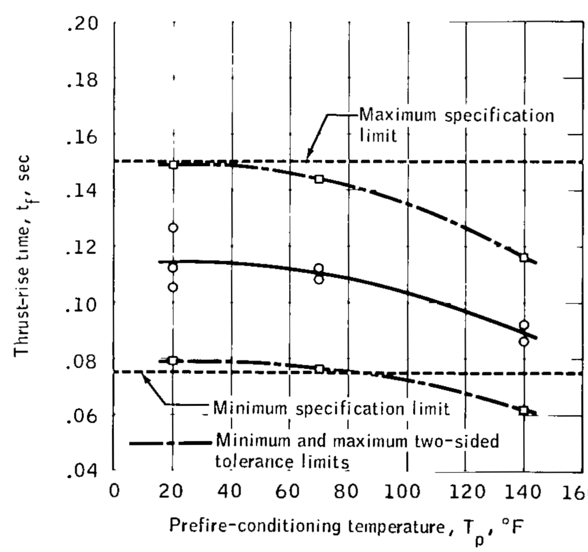
(e) Ignition-delay times of the five motors in ignition category 4 (duplicated normal ignition conditions).



(f) Thrust-rise times independent of prefire cavity pressure and the number of igniter cartridges used.

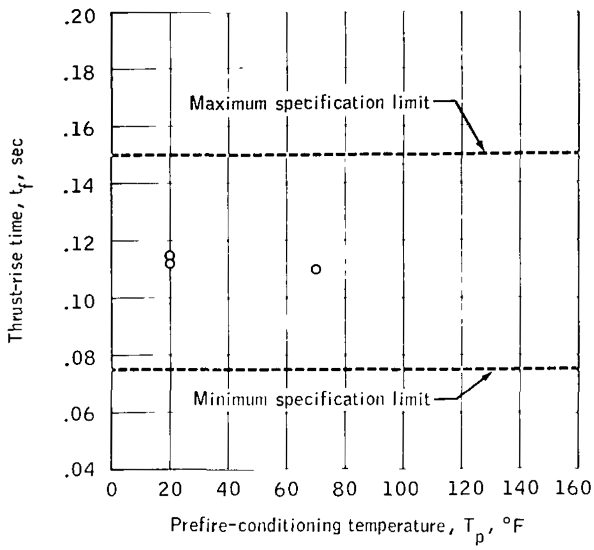


(g) Thrust rise times of the two motors in ignition category 1 (duplicated only a failed igniter cartridge).

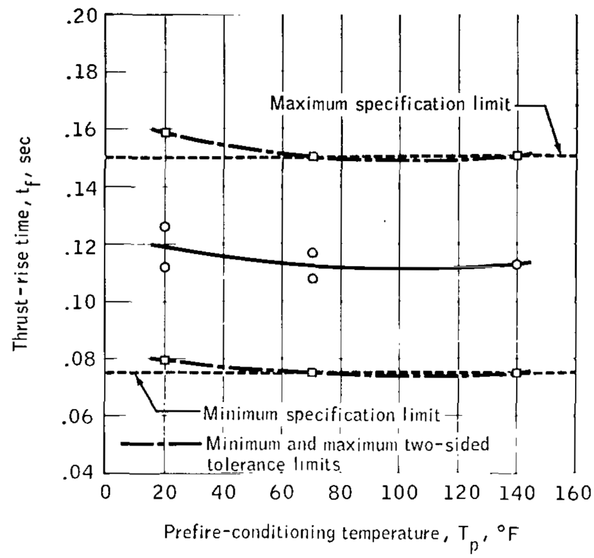


(h) Thrust-rise times of the seven motors in ignition category 2 (simulated only a failed nozzle closure).

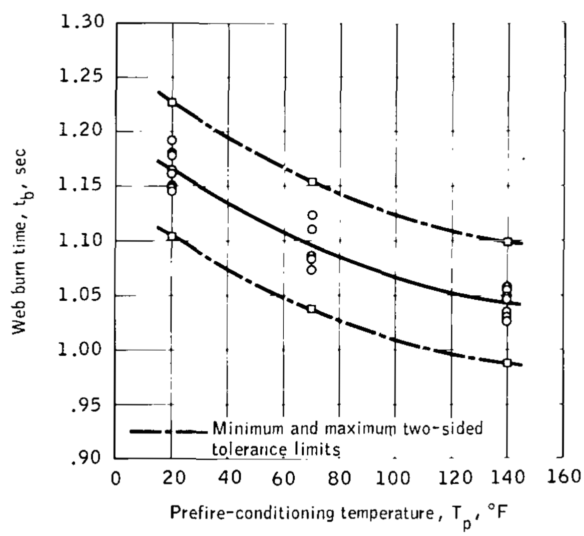
Figure 11. - Continued.



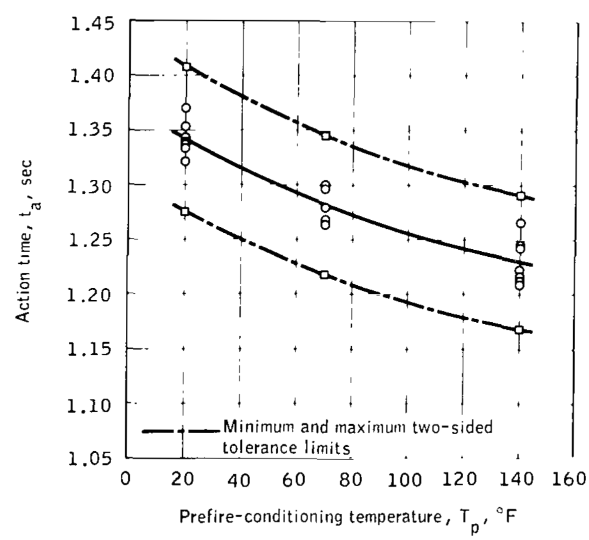
(i) Thrust-rise times of the three motors in ignition category 3 (duplicated a failed igniter cartridge and simulated a failed nozzle closure).



(j) Thrust-rise times of the five motors in ignition category 4 (duplicated normal ignition conditions).

