SOUTHWEST RESEARCH INSTITUTE

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Department of Applied Electromagnetics

DOCUMENT NO. OMH-2

OPERATING, MAINTENANCE AND HANDLING PROCEDURES

FOR THE

M172 BODY MASS MEASUREMENT DEVICE

FLIGHT HARDWARE

PRELIMINARY - NASA APPROVAL PENDING

3.0 DESCRIPTION OF BODY MASS MEASUREMENT DEVICE

3.1 General Information

3.1.1 Description of Structure and Configuration

The general features of the body mass measurement device (BMMD) are illustrated in the figure (Figure 3.1.1-1). This is a view as seen from the side of the device, with the measurement seat and backrest clearly evident. Additional views of the BMMD are seen in Figures 3.1.1-2 and 3.1.1-3.

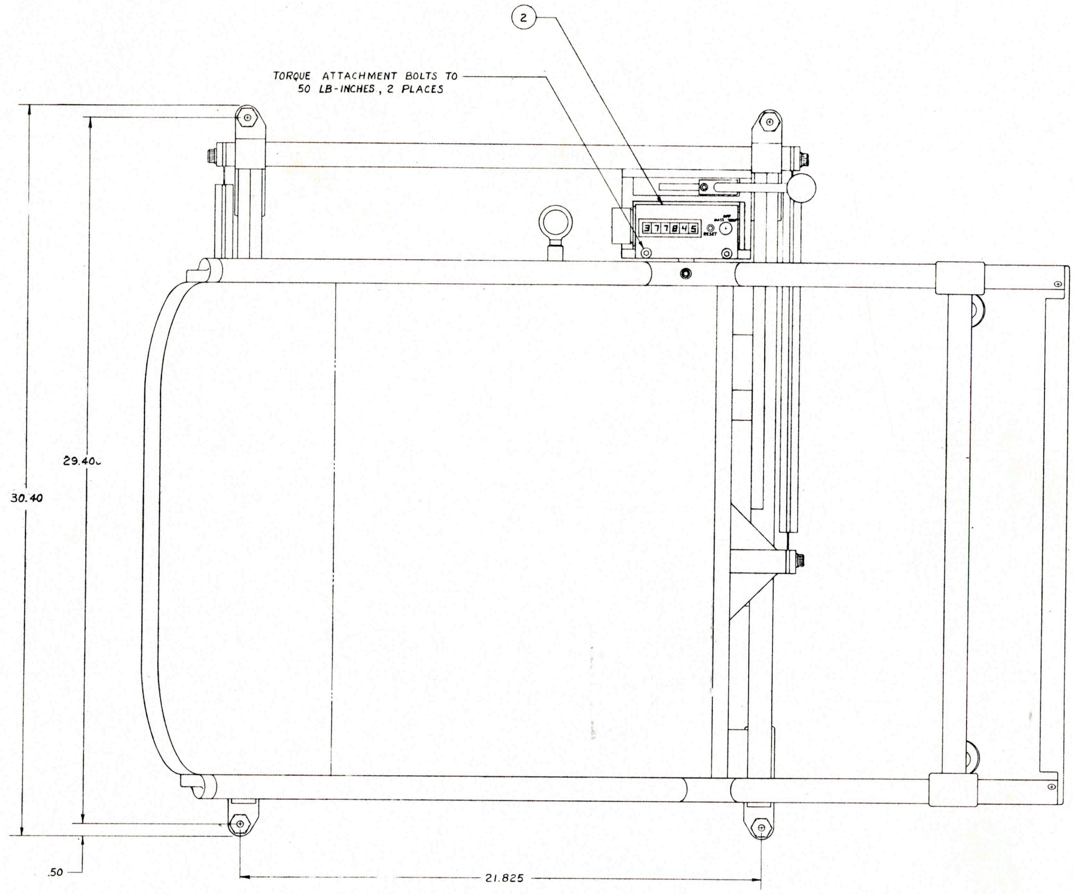
The body mass measurement device comprises a mechanical subsystem and an electronics subsystem. This device is completely self-contained, with the exception of requiring a DC-power source (nominal 28 volt) and a plane stable supporting surface. Immediately adjacent to the seat is the display face of the electronics subsystem.

To operate the device, the subject to be measured lowers himself into the seat, adjusts foot-rest handlebar position if necessary, and fastens the body restraint straps. The "mass/off/temp" switch of the electronics subsystem is put in the "mass" position, and the digital display is cleared by actuating the reset switch. A control lever is then pushed forward to unlock the seat. The subject tenses his muscles, holds his breath (breath will be held for about ten seconds) then releases a sear and the seat begins to oscillate.

An electro-optical transducer sends a signal to the device's logic circuit each time the seat crosses the equivalent midpoint in its oscillating cycle. After two cycles have been completed, the total elapsed time for the next three cycles, in tens of microseconds, appears on the device's digital display. The device is shut down by actuating the control lever, which moves the seat to the offset position, latches the sear, and finally locks the seat. The period reading, shown on the digital display, is recorded. The "mass/off/temp" switch is put in the "temp" position, the reset switch is actuated, and the temperature, shown on the digital display, is recorded. The electronics is then de-energized. The recorded readings (i.e. temperature and time period of oscillation) are used to obtain mass values by reference to a calibration curve, conversion chart, or equation.

3.1.2 Size

The unit is designed to fit all flight crew (crew member) personnel. Foot-rest handlebar (i.e., the crossbar) is adjustable.