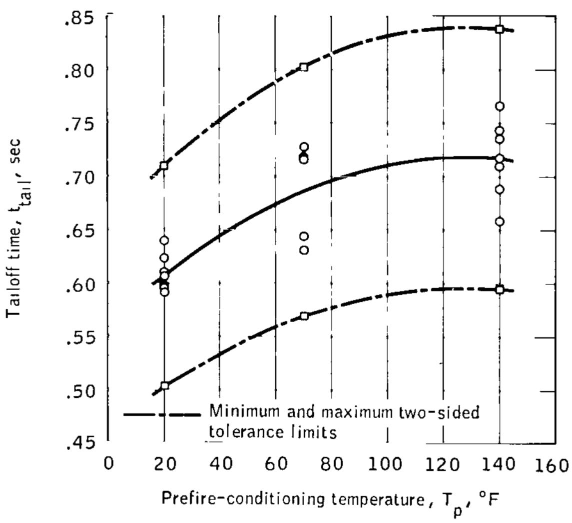


(k) Web burn time.

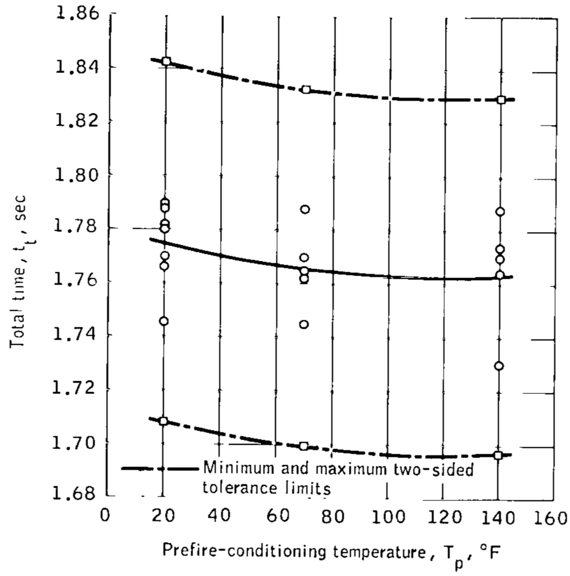


(l) Action time.

Figure 11. - Continued.

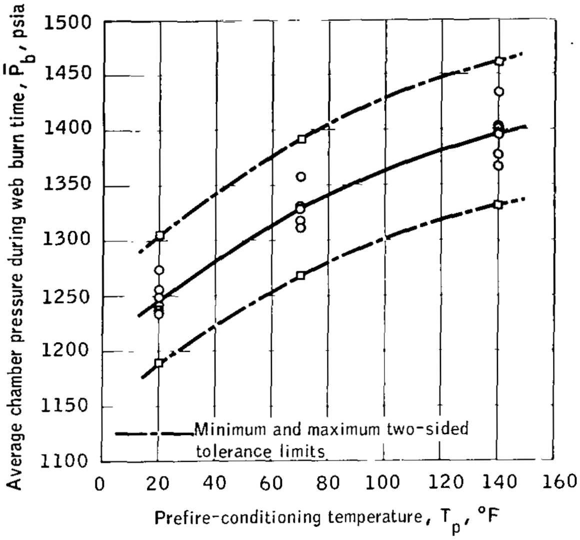


(m) Tailoff time.

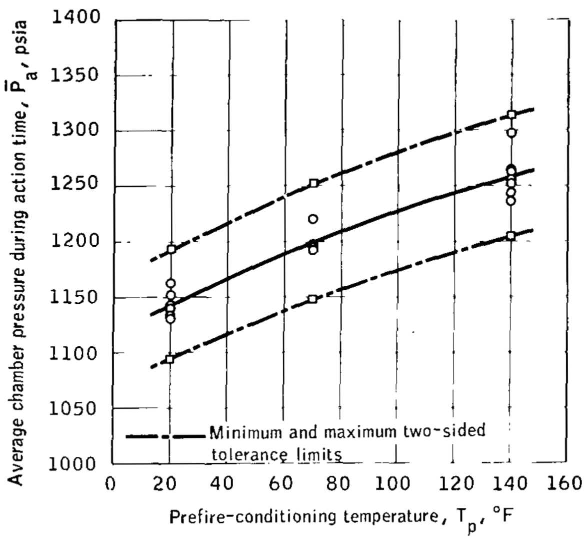


(n) Total time.

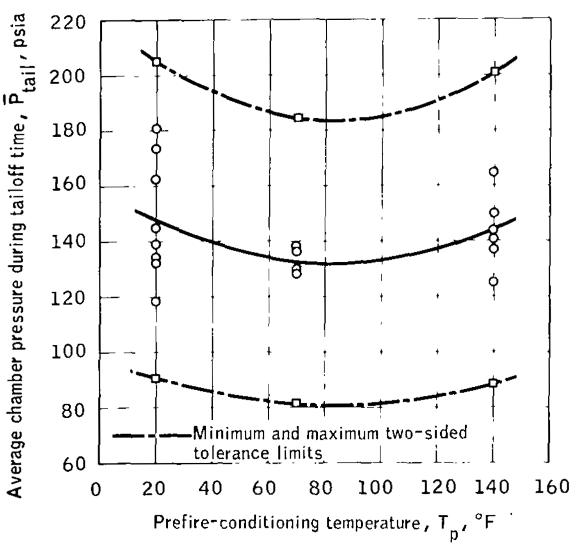
Figure 11. - Concluded.



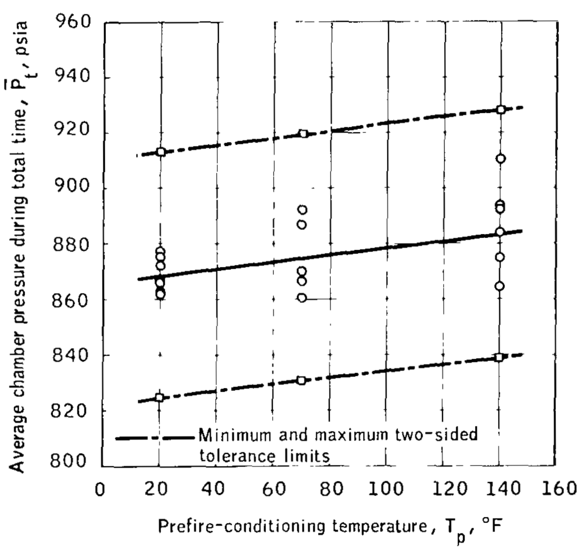
(a) Average chamber pressure during web burn time.



(b) Average chamber pressure during action time.