VIEW B-B

FIGURE 3.1.1-2

BODY MASS MEASUREMENT DEVICE
TOP VIEW

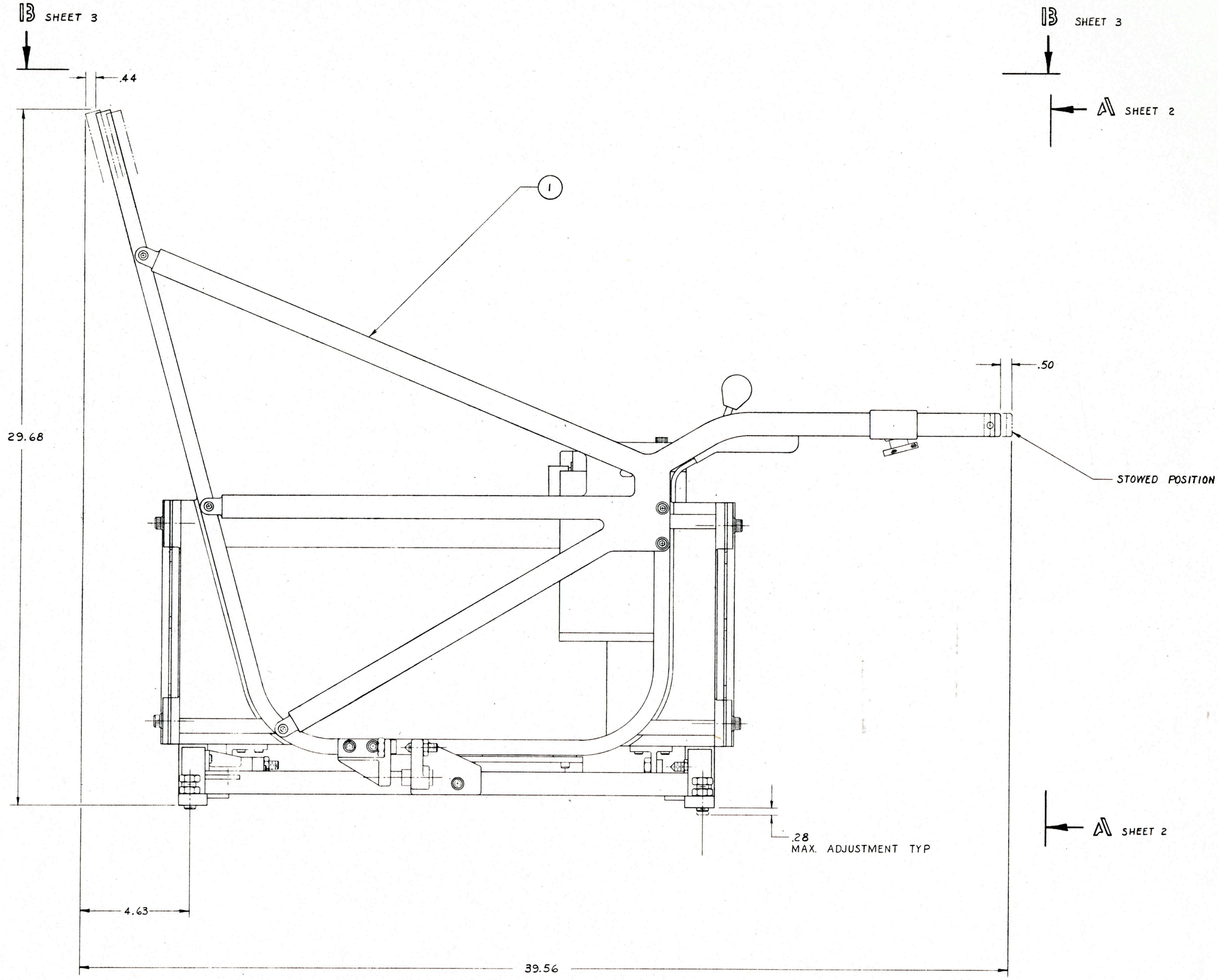
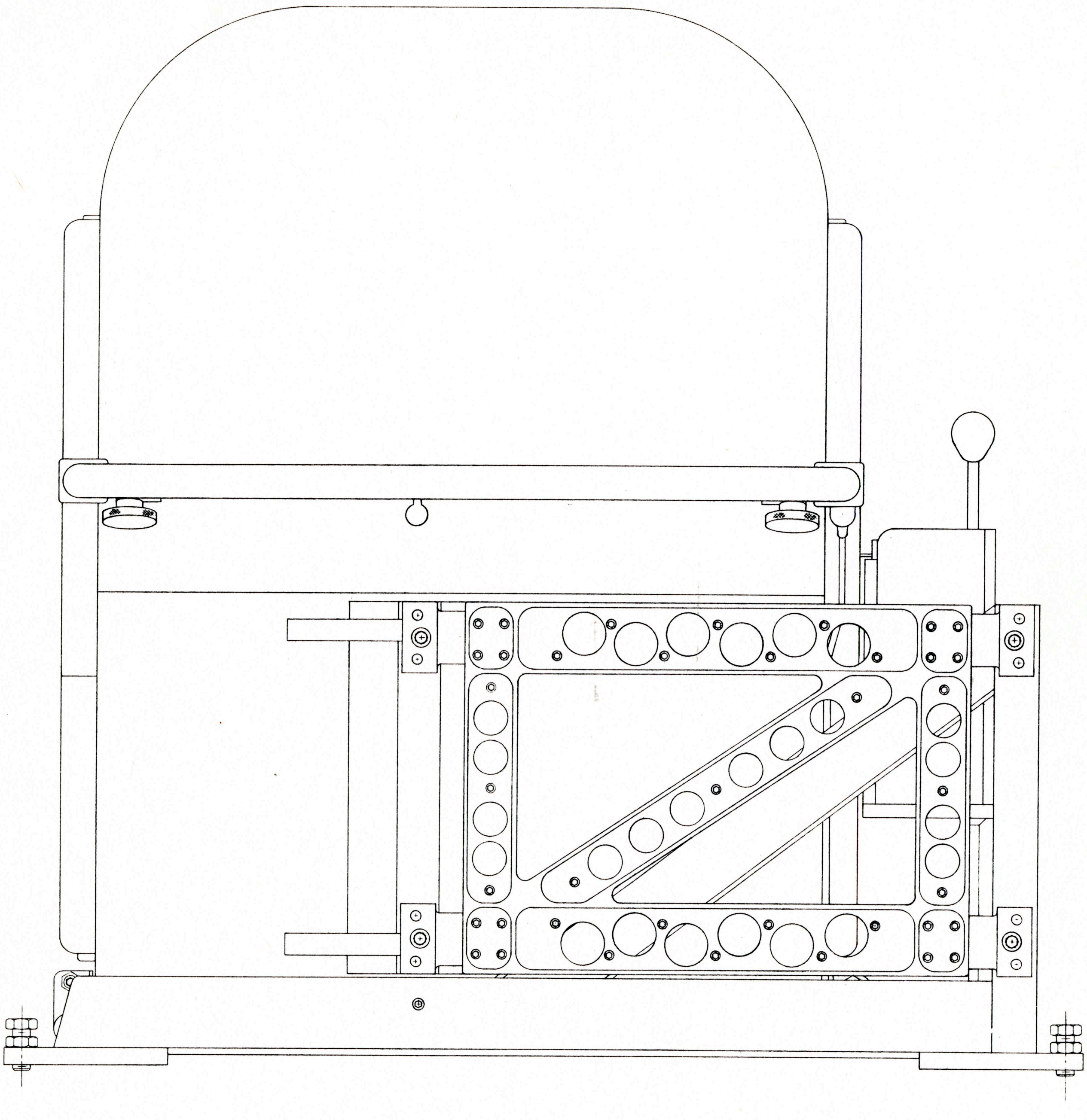


FIGURE 3.1.1-3

BODY MASS MEASUREMENT DEVICE
SIDE VIEW



VIEW A-A

FIGURE 3.1.1-4

BODY MASS MEASUREMENT DEVICE
END VIEW

The envelope of the device is 30.50 inches x 38.75 inches x 31.25 inches high; and occupies a volume of approximately 19 cubic feet.

Weight of the device is approximately 75 pounds.

3.1.3 Mass Measurements

Body mass of personnel up to 100 kg may be determined in either one "g" or zero "g" environment.

3.1.4 Principle of the Device

The functional principle of the BMMD is the periodic motion of a vibratory or oscillatory spring-mass system. The human subject, seat, and spring supporting components together form a leaf-spring type of system which in normal operation results in a simple harmonic oscillator. As an oscillator, it is able to oscillate at a frequency of motion (a number of oscillations or vibrations per unit of time) which obeys a mathematical relationship to the mass of the oscillating body. Knowing the frequency of oscillation, one can calculate the mass of the oscillating body.

In actual practice the electronics subsystem detects and displays the time period of oscillation (reciprocal of the frequency of oscillation). This time period of oscillation for the BMMD which is actually measured and displayed is the total elapsed time for the third through the fifth cycles after the beginning of oscillation. It is this total time period which is used in the formula for calculating the mass of the subject.

3.1.5 Interfaces

Electrical interface in the BMMD is the power supply to the electronics subsystem. This cable and connector are located at the mounting position of the BMMD Electrical ICD 40M35644 is applicable.

There are no mechanical interfaces with other experiments. Mechanical ICD 13M12101 defines mounting requirements.

3.2 Subsystems

3.2.1 Schematics

The schematic diagram of the mechanical subsystem is shown in Figure 3.2.1-1.

The block diagram of the electronics subsystem is shown in Figure 3.2.1-2.