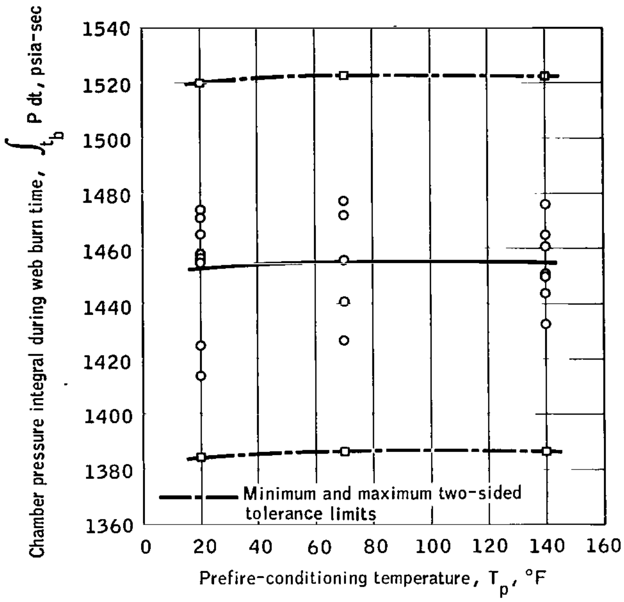


(c) Average chamber pressure during tailoff time.

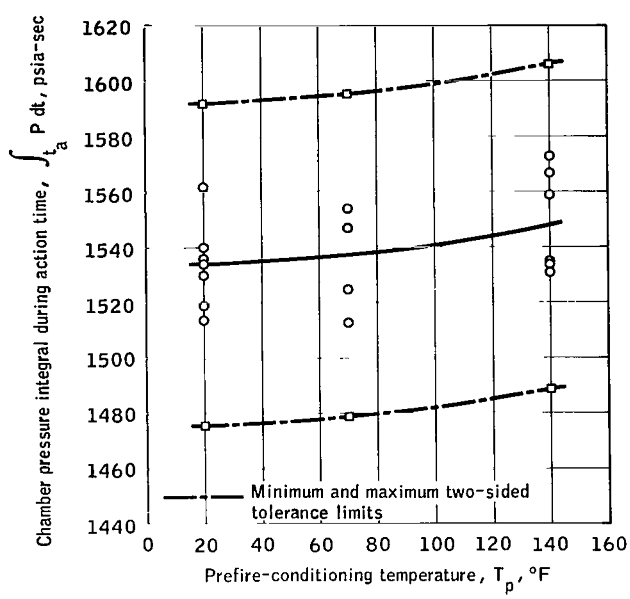


(d) Average chamber pressure during total time.

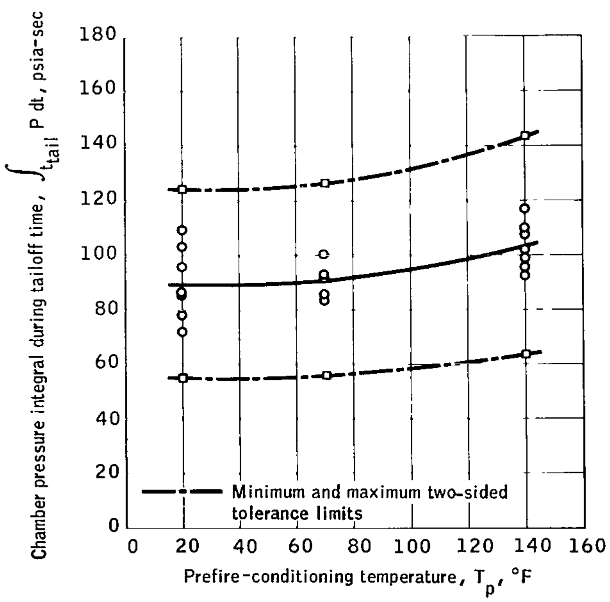
Figure 12. - Variation of motor average-chamber-pressure characteristics as a function of prefire-conditioning temperature.



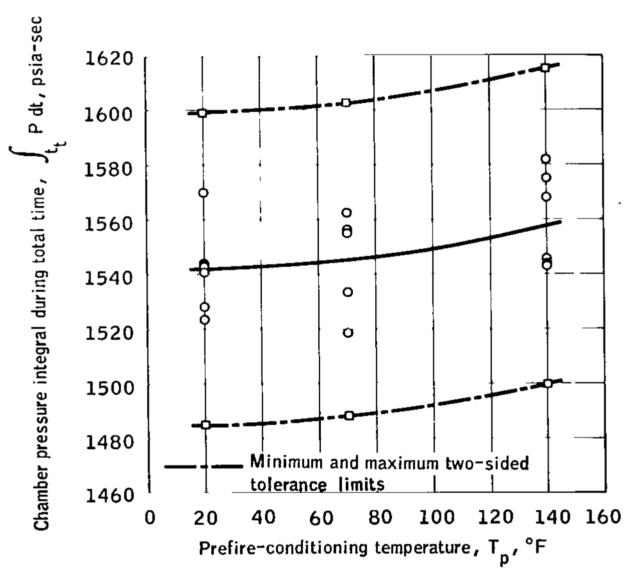
(a) Chamber pressure integral during web burn time.



(b) Chamber pressure integral during action time.

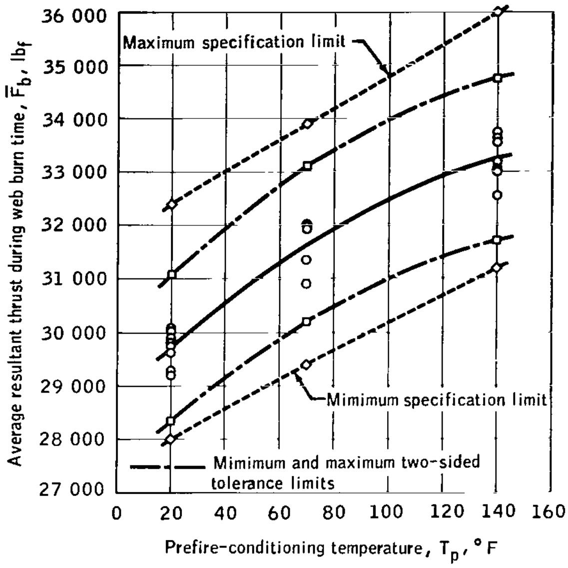


(c) Chamber pressure integral during tailoff time.

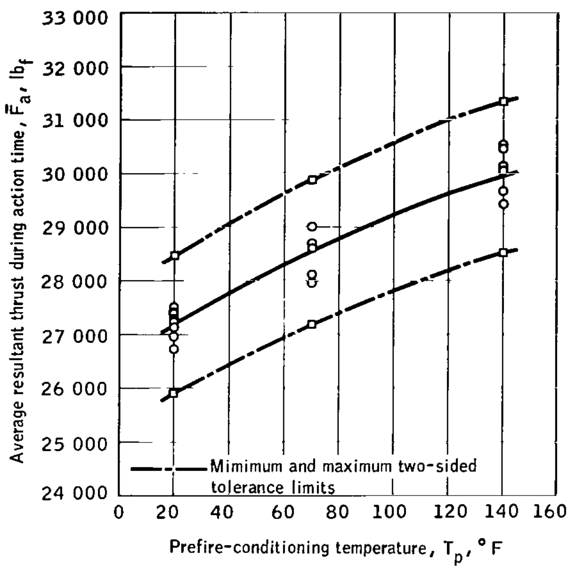


(d) Chamber pressure integral during total time.

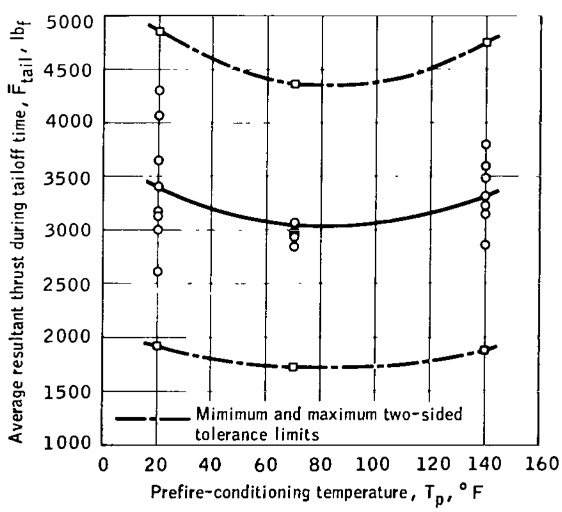
Figure 13. - Variation of motor chamber-pressure-integral characteristics as a function of prefire-conditioning temperature.



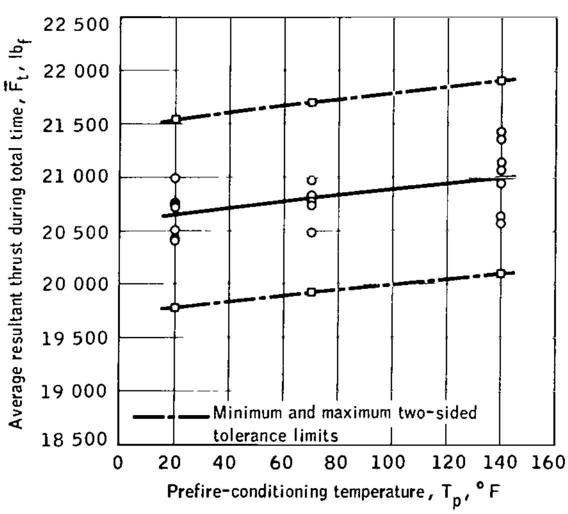
(a) Average resultant thrust during web burn time.



(b) Average resultant thrust during action time.

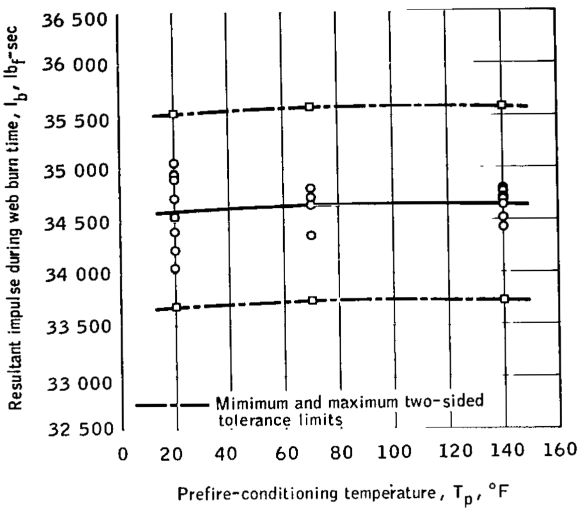


(c) Average resultant thrust during tailoff time.

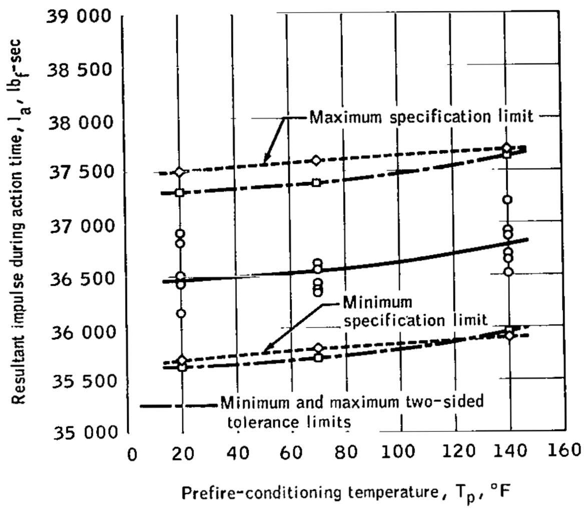


(d) Average resultant thrust during total time.

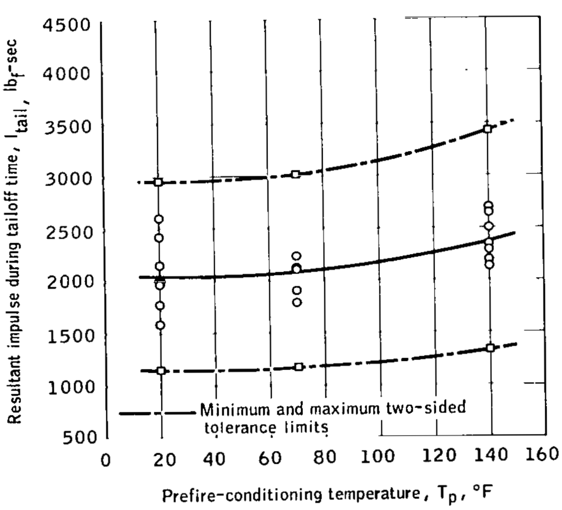
Figure 14. - Variation of motor average-resultant-thrust characteristics as a function of prefire-conditioning temperature.