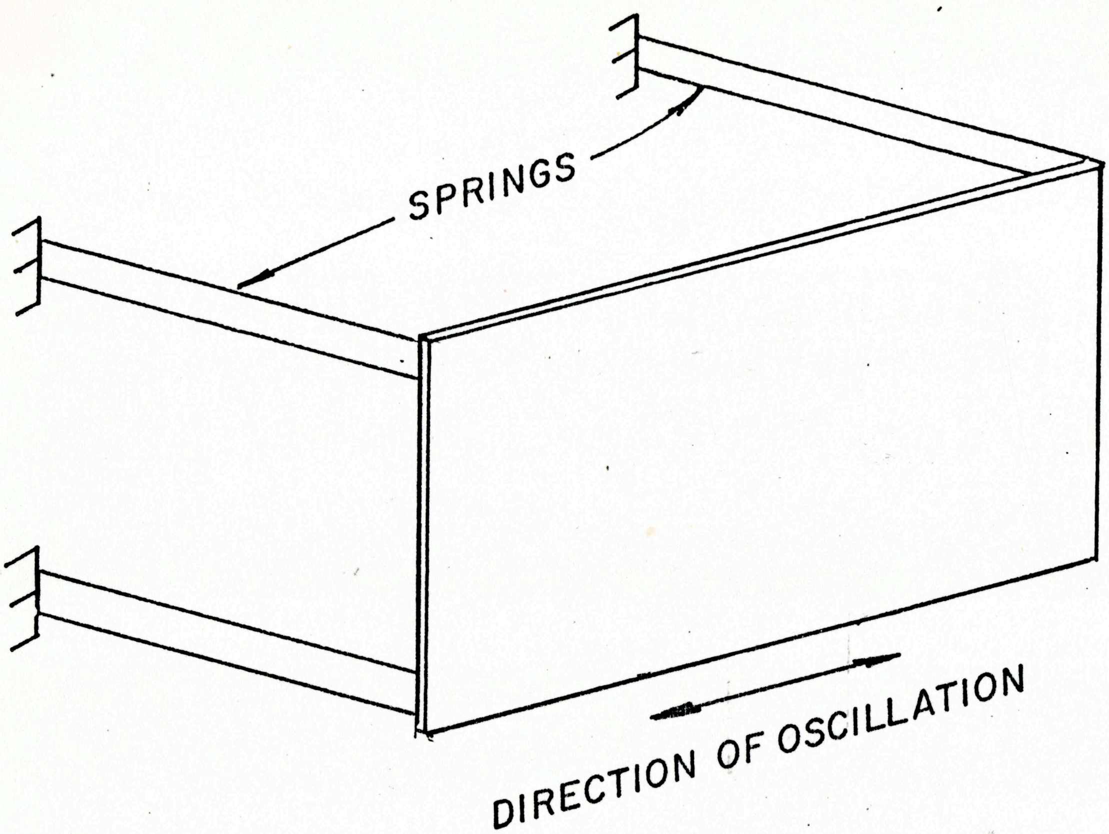


FIGURE 3.2.1-1

Mechanical Subsystem Block Diagram

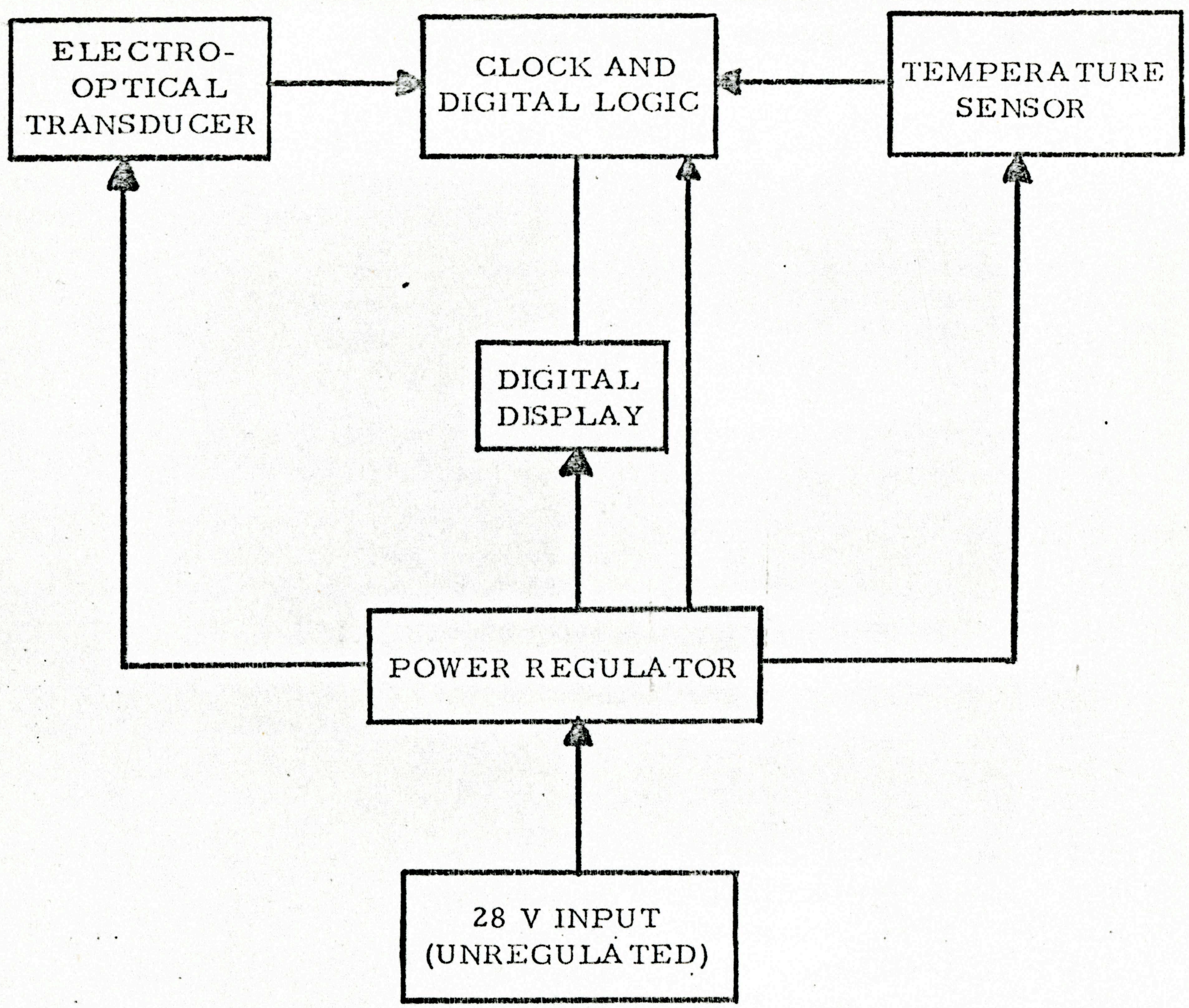


FIGURE 3.2.1-2- ELECTRONICS SUBSYSTEM BLOCK DIAGRAM

3.2.2 Description of Mechanical Subsystem

The subsystem drawing (SwRI drawing number 2837-100-01) illustrates the features of the mechanical subsystem of the body mass measurement device.

The main components of the mechanical subsystem are the frame, springs, seat, seat lock, restraint system, and sear mechanism.

The frame forms the structure of the device, and the seat is suspended from the frame by means of springs. When the device is not in use, the seat is locked to the frame by the seat lock. Protection to the springs is provided in the locked configuration because the mass of the seat is no longer suspended on the springs, therefore forces accidentally applied to the seat are not transmitted to the springs.

The springs are plate-fulcra type, and consist of a pair of identical flat plates, one at each side of the frame. One end of each spring is rigidly attached to the seat, one at the front and the other at the rear. This arrangement suspends the seat from the frame on the springs, and allows relative motion between the seat and frame during the measurement cycle.

The restraint system consists of body restraint straps which couple the seat and the subject whose mass is to be measured. After the subject lowers himself into the seat, these restraint straps are fastened around his body and attached to the seat. This couples the subject to the seat, preventing relative motion during the measurement cycle.

The sear mechanism serves to hold the seat an exact distance from its neutral position, in preparation for the measurement cycle. In this position the springs are also offset. In operation, a control lever is first used to unlock the seat. When the subject is ready for mass measurement, he releases the sear, and the restoring force of the springs causes the seat to oscillate. After the mass measurement is completed, the control lever is actuated in the reverse direction. This moves the seat and springs to the offset position, latches the sear, and locks the seat.

3.2.3 Description of Electronics Subsystem

The electronics subsystem (SwRI drawing number 2837-700-01) consists of five separate functional components. These components are the power regulator, the temperature sensor, the electro-optical transducer, the clock and digital logic, and the digital display. Figure 3.2.1-2 is a block diagram of the electronics subsystem.

The five components are encapsulated into a single module. The SMMD and BMMD electronics subsystems are identical. Following is a brief description of each component:

a. Power Regulator

Voltage regulation of the spacecraft-supplied power is accomplished by a "switching" regulator, which provides maximum efficiency in voltage regulation. Pulse current is supplied to a storage element as required to maintain the desired +5 volts DC output. A balanced filter is incorporated in the input section to reduce conducted EMI on the input lines and to provide protection against transients from the spacecraft source.

The power regulator supplies power necessary to operate the electronics subsystem and derives its power from the unregulated power supply of the spacecraft.

b. Electro-Optical Transducer

The electro-optical transducer component senses the passage of the specimen tray or seat through its equilibrium position. The first two periods of oscillation are ignored by the logic circuitry in order to allow any transients produced by the release mechanism to dissipate. The beginning of the third period signals a start count to the clock and digital logic component, and the beginning of the sixth period signals a stop count to the clock and digital logic component.

The optical source consists of a solid state light emitting diode in the 900 nanometer wavelength range, while the sensor consists of a solid state photosensitive device. The electro-optical transducer operates on power furnished by the power regulator.

c. Temperature Sensor

The temperature is sensed by a thermistor probe. The probe determines the "on time" of an integrated monostable multi-vibrator, which in turn controls the input to the clock and digital logic component. Temperature is displayed to the nearest degree by two of the six digits in the digital display. Accuracy is ± 1 °F between 65 °F and 80 °F. The temperature is displayed continuously when the function switch is in the "temp" position and may be updated by depressing the "Reset" switch. The temperature sensor operates on power furnished by the power regulator.

d. Clock and Digital Logic

The clock and digital logic component consists of a 1 MHz oscillator, seven integrated circuit up/down decade counters, and six BCD to 7-bar converters. The control logic necessary to perform the functions for mass and temperature measurements is also contained in the clock and digital logic component.

When measuring mass, the counter will "count up", and the period of 3 oscillations is displayed on the digital display component.

As the thermistor has a negative temperature coefficient, the counter will "count down" from a pre-set number when measuring temperature, and the temperature can be read directly from the digital display.

The clock and digital logic component operates on power furnished by the power regulator.

e. Digital Display

The digital display component is composed of six 7-bar light emitting diode numerical displays. The signals processed by the clock and digital logic component are displayed in digital form by the digital display component.

The digital display component operates on power provided by the power regulator.

3.2.4 Limitations and Restrictions

The environment of the BMMD after acceptance testing must be maintained at all times equal to Class 100,000 or better clean room conditions as described in FED-STD-209. Other environmental limitations are listed in Tables 3.2.4-1 and 3.2.4-2.

The BMMD is designed to measure the mass of persons ranging up to 100 kg in a one "g" environment and in a zero "g" environment. Measurement of masses greater than the stated upper limit may damage the plate-fulcra springs and render the device inoperable.

Accuracy of all measurements of body mass is diminished by respiratory or by other bodily movements during the actual measurement period.

In a one "g" environment, the device must be set up on a fixture to allow careful leveling so as to minimize the effect of gravity.

Mounting of the units must be accomplished and maintained at a condition of sufficient rigidity that the accuracy of the unit during operation will not be degraded.

Air motion in the vicinity of BMMD during operation will degrade the accuracy of the measurements in proportion to the velocity of the air (i.e., environmental atmosphere) currents.

The BMMD shall not be operated during spacecraft acceleration maneuvers. Results would be possible degradation of accuracy of the measurements, alteration of calibration due to minor damage, or possibly damage to the plate-fulcra springs.

Decompression rate shall be limited to TBD.

Required power supply during operation is a nominal 28^{+2}_{-4} VDC.

Under Voltage - Voltage shall not go below the lower limits of the steady state voltage of 28^{+2}_{-4} volts by more than 3.0 volts, and shall return to the steady state voltage within one second.

Over Voltage - Voltage shall not exceed the upper limits of the steady state voltage of 28^{+2}_{-4} volts by more than 3.0 volts, and shall return to the steady state voltage within one second.

Transients - Voltage transients at the Experiment/OWS interface from the Experiment or from the OWS, shall not exceed $\pm$ 50 volts peak and 10 microseconds duration.

Physical contact by the human subject against the stationary parts of the unit must be absolutely prevented during the times of free oscillation of the seat; i.e., when taking body mass measurement. Decay of oscillation at that moment would induce error in the time period determination on the electronics subsystem.

CAUTION - The device must not be dropped or otherwise subjected to shock or impact at any time.

3.3 Controls and Displays

3.3.1 <u>Illuminated Digital Readout Display</u>

3.3.1.1 Function - To alternatively display temperature and/or time period of oscillation.

Temperature: The two digits on the furthermost right-hand end of the readout display temperature in degrees Fahrenheit to the nearest whole degree without fractions of a degree.

Time period of oscillation: All six digits of the readout display time in seconds with the decimal place implied but not shown following the first digit from the left.

3.3.1.2 Operational Mode - The display is operational at all times when power is on, and after reset.

3.3.2 <u>Mass/Off/Temp</u>

3.3.2.1 Function - Electrical power contact to the BMMD electronics subsystem.

3.3.2.2 Operational Mode - Mass-Switch placed to Mass position for display of time period of oscillation.

3.3.2.3 Operational Mode - Temp-Switch placed to Temp position for display of temperature of the device.

3.3.3 <u>Control Lever</u>

3.3.3.1 Function -

(1) To lock the seat and thus stop all free oscillation except during the actual measurement of a time period of oscillation.

(2) To offset the seat and cock the sear.

(3) To release the seat for free oscillation for the actual measurement of a time period of oscillation.

3.3.3.2 Locked Mode - Position of the control lever is backward toward the seated crew member.

3.3.3.3 Operational Mode - Position of the control lever is forward away from the seat and toward the feet of the seated crew member.

3.3.4 <u>Reset Switch</u>

3.3.4.1 Function - To clear the illuminated digital readout display preparatory to making a new measurement of either temperature or time period of oscillation.

3.3.4.2 Operational Mode - Manually actuated and released for reset.

3.3.5 <u>Sear</u>

3.3.5.1 Function - To release the spring-seat-crew member mass system to initiate free oscillation.

3.3.5.2 Operational Mode - Thumb Seat Release - Manually pressed by right thumb while both hands are firmly gripped onto cross-bar. This is a 5/8 inch diameter thumb lever located on the underneath side of the adjustable cross-bar in position for actuation by the right thumb.

3.3.5.3 Operational Mode - Ring Frame Release - Manually pulled horizontally as an auxiliary sear release for use in calibration procedures. The ring is 1 inch inside diameter and is located on the frame, left side, adjacent to the Adjusting Screw Bracket.

4.0 PROCEDURES FOR MASS MEASUREMENT AND CALIBRATION

After launch and stable orbit is achieved in zero "g" environment (and at other set-up times as contingenices may necessitate) the BMMD is placed into service by removal of the lockout bolts and by adjustment of the mounting feet.

Removal of the lockout bolts. The presence of these bolts, size 3/8-24 UNF, length TBD, locks the seat to preclude oscillation or other movement of the seat relative to the frame. The bolt fits through a hole on the lower side of the Adjusting Screw Bracket (on the frame, one on each side of the BMMD) and threads into the Lockout Socket Bracket (on the seat, one on each side of the BMMD). Use TBD type wrench, size TBD).

Adjustment of the mounting feet. The hold-down bolts and adjusting screws on the two front feet of the BMMD require adjustment after zero "g" environment is achieved, in order to remove possible bending strain from the frame of the device. The head of the hold-down bolt is uppermost; below the bolt head and its washer is the adjusting screw; below the adjusting screw is the jam nut.

Open-end wrench sizes for these items are:

(a) Hold-down bolt: TBD
(b) Adjusting screw: TBD
(c) Jam nut: TBD

Proceed as follows:

(1) Loosen the hold-down bolts and the jam nuts on the two front feet.

(2) On left front foot, retract adjusting screw (turn counter clockwise) approximately 1/8 inch (3 turns).

(3) On right front foot, retract adjusting screw (turning counter clockwise) approximately 2 turns or until adjusting screw loses contact with the sleeve in the floor, whichever occurs first. Tighten the adjusting screw just sufficiently to maintain contact upon the face of the sleeve in the floor; then tighten the jam nut; then tighten the hold-down bolt.

(4) On the left front foot, tighten the adjusting screw until it regains contact upon the face of the sleeve in the floor.

(CAUTION: Do not advance the adjusting screw beyond the point of initial contact with the sleeve, because that would introduce a bending strain into the frame of the BMMD.)

The purpose of the foregoing adjustments is to remove residual bending strain from the device, which might be transmitted from deflection of the structural floor/deck of the OWS.

4.1 Procedure for Mass Measurement

The instrument measures mass by timing the period of oscillation of a spring-mounted seat with the crew member or calibration masses in it. The timed period is converted to a mass measurement through the use of a simple formula.

4.1.1 Precautions

(a) Do not enter the seat unless control lever is in locked mode.

(b) The plate-fulcra springs which support the seat and provide for its oscillation should be protected from damage from bending, scratching or banging.

(c) Do not attach calibrating masses or calibrating mass adapters, or remove them, without first locking the seat with the control lever. Otherwise, the plate-fulcra springs may be damaged.

(d) When the device is not in use, place power switch in Off position and control lever in locked mode.

(e) The BMMD must not be operated during vehicular acceleration, or during vehicular rotation greater than TBD revolutions per minute.

(f) Prior to making any mass measurements, the device must be properly installed in place. For measurements in zero "g" the device will have been previously installed in the OWS. For measurements in one "g" the device must have been previously installed on the leveling fixture, Ground Support Equipment. See Section 5.6 Installation.

4.1.2 Body Mass Measurement Procedural Checklist

- 1 Verify that control lever is in locked mode (See 3.3.3.2).

-2 Crew member removes all loose gear from his pockets.

-3 Crew member enters seat and slides forward until buttocks are firmly against front panel. Knees will be flexed toward the chest. Put feet on adjustable cross-bar, against outboard portion. The adjustable cross-bar must be as far backward (proximal to the seat) as the crew member can comfortably accept. (See Section 4.1.2.2 for cross-bar adjustment procedure if necessary).

-4 Apply restraint straps.

-5 Place the Mass/Off/Temp switch in Mass position.

-6 Actuate the reset switch.

-7 Put arms inside the knees with hands against the feet and grasping the adjustable cross-bar. Thus the legs will be braced against the frame of the device and the arms will be braced against the medial aspect of the legs. The stationary cross-bar is not intended for use by the crew member.

-8 Move (push) control lever <u>forward</u> to operational mode (see 3.3.3.3) with left hand. Replace hand on cross-bar.

-9 Breathe deeply three times, holding breath after third inhalation. Remain still. Brace arms against legs against tubular side structure. Brace back of head firmly in contact with head rest. Release the sear with the thumb seat release under the right thumb, without moving hand.

-10 Maintain position for 10 seconds, then release breath and relax muscles.

-11 Stop/lock the seat by pulling control lever <u>backward</u> to locked mode.

-12 Record the readout of the digital display. Record also ground elapsed time and crew member designation as required.

-13 Repeat steps 6 through 12 for four additional measurement sequences.

-14 Compare the readings for repeatability. The span of 4 out of 5 readings should be less than 100 counts (i.e., only occasionally will a variation be seen in the 4th digit).

For example: 632451
632539
632482
632492
632429

Note this series exhibits acceptable repeatability in 4 out of 5 readings. The second and last reading exhibit a difference of 110. All other readings are within 100 counts of either the high or low reading.