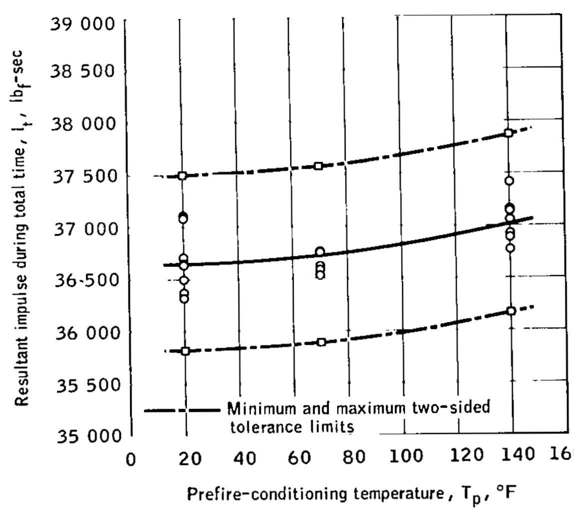
(a) Resultant impulse during web burn time.



(b) Resultant impulse during action time.

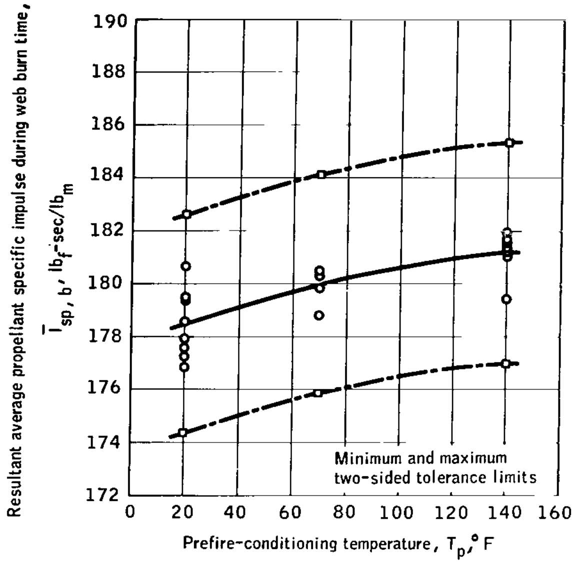


(c) Resultant impulse during tailoff time.

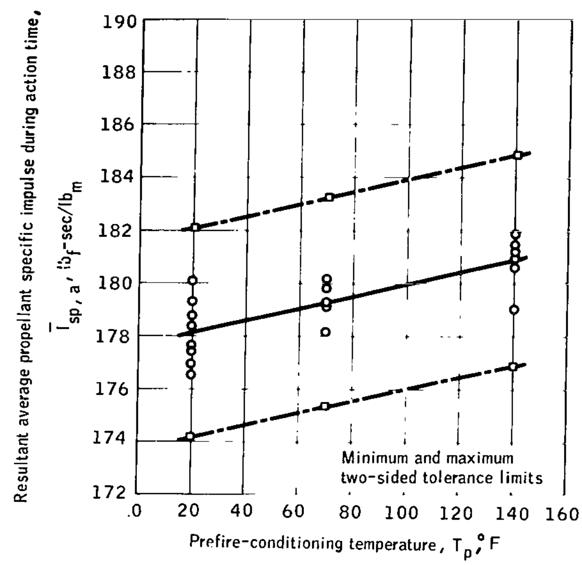


(d) Resultant impulse during total time.

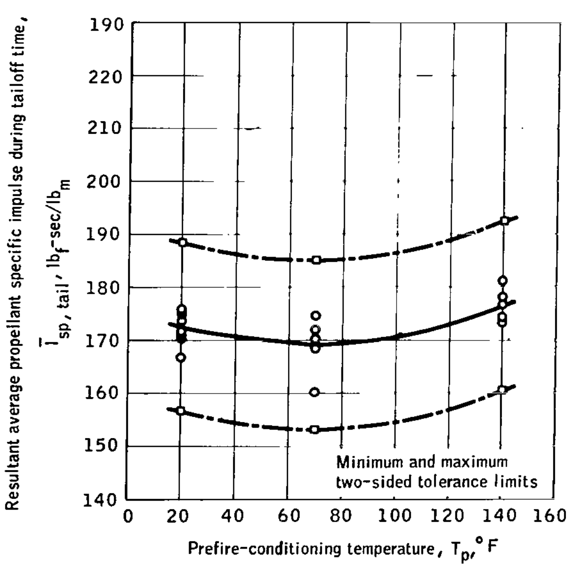
Figure 15. - Variation of motor resultant-impulse characteristics as a function of prefire-conditioning temperature.



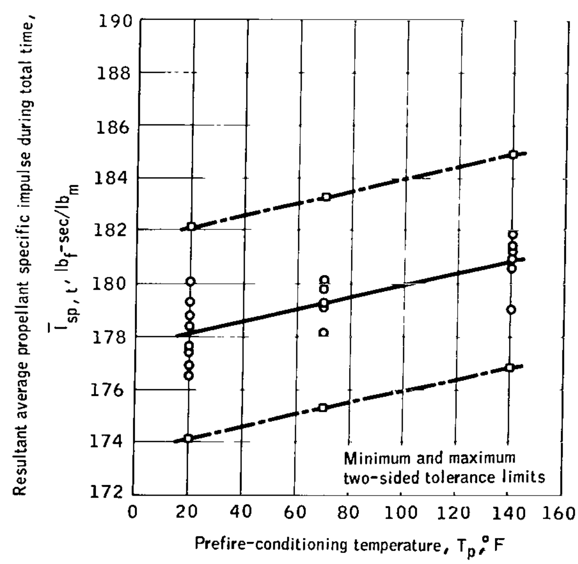
(a) Resultant average propellant specific impulse during web burn time.



(b) Resultant average propellant specific impulse during action time.



(c) Resultant average propellant specific impulse during tailoff time.



(d) Resultant average propellant specific impulse during total time.

Figure 16. - Variation of motor resultant-average-propellant-specific-impulse characteristics as a function of prefire-conditioning temperature.