If sufficient repeatability of readings was not obtained, repeat the series of measurements. In the event that repeatability still cannot be obtained, follow the Repeatability Check Procedure, Section 4.1.2.1.

-15 Place Mass/Off/Temp switch in Temp position.

-16 Actuate the reset switch.

-17 Record temperature of digital display.

-18 Place Mass/Off/Temp switch in Off position.

-19 Verify control lever is in locked mode.

-20 Release restraint straps and leave the seat, re-latching the restraint straps for stowage.

-21 For final determinations of masses, refer to calibration curves and temperature corrections.

-22 During in-flight use, the two lockout bolts need not be replaced. Seat can be locked with the control lever only.

CAUTION - Do not attempt to leave the seat or move the body (except to operate control lever) until the control lever is in locked mode.

4.1.2.1 Repeatability Check Procedure

This procedure is applicable only if acceptable repeatability of readings was not achieved in Sept 14 of Section 4.1.2.

(1) Emerge from the seat and fasten the restraint straps.

(2) Check repeatability of readings with empty seat. If readings repeat, crew member may not have been firmly braced in the seat, or minor head or respiratory motions, etc., may have occurred. Enter seat and repeat the mass measurement procedure.

(3) If empty seat does not produce repeatable readings, examine the device for mechanical interference of oscillating parts; the necessity of electro-optical transducer (zero crossover) adjustment (see Section 4.3.1), or for possible damage to the device. (See Section 4.3 Contingency Procedures).

4.1.2.2 Cross-bar Adjustment Procedure

The adjustable cross-bar must be situated as far backward toward the seat as each individual crew member can accept it, compatible with slight discomfort. The operating position may be different for each crew member. Adjustment procedure is:

(1) Knurled finger adjustment knob is located on the underneath side of the adjustable cross-bar, one on each end. Turn counter-clockwise to loosen the knurled knobs.

(2) Using both hands, manually press together to disengage the corresponding plugs from the sockets in the tubular members.

(3) Re-locate the cross-bar at a desired position to receive the engaging plugs.

(4) Forcibly press the engaging plugs outward to engage in holes in the sockets.

(5) Tighten both of the knurled knobs.

When the device is not in use, place switch in Off position and control lever in locked mode.

4.1.3 Temperature Corrections

A temperature correction must be made on any period reading given in this manual and on any period reading taken with the device unless the device temperature is 72°F.

Device Serial No. TBD has a TBD temperature coefficient, that is, the period TBD as temperature increases. Device Serial No. TBD has a positive temperature coefficient, that is, the period TBD as temperature increases.

Temperature correction procedure for device Serial No. TBD is as follows:

(a) To correct a reading in the manual, add TBD to the reading for each degree of temperature lower than 72°, or subtract TBD from the reading for each degree of temperature higher than 72°.

(b) To correct a reading on the device, subtract TBD from the reading for each degree of temperature lower than 72°, or add TBD to the reading for each degree of temperature higher than 72°.

Temperature correction procedure for device Serial No. TBD is as follows:

(a) To correct a reading in the manual, subtract TBD from the reading for each degree of temperature lower than 72°, or add TBD to the reading for each degree of temperature higher than 72°.

(b) To correct a reading on the device, add TBD to the reading for each degree of temperature lower than 72°, or subtract TBD from the reading for each degree of temperature higher than 72°.

4.2 Calibration Procedure

Calibration procedure is similar to body mass measurement procedure except that specified flight masses are positioned in the seat in lieu of the crew member. The calibration mass adapter is used as necessary in order to position these flight masses in the seat.

Individual calibration readings should be made with the specified masses up to but not exceeding 100 kilograms. Record the data prescribed in Table 4.2-1. Figure 4.2-1 shows the BMMD calibration points for one "g".

The sear release (to release the seat to oscillate) for calibration is performed with the Ring Frame Release; see Section 3.3.5.3 Operational Mode.

The procedure for calibration mass determinations is:

(1) The mass must be secured in the seat.

(2) Place control lever in operational mode.

(3) Pull the ring frame release and HOLD.

(4) Actuate thumb seat release.

(5) Release the hold on the ring frame release; the seat will then begin oscillation.

(6) Record the readout of the digital display and perform other procedures for calibration as in body mass measurement. Refer to Section 4.1.2.

Prior to any operational use in the one "g" environment the BMMD must have been previously installed on the ground support equipment in order to minimize the effects of gravity and prevent damage to the plate-fulcra springs. If precise leveling is accomplished by means of the adjustable feet on the BMMD, then ground support equipment may not be required. See Section 5.6 Installation.

4.3 Contingency Procedures

Any of these conditions may be applicable in contingency procedure:

(a) Electro-optical transducer malfunction. See Section 4.3.1 and 4.3.1.1.

(b) Electronics subsystem malfunction. See Sections 4.3.2 and 4.3.2.1.

(c) Minor contamination of cleanliness conditions. See Section 4.3.3.

(d) High acceleration or severe maneuvers of the OWS. See Section 4.3.4.

(e) Axial adjustment on seat lockout. See Section 4.3.5.

(f) Seat release, 2-man method. See Section 4.3.6.

(g) Mounting feet adjustment. See Section 4.3.7.

4.3.1 Electro-optical transducer

If repeatability cannot be achieved, and obvious mechanical interference or damage are not apparent, then either of two adjustments of the crossing blade may be necessary:

The zero crossing blade may be out of axial adjustment such that the transducer does not detect the crossing blade when oscillating. In such case, the electro-optical transducer would fail to count and the digital display readout would not count or would remain at zero. Axial adjustment of the zero crossing blade would be required; Section 4.3.1.1.

The necessity of lateral adjustment of the zero crossing blade is not anticipated; the adjustment is planned as a manufacturer's adjustment only. However, if repeatability of readings of the digital display readout cannot be obtained (see Section 4.1.2 step 14) and no apparent interference between oscillating and stationary parts can be found which would produce damping of the oscillations, then lateral adjustment may be applicable; Section 4.3.1.2.

4.3.1.1 Zero Crossing Adjustment - Axial

The adjustment is made by means of the small hex socket head axial adjustment screw which is located in the aft face of the intersection block of the seat brace assembly on the left side of the BMMD, approximately adjacent and aft of the electronics subsystem and the control lever. The lock screw is in the top face of the intersection block. Use hex wrench size 3/16 for the lock screw.

The procedural checklist is:

(1) Seat must be empty, with the restraint straps firmly latched.

(2) Release control lever to operational mode.

(3) Manually stop or damp the motion of the seat.

(4) Manually initiate motion of the seat to an amplitude of movement of approximately 1/64 inch.

(5) Actuate the reset switch.

(6) If the digital readout display remains at zero, this is confirmation that the zero crossing . is out of adjustment and not adequately passing within the optical path of the electro-optical transducer. If so, proceed to the next succeeding steps.

(7) Return control lever to locked mode (to lock the seat).

(8) Release the lock screw; turn counter-clockwise 1 turn.

CAUTION - Verify that control lever is in locked mode (to prevent movement of seat) before applying the hex wrench to either the lock screw or the adjusting screw.

(9) Turn the adjusting screw 1/4 turn clockwise. Tighten lock screw.

(10) Repeat steps 2.) through 6.) above. In the event the transducer is still out of adjustment as revealed by a non-reading of the digital readout display then repeat again these steps in this order:

Steps 7)
and 8)
and 9)
and 2) through 6).

In the event the transducer remains out of adjustment as revealed by a non-reading on the digital readout display, then repeat again the same sequence of steps. Each time the adjusting screw will be turned 1/4 turn clockwise. If it occurs that 4 such adjustments of the adjusting screw have been made for a total of 1 turn of the screw, and readout on the display still has not been achieved, then the adjusting screw should be returned to its original position. In that event, further sequential adjustments should be performed by counter-clockwise movements of the adjusting screw in 1/4 turn increments, in lieu of clockwise adjustments.

At the completion of adjustments, return control lever to the locked mode, and also verify the lock screw is tightened. For each new set-up of the BMMD, the transducer and zero crossing blade should be checked for proper adjustment, as per the procedural checklist of steps 1.) through 6.) in preceeding description.

4.3.1.2 Zero Crossing Adjustment - Lateral

It is not anticipated that this type of adjustment will be required unless physical interference of the crossing blade against the electro-optical transducer occurs. That possibly could exist if minor blade damage or minor structural distortion has occurred and repeatability (see Section 4.1.2 step 14) cannot be obtained.

The adjustment is made by means of the hex socket head lateral adjustment screw in the inboard face of the intersection block of the seat brace assembly on the left side of the BMMD. The same lock screw as for the axial adjustment (see Section 4.3.1.1) is applicable. The lock screw is accessible from the top face of the intersection block. Use hex wrench size 3/32 for the lateral adjustment screw, and use hex wrench size 3/16 for the lock screw.