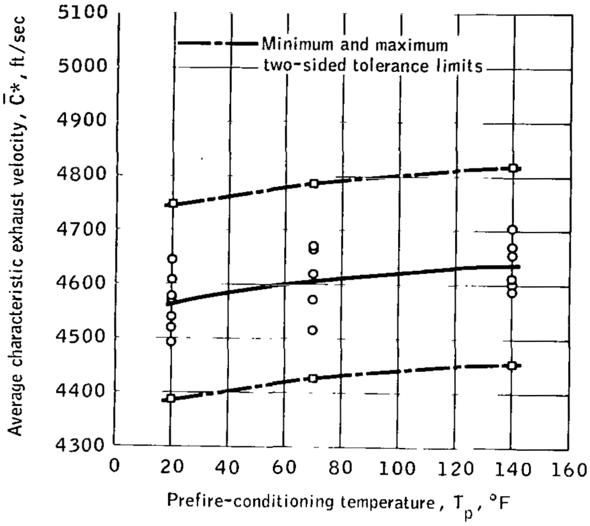


Figure 17. - Variation of motor average characteristic exhaust velocity as a function of prefire-conditioning temperature.

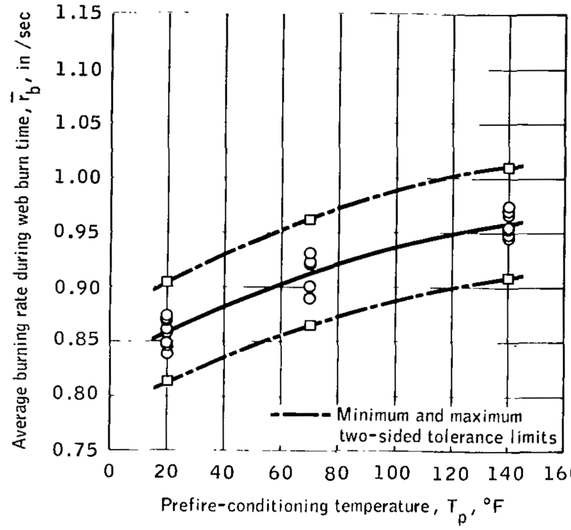


Figure 18. - Variation of motor average burning rate during web burn time as a function of prefire-conditioning temperature.

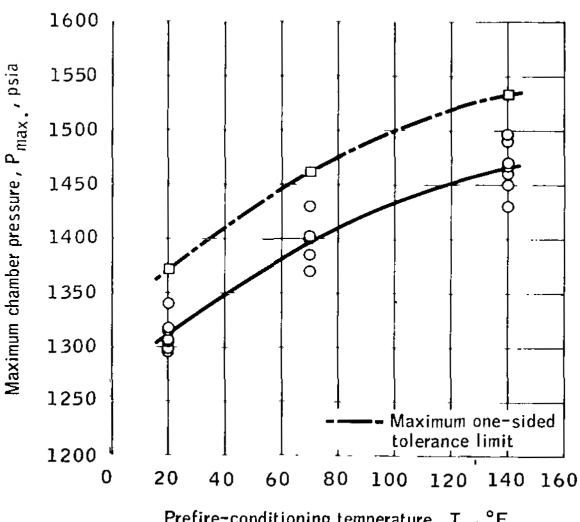


Figure 19. - Variation of motor maximum chamber pressure as a function of prefire-conditioning temperature.

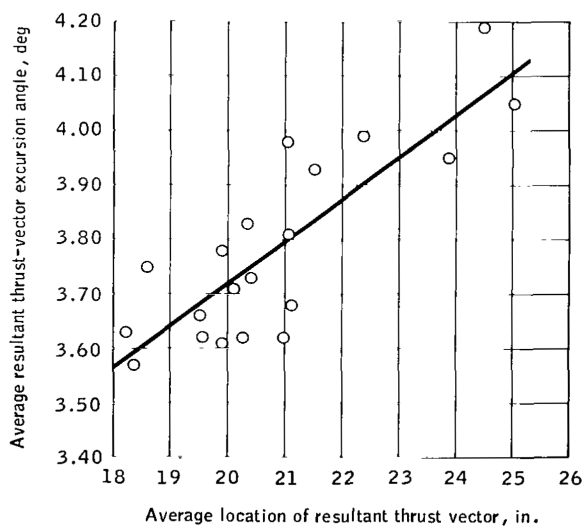
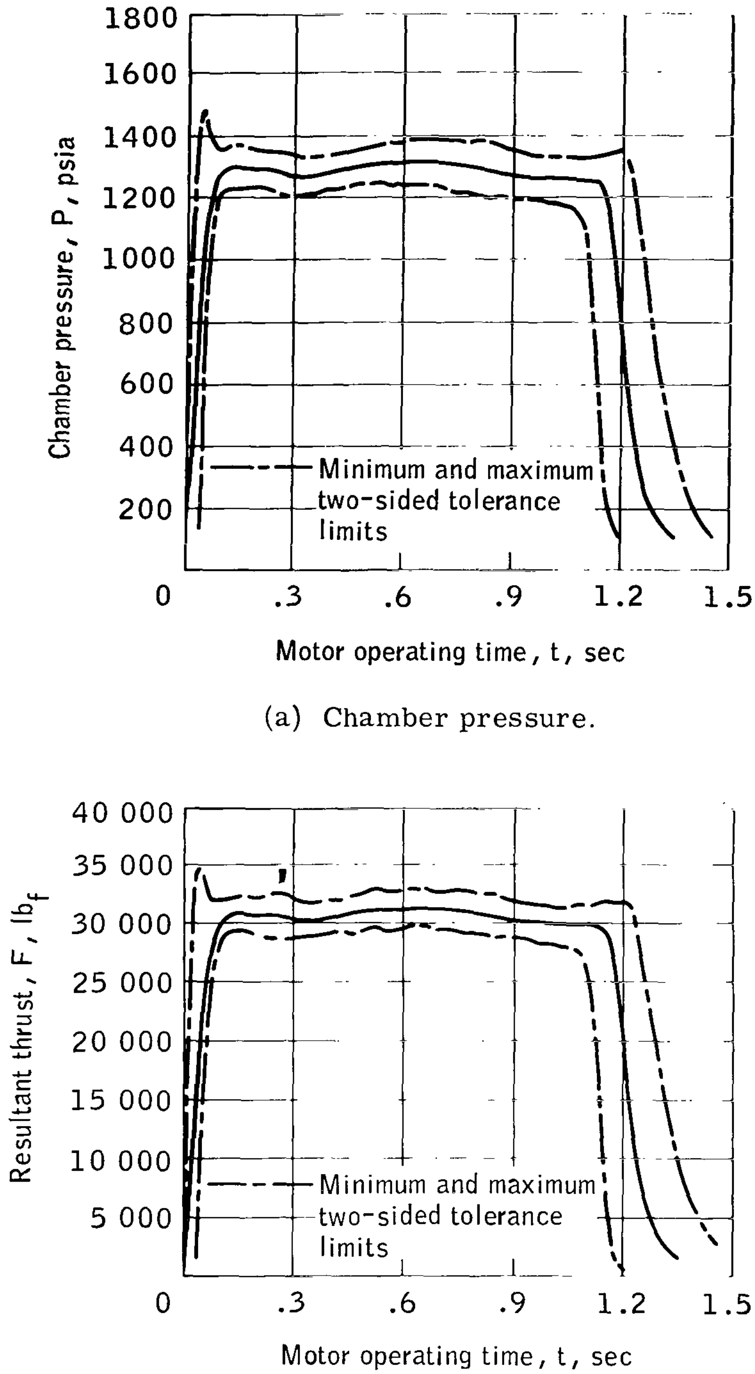