The procedural checklist is:

(1) Seat must be empty, with the restraint straps firmly latched.

(2) Verify control lever is in locked mode.

(3) Release the lock screw.

(4) Turn adjusting screw one turn either direction. Tighten lock screw.

CAUTION - Verify that control lever is in locked mode (to prevent movement of seat) before applying the hex wrench to either the lock screw or the adjusting screw.

(5) Release control lever to operational mode to verify presence or abolishment of excessive damping or further need for adjustment. Repeat steps 2.) through 5.) as required, to effect a satisfactory positioning of the zero crossing blade.

At the completion of adjustments, return control lever to the locked mode, and also verify that the lock screw is tightened.

4.3.2 Electronics Subsystem

In the event the digital readout display is not illuminated in either of the power-on positions of the Mass/Off/Temp switch then either of two contingencies may exist:

-1 Loss of power supply to the electronics subsystem.

-2 Internal failure of the electronics subsystem. Repair for internal features of the electronics subsystem is not provided; remove and replace the subsystem. For procedure on replacement of electronics subsystem see Section 4.3.2.1.

4.3.2.1 Replacement of Electronics Subsystem

REMOVAL - The electronics subsystem is retained in place with the aid of two hex socket head shoulder-cap screws in the face of the electronics subsystem. These two hex socket head screws are captive with the electronics subsystem, and are loosened (or tightened) with hex wrench size TBD.

Therefore, the procedure for removal is:

(1) Verify the Mass/Off/Temp switch is in the Off position.

(2) Release the zero "g" connector and disconnect the power supply cable from the electronics subsystem.

(3) Release (i.e., loosen) the two captive hex socket head screws which are located in the front display face of the electronics subsystem.

(4) The subsystem is now free to be removed by retracting it in a sliding motion along the electronic mounting plate, perpendicular to the base plate of the SMMD and past the edge of the specimen tray.

INSTALLATION - The procedure for installation of the electronics subsystem is:

(1) Place the electronics subsystem in close proximity to the facing surface of the electronics mounting plate (which contains the zero-crossing blade and its protecting guard situated on the outer edge of the plate and in proximity to the edge of the specimen tray).

(2) When the subsystem is in alignment with the mounting plate and with approximately 0.090 inch clearance between them, the two locating pins protruding from the baseplate of the receiver will engage their appropriate alignment holes in the bottom face of the electronics subsystem.

The over-hung portion of the electronic subsystem fits over the guard (on the mounting plate) protecting the zero-crossing blade.

(3) Tighten the two hex socket head screws (captive) which are in the face of the electronics subsystem. These screws engage the electronics mounting plate.

(4) Verify the Mass/Off/Temp switch is in the Off position.

(5) Connect and latch the zero "g" connector for power supply to the subsystem.

NOTE: After replacement of the electronics subsystem, the calibration should be verified with a single mass determination, or device should be re-calibrated. See Section 4.2 Calibration Procedure.

4.3.3 Cleanliness as Affecting Accuracy

Minor contamination by dust particles, extraneous food particles or other materials may alter the optical path of the electro-optical transducer. In such event, a small brush or small stream of air should clear the transducer. If the electronics subsystem must be removed in order to clear the optical path, or to observe the cleanliness thereof, see Section 4.3.2.1.

4.3.4 High Acceleration or Severe Maneuvers

Although it is not planned that the lockout bolts (used for launch) would be required to be replaced at any time in the zero "g" environment, certain contingencies may necessitate their replacement as back-up to the control lever locked mode:

(a) Extraneous vibration of severe degree within the OWS.

(b) Shock due to docking, effects from other experiments, etc.

To replace the lockout bolts, insert into holes in the lower side of the adjusting screw brackets (on the frame each side near middle of seat) and thread into lockout socket brackets (on each side of the seat). The bolts are 3/8-16 UNC. Use caution to avoid overstressing the structure; snug tight with TBD wrench size TBD.

NOTE: In the event of minor banging or bumps to the plate-fulcra springs, the calibration should be verified with a single mass determination, or device should be re-calibrated. See Section 4.2 Calibration Procedure.

4.3.5 Axial Adjustment on Seat Lockout

It is not anticipated that this adjustment will be required, and is not recommended for in-flight procedure. However, for axial alignment on the four (4) seat lockouts (for locking the seat: locked mode), the adjustable set screw is situated on the upper aspect of the adjusting screw bracket on the sides of the frame of the BMMD, left side and right side, in the rear adjusting screw bracket on the midline behind the seat, and in the frame on the midline front below the attachment points of the plate-fulcra springs.

The adjustment is by a 3/8-24 UNF adjustable set screw (one on each side of the BMMD plus midline front and midline back), requiring hex wrench size 3/16:

(1) Verify control lever is in locked mode.

(2) Loosen jam nuts prior to making the adjustment, using TBD wrench size TBD.

(3) Tighten the adjusting screws until snug.

(4) Tighten the jam nuts.

Necessity for such adjustment must be evaluated by the crew member toward maintaining operability of the device, and could be required only if the seat is loose (not adequately locked) when control lever is in locked mode.

4.3.6 Seat Release, 2-Man Method

The seat may be released to start oscillation by means of the ring frame release as an alternate procedure. This alternate procedure may be desirable if repeatability of readouts (on the electronics subsystem) cannot be obtained, and all other errors or contingencies of repeatability have been investigated.

The procedure is:

(1) Pull the ring frame release and HOLD. This must be done by a second crew member or person not seated in the BMMD.

(2) Actuate thumb seat release.

(3) Release the hold on the ring frame release. The seat will then begin to oscillate.

4.3.7 Mounting Feet Adjustment

It is not anticipated that any adjustment of the mounting feet (bolts) should be required in the zero "g" environment. However, it is conceivable that allowance may be necessary for extraneous or unforeseen structural deflection of the floor deck. This should be evaluated as a last contingency if other measures to achieve accuracy and-reproducability of results are not successful.

The two front, or forward, feet may be loosened and then re-tightened in repetitive sequence in order to equalize the stress across structural members of the BMMD to achieve as nearly un-stressed condition of the structure as feasible. Use TBD wrench, size TBD for the adjustment. Use TBD wrench, size TBD for jam nuts.

5.0 GROUND OPERATING, MAINTENANCE, AND HANDLING

5.1 Maintenance and Servicing

The body mass measurement device requires no maintenance other than maintaining cleanliness. The only adjustment required is the electro-optical transducer adjustment described in Section 4.3.1.

If for any reason the BMMD is dismantled, especially if any dismantling is done on the springs, base, or seat assembly, then the device must be recalibrated to establish a new calibration formula. Dismantling, except of the electronics subsystem, is not to be done except by authorized experiment developer personnel.

5.1.1 Contamination Control and Cleaning Procedure

Exterior Cleanliness Levels - Observation shall ensure that the hardware exterior surfaces are visibly clean and free of hydrocarbons. Visibly clean shall be construed to mean the freedom of the surface from particulate matter fifty (50) microns and larger in size and from all films other than known innocuous films. Selection of the cleaning solution and/or method shall be consistent with the contaminants to be removed, the materials of construction of the hardware to be cleaned and the level of cleanliness desired. Cleaning methods must be nondetrimental to the materials of construction. Application of each cleaning solution must be restricted to usages where problems subsequent to cleaning will not occur as a result of the application, e.g., corrosion from entrapped fluids, vacuum outgassing, etc.

5.1.1.1 Facilities

All cleaning of the BMMD shall be limited to properly constructed and operated facilities to assure Class 100,000 or better clean room conditions as described in FED-STD-209.

5.1.1.2 Clean Room Requirements

The cleaning operations outlined in this document shall be conducted in a controlled clean room. The minimum requirements for this room shall be as follows:

(1) Room temperature: 72°F ± 10°F

(2) Relative humidity: 30% to 70%

(3) Neither smoking nor eating shall be permitted inside the room.

(4) Use only ballpoint pens for writing. Lead pencils and erasers are not permitted.

(5) Avoid solvent contact with hands to prevent removal of natural skin oils and consequent excessive "skin peeling" and flaking.

(6) Use exhaust systems in immediate area where welding, soldering or other related operations are performed.

(7) Clean all equipments, instruments, materials and parts before entry to area by means of dusting, vacuum cleaning, washing or other acceptable means as best suited to the article involved.

(8) No machining, grinding, filing or similar operations are permitted.

(9) The room will be maintained at a positive pressure to ensure that all air leakage is outward.

(10) Where practical, cleaning operations involving the use of solvents should be performed in an adjoining or nearby area. Following cleaning, the article should be returned promptly to the clean room to prevent contamination.

(11) Access to the clean room is limited to only those persons necessary for the room operation.

(12) Janitorial service shall consist of a properly supervised, regularly scheduled cleaning program.

(13) Keep bench tops free of unneccessary materials, parts and equipment. Also, keep area underneath benches clear to allow easy access by janitors.