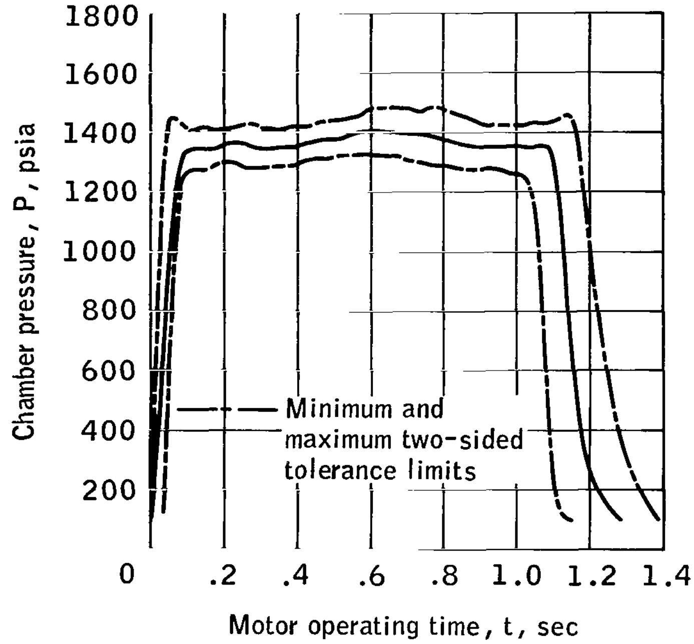
Figure 20. - Variation of motor average resultant thrust-vector excursion angle as a function of motor average location of resultant thrust vector.



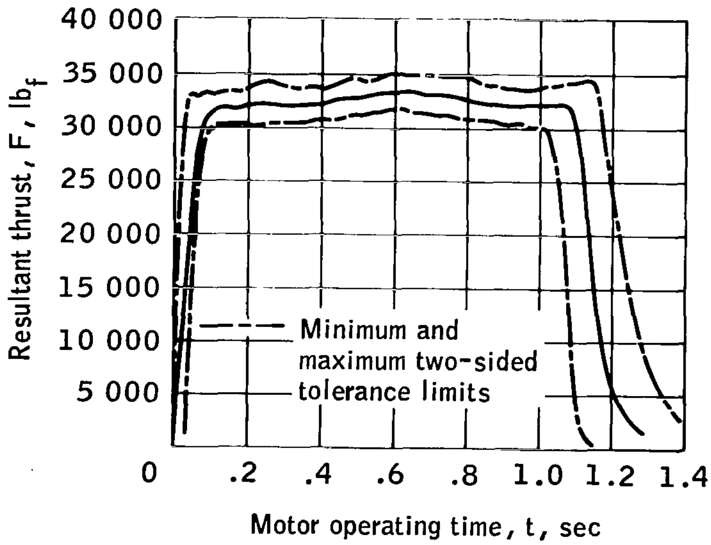
(a) Chamber pressure.

(b) Resultant thrust.

Figure 21. - Nominal motor performance as a function of operating time and the calculated statistical limits (two-sided tolerance limits) at 20° F.

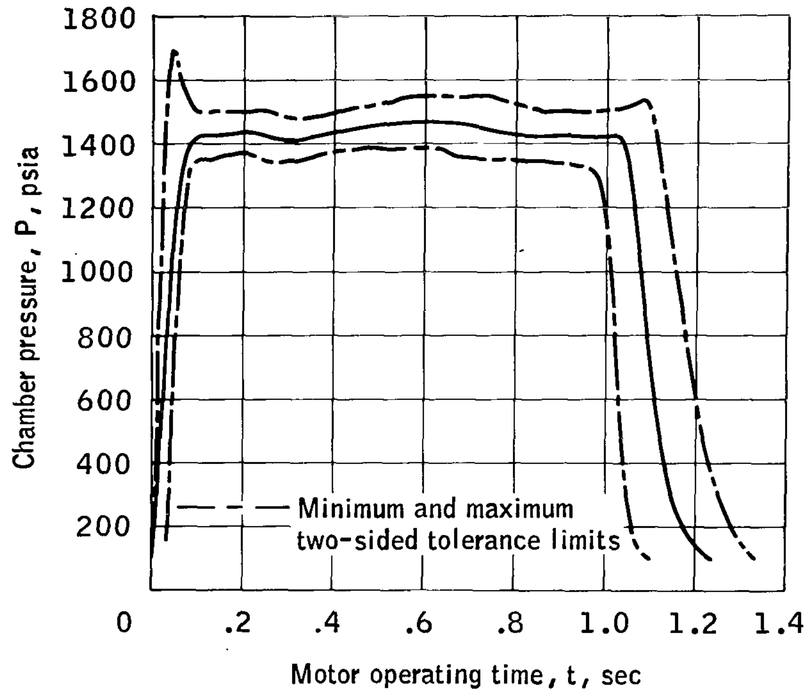


(a) Chamber pressure.