(14) The protective garments designated for clean room use will not be worn outside the clean room area.

(15) All personnel occupying the clean room will practice good personal hygiene such as clean hands, clean fingernails, clean shoes, neatly combed hair, etc. Personal cleaning and grooming will be done outside the clean area.

A spot check of the dust particle density in this laboratory shall be made periodically, and the results recorded for future reference purposes.

5.1.1.3 Precautions

All cleaning work in which solvents are utilized shall be performed in a well-ventilated area of the cleaning room to prevent inhalation hazards to personnel and to prevent explosive gas mixtures from forming.

5.1.1.4 Materials and Equipment

The following materials and equipment are approved for use in the cleaning operations.

(1) Vacuum cleaner, Black and Decker Model U-190, Type A, or equivalent

(2) Spray gun, Binks Model 7, or equivalent solvent applicator

(3) Brush

(4) Clean room articles such as lint-free wiping cloth, gloves, caps and frocks; Angelica Uniforms, or equivalent

(5) Nitrogen, Federal BB-N-411b

(6) Ethyl alcohol, Federal O-E-760, Grade I, Class A or Class B, or the best grade commercial (99% pure, by volume) isopropyl alcohol.

5.1.1.5 Disassembly of Body Mass Measurement Device

Prior to cleaning, the mass measurement device shall be disassembled into the following subsystems:

(1) Electronics subsystem

(2) Mechanical subsystem

Disassembly shall be accomplished by removal of the electronics subsystem.

Removal - The electronics subsystem is retained in place with the aid of two hex socket head shoulder-cap screws in the face of the electronics subsystem. These two hex socket head screws are captive with the electronics subsystem, and are loosened (or tightened) with hex wrench size TBD.

Therefore, the procedure for removal is:

(1) Verify the Mass/Off/Temp switch is in the Off position.

(2) Release the zero "g" connector and disconnect the power supply cable from the electronics subsystem.

(3) Release (i.e., loosen) the two captive hex socket head screws which are located in the front display face of the electronics subsystem.

(4) The subsystem is now free to be removed by retracting it in a sliding motion along the electronic mounting plate, perpendicular to the base of the BMMD in an upward direction.

5.1.1.6 Cleaning Procedure

Each subsystem shall be cleaned in accordance with the procedure following. Personnel handling the cleaned components shall be equipped as a minimum with clean room type gloves, frocks and caps.

Prior to cleaning the subsystem, remove any lubricants, greases, or other similar material present with a lint-free cloth. The cloth may be saturated with alcohol to assist in removing these materials.

Remove dust and other particles from the subsystem by carefully vacuum cleaning its surfaces.

Clean the subsystem by directing a low velocity stream of alcohol on its surfaces. The Binks spray gun may be utilized in this operation. The brush may be used to dislodge dirt and other particles from crevices and other difficult-to-reach surface areas.

Dry the subsystem by directing a stream of dry nitrogen over its surfaces. The flow rate shall be in excess of 10 cubic feet per minute and the period of application shall be a minimum of 2 minutes.

Visually inspect the subsystem surfaces and reassemble the BMMD by installing the electronics subsystem upon the mechanical subsystem, as per Section 5.1.1.7.

5.1.1.7 Installation of Electronics Subsystem

The procedure for installation of the electronics subsystem, including reassembly after cleaning, is:

(1) Place the electronics subsystem in close proximity to the facing surface of the electronics mounting plate (which contains the zero-crossing blade and its protecting guard situated on the outer edge of the plate and in proximity to the edge of the seat).

(2) When the subsystem is in alignment with the mounting plate and with approximately 0.090 inch clearance between them, the two locating pins protruding from the bottom (distal face) of the electronics subsystem will engage their appropriate alignment holes in the receiver.

The over-hung portion of the electronic subsystem fits over the guard (on the mounting plate) protecting the zero-crossing blade.

(3) Tighten the two hex socket head screws (captive) which are in the face of the electronics subsystem. These screws engage the electronics mounting plate.

(4) Verify the Mass/Off/Temp switch is in the Off position.

(5) Connect and latch the zero "g" connector for power supply to the subsystem.

NOTE: After replacement of the electronics subsystem, the calibration should be verified with a single mass determination, or device should be re-calibrated. See Section 4.2 Calibration Procedure.

5.1.2 Record of Maintenance

A continuous record should be maintained for any adjustments, cleaning, or dismantling as may occur to each device.

To facilitate servicing, a copy of the record should accompany the device up to the time of launch.

See Table 5.1.2-1 for the sample form of Record of Maintenance.

5.2 Preservation, Packing, and Storage

Preservation to maintain cleanliness must be observed each time the unit hardware is transported, stored, or otherwise not in actual use in the service for which it is intended.

At time of delivery the unit will be protected by double bags. The inner bag shall be made of Nylon 6 which is 2 mils thick. The outer bag shall be made of antistatic polyethylene film, 6 mils thick. Heavy items or items having sharp edges, points, etc., which may puncture or damage the barrier bags shall be overwrapped as necessary with 2 mils thick material of the same type as the inner bag, to form a cushion. The interior of each bag shall be purged with dry inert gas immediately prior to heat sealing. Each bag shall be heat sealed using a sealing technique that will ensure that the volume of gas sealed in the bag is the minimum possible, to permit room for expansion of the entrapped gases during air shipments. A decal shall be placed on the outside of the inner bag indicating that the item has been cleaned to meet the requirements of MSC-SPEC-C-8, "Specification for Spacecraft On-Board Equipment Cleanliness". The decal shall also show evidence of company and government inspection and verification of cleanliness and packaging and the date of the inspection.

5.2.1 Preservation-Packaging Procedure

This shall consist of sealing the mass measurement device inside two appropriately sized bags (double bagging). The mass measurement device shall at all times be handled by personnel equipped as a minimum with clean room type gloves, frocks and caps. Prior to bagging, the mass measurement device shall be cleaned in accordance with Section 5.1.1. This procedure shall be performed as part of the Acceptance Test Specifications and Procedures (ATSP) and shall be applied each time the unit hardware is packaged or repackaged.

5.2.1.1 Materials and Equipment

The following materials and equipment are approved for use in this procedure:

(1) Nylon 6 bags, 2 mils thick

(2) Polyethylene bags, Commercial grade, 6 to 10 mils thick

(3) Nitrogen, Federal BB-N-411b

(4) Heating sealing machine, Clean Room Products, Inc., Model No. 230-SA Super Sealmaster, or equivalent.

(5) Clean room articles such as wiping cloth, gloves, caps, frocks; Angelica Uniforms, or equivalent.

5.2.1.2 Interior Bag

Flush the inside of the bag with dry nitrogen flowing at a rate greater than 5 cubic feet per minute until a minimum of 3 complete volume changes of gas have occurred in the bag. The bag shall be sized such that 3 heat seals can be performed on the closure end.

5.2.1.3 Placement

Immediately after procedure step 5.2.1.2 place the mass measurement device inside the bag, flush the inside of the bag with nitrogen, evacuate the gas, and finally heat seal the open end of the bag.

5.2.1.4 Exterior Bag

Perform procedure step 5.2.1.2 on the exterior bag.

Flush the single bagged device with nitrogen until visibly clean and then place the device inside the exterior bag with the sealed end in first. Evacuate the gas from the exterior bag, and finally heat seal the open end of the exterior bag.

The following documents shall be placed print side outward inside the exterior bag:

(a) Packing Identification Slip (Exhibit A)

(b) Approval Slip (Exhibit B)

Under no circumstances will documents be placed inside the interior bag.

5.2.2 Packing Procedure

This section provides the procedure for packing the mass measurement device.

5.2.2.1 Clean Room Requirements

The packing operations outlined in this procedure shall be performed in a clean room meeting the requirements specified in Paragraph 5.1.1.2.

5.2.2.2 Application

Packing, which is defined as enclosing the double bagged mass measurement device in a protective case, shall be conducted as a part of the Acceptance Test Specifications and Procedures (see ATSP-2).

5.2.2.3 Materials and Equipment

The following materials and equipment are approved for use in performing these procedures:

(1) Vacuum cleaner, Black and Decker Model U-190, Type A, or equivalent

(2) Box, packing, SwRI Drawing No. TBD.

5.2.2.4 Packing Placement

Remove dust and other foreign particles from the inside of the packing box by means of the vacuum cleaner.

Place the sealed bagged mass measuring device into the foam-lined packing box in the upright position.

Place a 2-inch layer of foam material on top of the mass measurement device and then place the acceptance data package (ADP) packaged in a plastic bag on top of the foam material. Place the lid on the shipping container and install the locking screws.

5.2.2.5 Packing Box Marking

The packing box shall be marked in accordance with MIL-STD-130, and in accordance with Statement of Work dated 1 October 1970 and shall include the following:

Deliver to: McDonnell Douglas Corp., Western Division
Huntington Beach, California

Manuf. by: Southwest Research Institute
San Antonio, Texas

Contract No.: F41609-70-C-0029
Date of Manufacture: ______________
(Month and Year)

5.2.3 Storage Procedures

This section provides the requirements for storing the mass measurement device. These procedures apply to unpreserved, unpackaged devices, as well as to preserved, packaged devices.

5.2.3.1 Unpreserved and Unpackaged

The storage area for unpreserved, unpackaged mass measurement devices shall meet the clean room requirements specified in Paragraph 5.1.1.2, and shall be controlled as follows:

(a) Humidity: 30% to 70%

(b) Temperature: +30°F to +120°F

5.2.3.2 Preserved and Packaged

The storage for preserved and packaged mass measurement devices shall be as follows:

(a) Humidity: Not Applicable

(b) Temperature: +30°F to +100°F

5.2.3.3 Acceptance Requirements

The mass measurement device shall be stored in its packing box (shipping container) after it has been cleaned and packaged.

5.3 Shipping and Moving Procedure

This section describes the transportation procedure for the device -

- between laboratories, rooms, or work areas within a building or assembly area.

- between buildings or contractor job sites or NASA installations whereby the instrument package would be exposed to an uncontrolled environment.

5.3.1 On-site Transport

On-site transport of the device (when the device is not being actually installed or in operation for mass measurement determinations) must be accomplished under Class 100,000 clean room conditions employing the protective bags. See Section 5.2.1 on preservation-packaging procedures. See Section 3.5 on handling procedures.

The device must be protected against any and all damage of transit while it is out of the shipping container. The BMMD must not be dropped or otherwise subjected to shock or impact at any time.

5.3.2 Off-site Transport

Off-site transport of the device (between SwRI and MDAC-WD and MSC and KSC and other destinations, etc.) must employ the same procedures as Section 5.3.1 plus the additional procedures of this section.

The device must be transported within the protective shipping container. Applicable procedure for packing is Section 5.2.2 of this document. Applicable procedure for handling is Section 5.5 of this document.

5.3.2.1 Mode of Transportation

Air transportation and water transportation are recommended. For any and all means of transportation, the environmental limits of Table 3.2.4-1 shall be applicable.

5.4 Receiving and Inspection

(a) Verify presence and completeness of Acceptance Data Package.

(b) Visually inspect experiment equipment for damage or deterioration from shipping, handling, or storage.

(c) Servicing - no requirement.

CAUTION - It is of utmost importance to maintain the integrity of the cleanliness of the device as well as to provide protection from physical damage. Verification shall be established at all receiving points that the equipment is free of contamination. Freedom of hydrocarbons shall be verified by inspection with ultraviolet light (black light) or other suitable methods. Freedom of particulate matter shall be verified by visual inspection under sufficient light intensity to illuminate the area being inspection.

Cleaning of the device, as it may be required if contamination occurs, shall be performed by the procedures of Section 5.1 of this document.

5.5 Handling Procedure

This procedure provides the requirements for handling the mass measurement device and applies to all personnel assigned to the handling of this device.

The mass measurement device from the beginning of the first Acceptance Test Specifications and Procedures (ATSP-2) test shall at all times be handled by personnel wearing as a minimum clean room type gloves, frocks and caps.

The mass measurement device shall be cleaned only by methods presented in Section 5.1 of this document. Extreme care shall be used at all times to prevent damage to the device.

CAUTION - The plate-fulcra springs supporting the seat may be damaged by improper handling. Do not lift or manipulate by means of the seat, but only by means of the frame structure.

5.5.1 Lift Sling

A lift sling is to be used in such manner that no stress is placed on the seat. Care must be taken to prevent damage of the outer or inner bag covering the instrument.

5.6 Installation

When operated in a one "g" environment, the body mass measurement device can be used to weigh persons up to 100 kilograms. The device must be carefully leveled to eliminate the effect of gravity on the period of the oscillating portion of the system. This leveling is not necessary in a zero "g" environment.

5.6.1 Setting Up the Device on the Leveling Fixture

The BMMD is attached to the ground support equipment leveling fixture through a four-point mounting arrangement. The four points make up a rectangle with 21.825 x 29.400-inch sides. The mounting surface must be solid and free of vibrations. A surface which can be tilted, shaken, or otherwise moved can affect the precise orientation of the seat and introduce gravity effects into the time period readings.

Attach the device to the horizontal surface of the leveling fixture by threading the appropriate mounting screws and washers into the tapped holes in the surface. Refer to ICD 13M12101. Refer also to Section 5.6.2 for detailed mounting instructions, bolt placement, and adjustments; this is the procedure for attachment to any horizontal/plane surface.

Place a small level on the surface of the TBD of the BMMD. The level is to be found in its receptacle in the base of the leveling fixture. The function of this level is to check the level of the BMMD: specifically to verify the verticality of the plane of the plate-fulcra springs. Adjust the three leveling feet of the leveling fixture to level the device.

Further set-up of the device requires the application of power. Operation requires approximately TBD ampere at 28 volts DC power. Prior to connecting power to the device, ensure that the switch is in the Off position. Engage the zero "g" connector.

Energize the electronics by turning the switch to the Mass position. Actuate the reset. Release the control lever to start the seat oscillating. The system should then count and give a readout; that is, digits other than 0 should appear on the readout. If the digits fail to count, the electro-optical transducer may possibly be out of adjustment, or other contingency may exist.

For contingency procedures, see Section 4.3.

Check mechanical function of the device. Lack of free oscillation can be caused by mechanical interference between fixed and moving parts within the mechanical subsystem. To test for free oscillation, return the control lever to the locked position, actuate the reset, and release the control lever. Start a ten-second time count, using a stopwatch, at the same time the control lever is released. Log the period reading during the time count. At the end of ten seconds, actuate the reset and log the period reading again. Then turn the control lever to the locked position and turn the power switch to "Off". The second period reading should not vary from the first one by more than TBD counts. If a greater variation exists, mechanical interference may exist. The device should then be checked and any interference (debris, etc.) removed. Lock the seat by returning the control lever to its initial position (see Section 3.3.3) for the locked mode.

For verification of calibration, check the calibration data, or curve, with one of the specified flight masses. Place the flight mass in the established position on the seat and obtain the appropriate readout as for the normal calibration procedure. See Section 4.2 for calibration procedure, table of calibration data and calibration curve. Compare the final mass determinations after temperature corrections have been applied. Re-calibrate as necessary by adjusting the leveling feet slightly until the correct reading is obtained.

The device is now ready for use. All operating, maintenance, and handling procedures of section 5.0 are applicable.

5.6.2 <u>Setting Up the Device in the OWS/Launch Vehicle</u>

The BMMD is attached to the compartment floor in its specified area in the OWS or launch vehicle. Attachment is made through a four-point mounting arrangement through the feet of the device. Four holes in a rectangular arrangement of 21.825 inches x 29.400-inches within the base structure permit this attachment. These holes receive the bolts as prescribed in the mechanical ICD 13M12101.

Leveling of the BMMD is not required for installation of the device for use in zero "g" environment. The only precaution required for installation is to take care to avoid torsional distortion or twisting of the base structure; that is, the structural members of the device must be non-stressed when installed. The adequately non-stressed condition will be achieved through the appropriate sequential tightening of the mounting bolts.

The sequential procedure is:

(1) Verify control lever is in locked mode, prior to lifting or mounting the device.

(2) Locate the 4 holes in the floor, forming the 29.40 x 21.825-inch rectangle.

(3) Drop sleeves (0.430 OD x 0.295 ID per ICD 13M12101) into the holes.

CAUTION: DO NOT lift the device by the seat or the plate-fulcra springs.

(4) Set the BMMD in position with the back of the head rest toward the compartment wall in the OWS, aligning the feet onto the 4 holes in the floor. The threaded insert, jam nut, and adjusting screw are already in the feet of the BMMD.

(5) Set the hold-down bolt (NAS 1004) with its washer (AN 960 D 416) into the adjusting screw and let the bolt engage the 1/4-28 sleeve below the floor; one at each foot, 4 required.

(6) Loosen all the jam nuts, using open-end wrench size TBD.

(7) Set the right rear foot:

Turn adjusting screw (clockwise; using open-end wrench size TBD) until the end projects through the threaded insert (in the foot of the BMMD) by approximately 1/8 inch. This will raise the foot of the BMMD off the face of the sleeve. Tighten the jam nut.

(8) At the left front foot:

Repeat the procedure of step (7). It is essential that this sequential procedure be followed.

(9) Tighten the hold-down bolts (NAS 1004) at the right rear and left front feet of the BMMD, using open-end wrench size TBD, to a torque of TBD.

(10) At the left rear foot:

Turn the adjusting screw (clockwise) until end of the screw makes contact with the face of the sleeve.

CAUTION: DO NOT advance the adjusting screw beyond the point of initial contact with the sleeve, because that would introduce a bending strain into the frame of the BMMD.