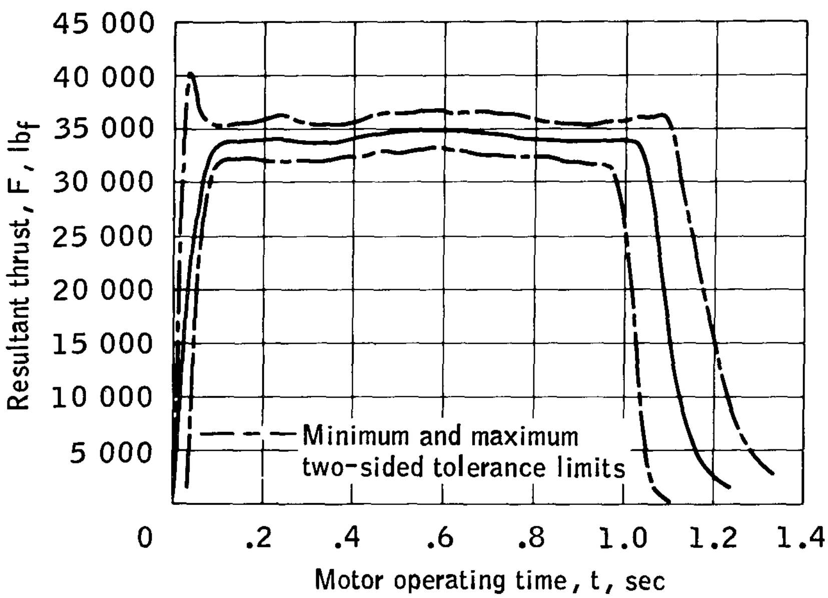


(b) Resultant thrust.

Figure 22. - Nominal motor performance as a function of operating time and the calculated statistical limits (two-sided tolerance limits) at 70° F.

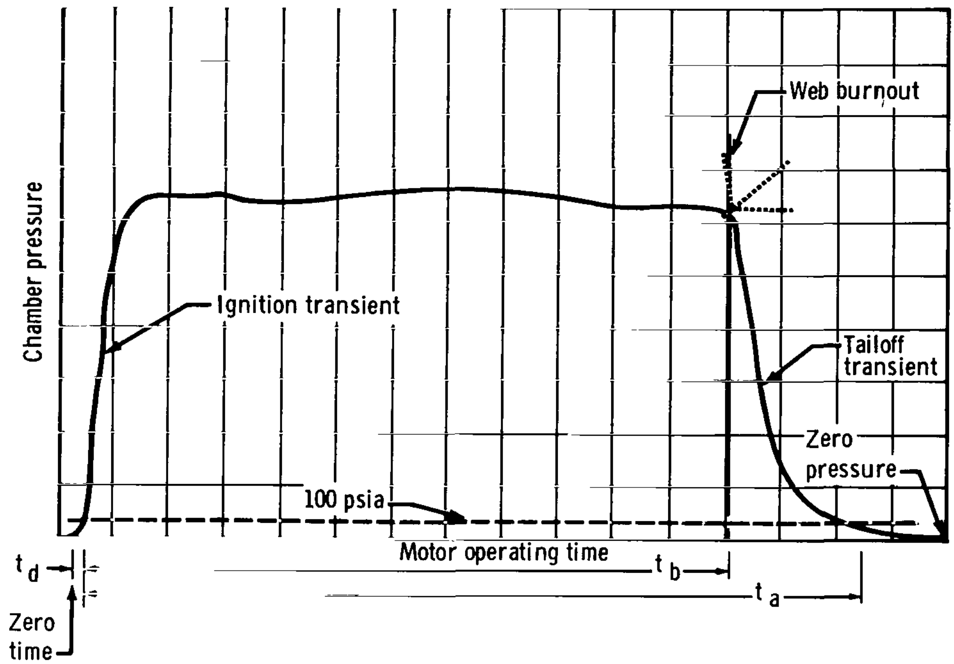


(a) Chamber pressure.

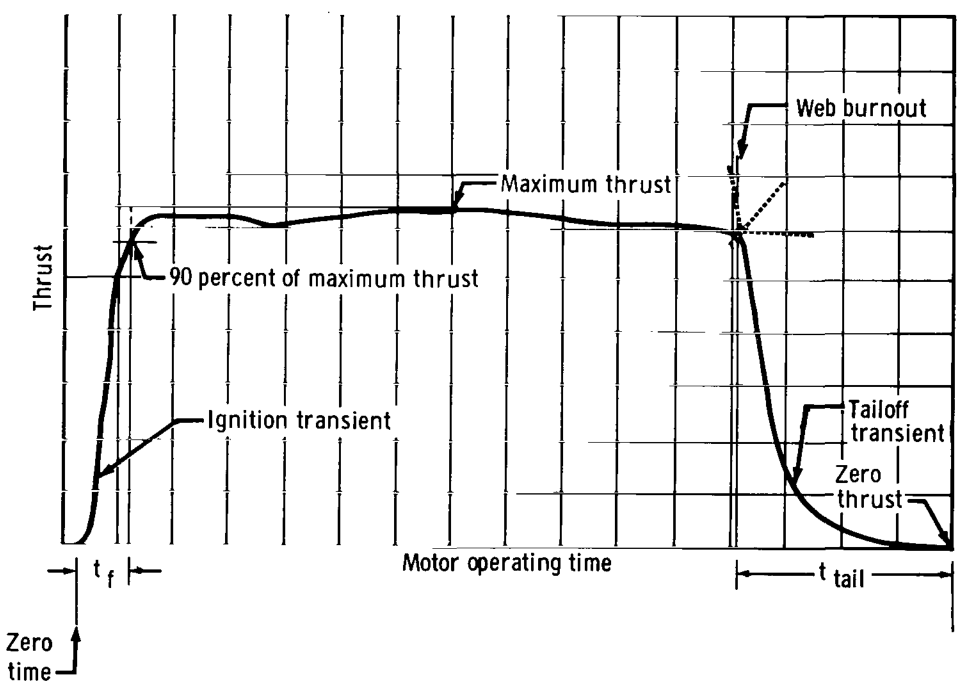


(b) Resultant thrust.

Figure 23. - Nominal motor performance as a function of operating time and the calculated statistical limits (two-sided tolerance limits) at 140° F.



(a) Based on chamber pressure.



(b) Based on thrust.

Figure 24. - Time characteristics definition.

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